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Generativity is a Core Value of the ESJ: A Decade of Growth

Erik Erikson (1902-1994) was one of the great psychologists of the 20th century[1]. He explored the nature of personal human identity. Originally named Erik Homberger after his adoptive father, Dr. Theodore Homberger, he re-imagined his identity and re-named himself Erik Erikson (literally Erik son of Erik). Ironically, he rejected his adoptive father's wish to become a physician, never obtained a college degree, pursued independent studies under Anna Freud, and then taught at Harvard Medical School after emigrating from Germany to the United States. Erickson visualized human psychosocial development as eight successive life-cycle challenges. Each challenge was framed as a struggle between two outcomes, one desirable and one undesirable. The first two early development challenges were 'trust' versus 'mistrust' followed by 'autonomy' versus 'shame.' Importantly, he held that we face the challenge of **generativity** versus **stagnation in middle life**. This challenge concerns the desire to give back to society and leave a mark on the world. It is about the transition from acquiring and accumulating to providing and mentoring.

Founded in 2010, the European Scientific Journal is just reaching young adulthood. Nonetheless, **generativity** is one of our core values. As a Journal, we reject stagnation and continue to evolve to meet the needs of our contributors, our reviewers, and the academic community. We seek to innovate to meet the challenges of open-access academic publishing. For us,

[1] Hopkins, J. R. (1995). Erik Homburger Erikson (1902–1994). *American Psychologist*, 50(9), 796-797. doi:http://dx.doi.org/10.1037/0003-066X.50.9.796

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generativity has a special meaning. We acknowledge an obligation to give back to the academic community, which has supported us over the past decade and made our initial growth possible. As part of our commitment to generativity, we are re-doubling our efforts in several key areas. First, we are committed to keeping our article processing fees as low as possible to make the ESJ affordable to scholars from all countries. Second, we remain committed to fair and agile peer review and are making further changes to shorten the time between submission and publication of worthy contributions. Third, we are looking actively at ways to eliminate the article processing charges for scholars coming from low GDP countries through a system of subsidies. Fourth, we are examining ways to create and strengthen partnerships with various academic institutions that will mutually benefit those institutions and the ESJ. Finally, through our commitment to publishing excellence, we reaffirm our membership in an open-access academic publishing community that actively contributes to the vitality of scholarship worldwide.

Sincerely,

Daniel B. Hier, MD

European Scientific Journal (ESJ) Natural/Life/Medical Sciences

Editor in Chief

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Economic, Fiscal, and Monetary Policy Uncertainty in Japan: What do They Affect?

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Abstract

This paper examines how economic, fiscal, and monetary policy uncertainty shape Japan's macroeconomic and financial conditions from 2004 to 2024. Using a VAR framework that includes economic policy uncertainty (EPU), fiscal policy uncertainty (FPU), and monetary policy uncertainty (MPU), we study their effects on money-supply growth, industrial production, inflation, and stock-market returns. We complement this analysis with GARCH-type volatility models to evaluate whether uncertainty meaningfully increases financial-market volatility. The results show that EPU has a consistent and significant impact on money-supply growth and industrial production, while inflation responds only weakly and gradually. Stock-market reactions are short-lived and show no strong evidence of heightened volatility. FPU and MPU play a secondary role: they appear in the VAR system but exert weaker and less stable effects on macroeconomic outcomes. Robustness checks, including alternative VAR lag structures, Granger causality tests, and additional volatility regressions, confirm the stability of these findings. The evidence suggests that Japan's institutional setting, particularly the Bank of Japan's communication strategy and policy tools, helps limit the transmission of uncertainty to asset-market volatility. These results highlight the importance of transparent and well-coordinated fiscal and monetary policies during periods of elevated uncertainty.

Keywords: Policy uncertainty, money supply, GARCH, VAR, Japan, financial volatility

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Introduction

Economic policy uncertainty (EPU) has become an important factor shaping macroeconomic and financial outcomes in many countries. Uncertainty about fiscal actions, monetary decisions, or regulatory changes can influence expectations, delay investment plans, and affect how households and firms use liquidity. A growing body of research, following Baker, Bloom, and Davis (2016) demonstrates that EPU shocks influence output, inflation, and asset prices. However, fewer studies examine how policy uncertainty interacts with monetary dynamics and financial volatility in Japan, a country with a long history of unconventional monetary policy, low interest rates, and evolving policy frameworks. Japan provides an ideal context to study these relationships. Since the early 2000s, the Bank of Japan (BoJ) has implemented a series of unconventional monetary policies, including quantitative easing (QE) and yield curve control, in an effort to counter deflation and support economic activity. At the same time, changes in fiscal and regulatory policies have generated substantial policy uncertainty, influencing money supply growth and investor behavior. Understanding how EPU transmits into monetary aggregates, real production, and financial volatility is crucial for both policymakers and market participants. This study makes three main contributions. First, it analyzes how EPU affects monetary aggregates and monetary transmission in Japan. Second, it examines how uncertainty shocks influence industrial production and inflation, two core indicators of real economic performance. Third, it explores whether EPU contributes to financial market volatility using a GARCH framework to capture asymmetric and nonlinear volatility responses. Together, these contributions help clarify how policy uncertainty interacts with key macro-financial variables within Japan's unique institutional environment. We test the following hypotheses:

- H_0 (Null Hypothesis): Economic policy uncertainty has no significant impact on Japan's money supply dynamics, monetary transmission, or financial market volatility.
- H_1 (Alternative Hypothesis 1): Economic policy uncertainty significantly affects Japan's money supply dynamics and monetary transmission.
- H_2 (Alternative Hypothesis 2): Economic policy uncertainty significantly influences financial market volatility in Japan, with effects that may persist over time.The remainder of this paper is organized as follows. Section 2 develops the theoretical framework and outlines the transmission channels through which economic policy uncertainty (EPU) can influence monetary dynamics, real activity, inflation, and financial volatility in Japan. Section 3 reviews the relevant literature on policy uncertainty and its macro-financial effects, highlighting existing findings and gaps this study seeks to address.

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Section 4 describes the data and methodology, including the construction of variables, model specifications, and estimation procedures for both the VAR and GARCH frameworks. Section 5 presents empirical results, beginning with descriptive statistics and unit root tests, followed by the main VAR results, impulse responses, variance decomposition, and volatility modeling using GARCH family models. Section 6 discusses the results in the context of existing literature, the study's limitations and potential avenues for extension. Section 7 outlines the policy implications of our findings for monetary authorities and financial regulators. Section 8 concludes by summarizing the main contributions of the paper.

Theoretical Framework

The influence of economic policy uncertainty (EPU) on monetary dynamics, real activity, inflation, and financial volatility operates through several well-established theoretical mechanisms. This section synthesizes the conceptual foundations of these channels and connects them to expected empirical outcomes.

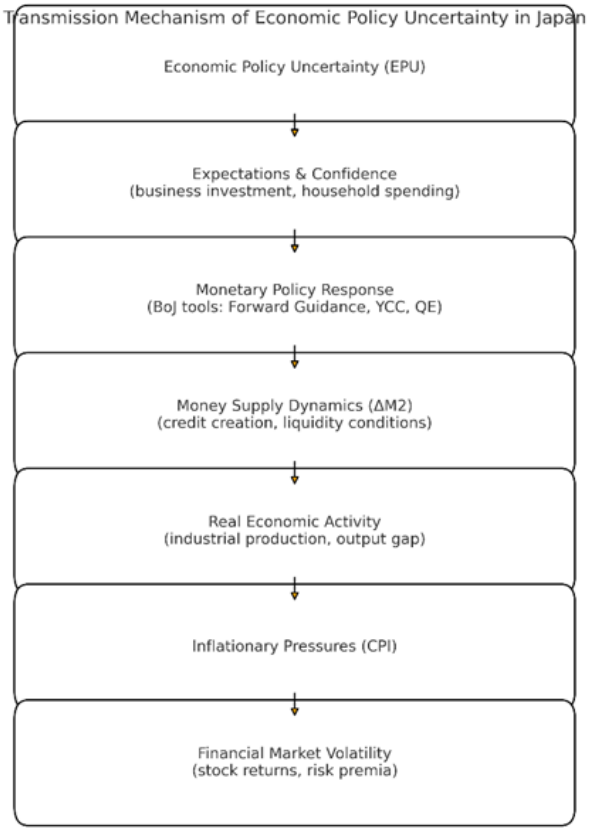

Figure 1: Transmission mechanism of economic policy uncertainty (EPU) in Japan

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Figure 1 summarizes the hypothesized transmission mechanism: EPU influences expectations and confidence, prompting a monetary policy reaction (e.g., forward guidance, yield-curve control, and asset purchases). These actions shape liquidity conditions and credit creation (ΔM2), which transmit to real activity (industrial production) and, with lags, to inflation. Financial-market volatility is expected to react primarily through the risk-premium channel, although its empirical salience may be limited in Japan's institutional setting.

Money Demand and Liquidity Preferences

Traditional monetary theory explains money demand as comprising transactions, precautionary, and speculative motives. Under conditions of heightened policy uncertainty, the precautionary motive becomes more pronounced: households and firms prefer to hold a greater share of their wealth in liquid balances to hedge against unforeseen shocks. This behavior leads to a rise in money demand beyond what is required for regular transactions (Telyukova & Visschers, 2013). Recent studies extend the classical money demand function by explicitly incorporating uncertainty, demonstrating that higher uncertainty increases liquidity preference and broad money aggregates (Gan, 2019). This mechanism provides a theoretical rationale for why EPU shocks can stimulate M2 growth as agents and financial institutions increase their demand for money in response to uncertainty about future policy directions.

Expectations and Monetary Transmission

Monetary policy transmission relies critically on expectations. When future policy paths become uncertain, expectations about interest rates, credit conditions, and policy interventions become less anchored, weakening the transmission of monetary policy through standard channels. Uncertainty reduces the responsiveness of consumption, investment, and credit decisions to policy signals. For example, elevated EPU leads firms to increase cash holdings as a buffer against potential adverse shocks, indirectly influencing liquidity conditions in the broader economy (Li, 2019). This mechanism implies that even if central banks expand liquidity or adjust interest rates, the effectiveness of such measures may diminish when uncertainty is high, resulting in altered or muted monetary dynamics.

Investment and Real Activity

Real options theory provides another key mechanism linking EPU to real activity. Because investment decisions are often costly and irreversible, firms prefer to delay investment when future conditions are uncertain, preserving the option to invest once the policy environment becomes clearer.

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This "wait-and-see" behavior reduces capital formation and slows industrial production (Aïd $ al., 2015). The empirical implication is that higher EPU should be associated with lower industrial output and more sluggish real sector responses. This mechanism aligns with observed negative responses of industrial production to EPU shocks in empirical studies and is a core reason for the real economy's sensitivity to uncertainty shocks.

Inflation and Price Dynamics

The relationship between EPU and inflation is subtler and often emerges more gradually than for real activity or money demand. Policy uncertainty can influence inflation expectations by altering wage-setting behavior, price contracts, and demand conditions. However, these effects typically require sustained periods of uncertainty to become significant. As a result, inflation's response to EPU shocks tends to be weaker or delayed relative to monetary aggregates or industrial production. Moreover, in economies like Japan with a history of low inflation expectations, uncertainty shocks may have limited immediate effects on price dynamics, instead manifesting through indirect channels over longer horizons (Das & al., 2023).

Financial Volatility

Financial market volatility is also influenced by policy uncertainty, primarily through its effect on risk premia. Increased uncertainty raises investors' required compensation for bearing risk, leading to heightened volatility in asset prices and returns. However, these volatility effects are often nonlinear and state-dependent, varying across policy regimes and market conditions. Capturing such dynamics requires models that can account for asymmetries and leverage effects in volatility responses. The GARCH model is particularly well-suited for this purpose because it models the logarithm of conditional variance, thereby ensuring positivity without imposing parameter constraints, and allows negative shocks to have disproportionate effects on volatility (Chang, 2017). Empirical evidence shows that EGARCH often outperforms symmetric models like GARCH (1,1) in capturing asymmetries and fat tails in macro-financial data (McAleer, 2014). Nonetheless, because volatility may be driven by the joint dynamics of multiple variables, future research could extend beyond univariate EGARCH models to multivariate or dynamic conditional correlation (DCC) frameworks for a more complete understanding of volatility transmission (Engle, 2002).

Literature Review

Economic policy uncertainty (EPU) has been widely recognized as a critical determinant of macroeconomic performance, financial stability, and corporate decision-making. Existing research consistently shows that

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heightened policy uncertainty influences investment behavior, corporate finance decisions, and market dynamics by increasing risk premiums and reducing firms' willingness to invest or expand (Al-Thaqeb and Algharabali (2019). Baker et al. (2016) demonstrate that rising EPU leads to more conservative corporate policies, lower capital expenditures, and delayed investment, while Al-Thaqeb and Algharabali (2019) emphasize its asymmetric effects across sectors and policy regimes. At the macroeconomic level, several studies focus on the relationship between EPU and key variables such as inflation, exchange rates, and industrial output. Athari et al. (2021) show that EPU Granger-causes inflation in Japan at specific time scales, particularly during periods of economic turbulence. Similarly, Sami and Abdelhak (2024) confirm a long-run positive relationship between EPU and inflation in Japan, indicating that policy uncertainty can amplify price instability. Kurasawa (2016) investigates EPU's effect on the USD/JPY exchange rate, revealing that both anticipated and unanticipated policies significantly influence currency movements. These findings highlight the pervasive influence of policy uncertainty on price dynamics and exchange rate stability. Other work extends the analysis to firm-level outcomes and sectoral performance. Augustine et al. (2023) find that policy uncertainty moderates the effects of inflation and interest rates on firm efficiency, amplifying their impacts depending on firm characteristics such as size and dividend policy. Zhu and Yu (2022) explore the nonlinear effects of EPU on industrial output in China, revealing an inverted U-shaped relationship and demonstrating that technological progress mitigates adverse effects when uncertainty is high.

The relationship between policy uncertainty and monetary dynamics has also been explored, though less extensively. Nusair et al. (2024) examine the asymmetric effects of EPU on money demand in developed countries, including Japan. They find that rising EPU increases money demand, whereas declining EPU has no significant impact, suggesting that monetary behavior responds differently to positive and negative uncertainty shocks. This highlights the importance of nonlinear modeling approaches in understanding monetary transmission mechanisms under uncertainty. EPU's influence on financial markets is another important dimension. Phan et al. (2018) show that EPU predicts stock returns in several countries, though the strength and direction of predictability vary by market and sector. Chiang (2020) finds that heightened policy uncertainty leads to lower stock returns in Japan, while Aman et al. (2024) demonstrate that high EPU reduces financial system efficiency by disrupting intermediation and market operations. Other research underscores the role of EPU in driving volatility across equity, commodity, and foreign exchange markets, linking major political and economic events to heightened uncertainty and market instability. Despite the breadth of existing research, significant gaps remain in understanding how economic policy

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uncertainty shapes money supply dynamics and monetary transmission mechanisms in Japan, particularly in interaction with industrial production, inflation, and financial market volatility. Prior studies have largely focused on EPU's effects on inflation, exchange rates, or stock markets, often using shorter sample periods or linear models. Few have investigated the dynamic interactions between EPU and monetary aggregates such as M2 or examined volatility responses and asymmetries using advanced econometric techniques like VAR and GARCH. This study addresses these gaps by providing updated evidence (2004–2024) between EPU and Japan's money supply, while also exploring its broader macro-financial effects through a multivariate time-series framework. This paper advances the literature by integrating them into a single framework, linking EPU, monetary dynamics, real activity, and volatility.

Data

We use monthly data from February 2004 to November 2024, encompassing 249 observations. The variables include:

- Economic Policy Uncertainty Index (EPU), Fiscal Policy Uncertainty Index (FPU), Monetary Policy Uncertainty Index (MPU).
- M2 Growth (d_m2): Monthly change in broad money supply.
- Inflation (inf_cpi): Inflation rate based on the consumer price index.
- Industrial Production (d_ip): Growth rate of industrial production
- ret_stock: Stock market returns

Data are sourced from the Economic Policy Uncertainty database, the European Central Bank, the data catalog of world bank and the Federal reserve bank of St. Louis FRED. All series are transformed to ensure stationarity, using first differences and log-transformations where appropriate.

Methods

Vector Autoregression (VAR)

We employ a VAR model to capture dynamic interactions among the variables. The general VAR(p) specification is:

$$Y_t = A_0 + A_1 Y_{t-1} + A_2 Y_{t-2} + \cdots + A_p Y_{t-p} + \epsilon_t$$

where Y_t is a vector containing [EPU, FPU, MPU, d_m2, inf_cpi, d_ip, ret_stock]. The lag order was selected using AIC and BIC, resulting in a preferred specification of VAR (1). Stability conditions are satisfied (all roots < 1). The chosen recursive structure, Y_t= [EPU, FPU, MPU, d_m2, inf_cpi, d_ip, ret_stock], reflects the assumption that shocks propagate sequentially based on the variables' relative speed of adjustment within the monthly time frame. The uncertainty indices (EPU, FPU, MPU) are placed first, as they capture high-frequency policy news and are assumed to be predetermined with respect to contemporaneous movements in macroeconomic aggregates and

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financial variables (Baker et al., 2016). Consistent with standard macro-financial VAR literature, the slower-moving real activity variables (d_ip, inf_cpi) precede the instantaneous financial market response (ret_stock), ensuring that stock returns reflect all preceding policy and macro shocks (Kilian et al., 2022).

Volatility Modeling: GARCH and GJR-GARCH

To examine the volatility dynamics of stock returns in Japan, we estimate GARCH(1,1) and GJR-GARCH(1,1) models. Both are widely used to capture time-varying volatility and asymmetry in financial markets. The Generalized Autoregressive Conditional Heteroskedasticity (GARCH) model is specified as follows:

$$\sigma_t^2 = \omega + \alpha\epsilon_{t-1}^2 + \beta\sigma_{t-1}^2$$

Where:

σ_t^2 is the conditional variance (volatility) at time t,
ϵ_{t-1}^2 is the squared residual from the mean equation at time t - 1,
σ_{t-1}^2 is the previous period's conditional variance,
ω, α, β are estimated parameters.

This model captures volatility persistence and the impact of past squared errors on future volatility.

To account for asymmetric responses to positive and negative shocks, we also estimate a GJR-GARCH(1,1) model:

$$\sigma_t^2 = \omega + \alpha\epsilon_{t-1}^2 + \gamma(\epsilon_{t-1}^2 . I(\epsilon_{t-1} < 0)) + \beta\sigma_{t-1}^2$$

γ captures the asymmetric effect of negative shocks on volatility.
$I(\epsilon_{t-1} < 0)$ is an indicator function that is1 if the previous shock was negative and 0 otherwise. This model allows for different volatility responses to positive and negative returns, a feature often observed in financial markets.

In addition to the basic GARCH models, we estimate GARCH(1,1) with EPU (Economic Policy Uncertainty) and MPU (Monetary Policy Uncertainty) included in the variance equation. This allows us to analyze how policy uncertainty influences volatility. The model specification is:

$$\sigma_t^2 = \omega + \alpha\epsilon_{t-1}^2 + \beta\sigma_{t-1}^2 + \lambda Uncertainty_t$$

Where λ is the coefficient for the uncertainty measure ($Uncertainty_t$ could be either EPU or MPU).

To ensure the robustness of our results, we perform additional tests, including: Heteroscedasticity and autocorrelation robust OLS regressions for the log-volatility on lagged uncertainty measures. Granger Causality Tests to test for the directional influence of uncertainty on volatility. Impulse Response Functions (IRFs) to explore the effect of shocks to policy uncertainty on volatility and asset prices.

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Results

Descriptive Statistics

The variables display substantial variability over the sample period. EPU exhibits pronounced spikes during major global and domestic events, including the 2008 financial crisis, the 2011 Tohoku earthquake, and the COVID-19 pandemic. Money supply growth remains relatively stable but shows responses to key policy shifts. Stock returns are characterized by volatility clustering.

Table 1: Descriptive Statistics and Correlations

Panel A: Summary Statistics

Variable	Count	Mean	Std	Min	25%	50%	75%	Max
EPU	250	107.17	31.88	48.41	85.50	104.50	123.91	239.05
MPU	250	110.27	50.11	31.79	77.42	102.12	129.33	365.13
FPU	250	104.80	40.54	45.66	75.22	97.82	125.12	305.71
d_epu	250	0.21	23.28	-107.93	-9.96	1.48	10.64	94.65
d_m2	250	0.00	0.00	-0.00	0.00	0.00	0.00	0.02
inf_cpi	250	0.00	0.00	-0.01	-0.00	0.00	0.00	0.02
d_ip	250	-0.00	0.02	-0.17	-0.01	0.00	0.01	0.06
ret_stock	250	0.00	0.04	-0.22	-0.02	0.01	0.03	0.11

Panel B: Skewness & Kurtosis

Variable	Skewness	Kurtosis
EPU	1.07	2.09
MPU	1.79	5.51
FPU	1.38	3.26
d_epu	-0.19	5.00
d_m2	3.99	31.50
inf_cpi	1.03	7.86
d_ip	-2.08	10.37
ret_stock	-1.09	3.80

Panel C: Correlation Matrix

	EPU	MPU	FPU	d_epu	d_m2	inf_cpi	d_ip	ret_stock
EPU	1.00	0.73	0.94	0.36	0.27	-0.15	-0.10	-0.22
MPU	0.73	1.00	0.64	0.34	0.07	-0.02	-0.06	-0.22
FPU	0.94	0.64	1.00	0.31	0.20	-0.20	-0.08	-0.17
d_epu	0.36	0.34	0.31	1.00	-0.07	0.00	-0.01	-0.32
d_m2	0.27	0.07	0.20	-0.07	1.00	-0.07	-0.06	0.17
inf_cpi	-0.15	-0.02	-0.20	0.00	-0.07	1.00	0.01	0.01
d_ip	-0.10	-0.06	-0.08	-0.01	-0.06	0.01	1.00	0.14
ret_stock	-0.22	-0.22	-0.17	-0.32	0.17	0.01	0.14	1.00

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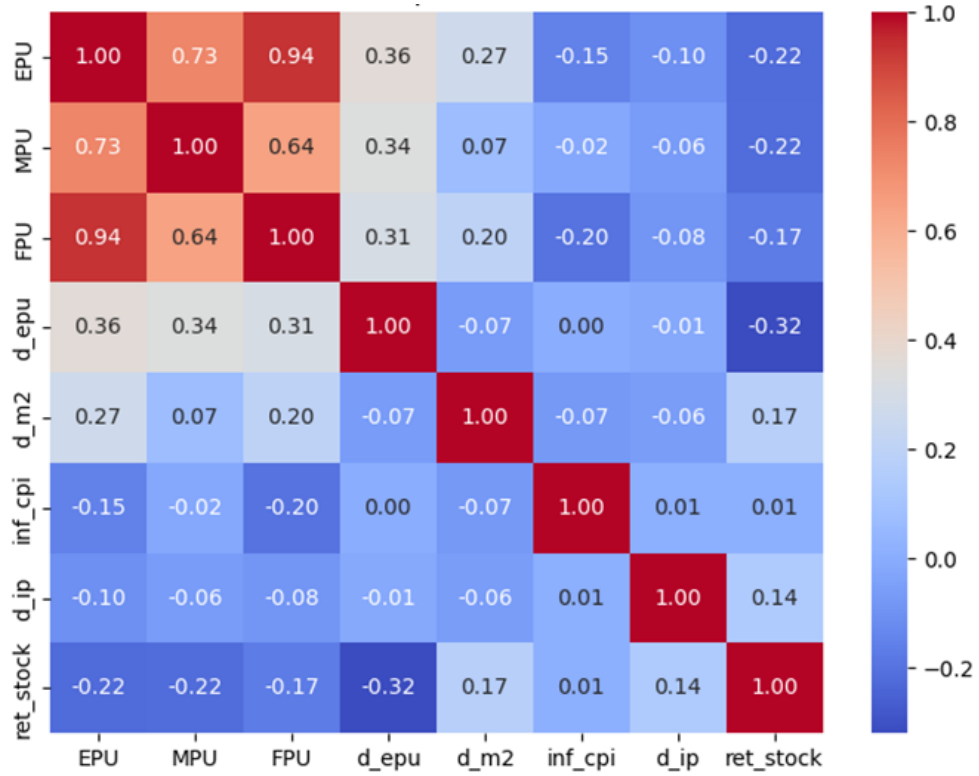

Figure 2: Correlation heatmap of the variables

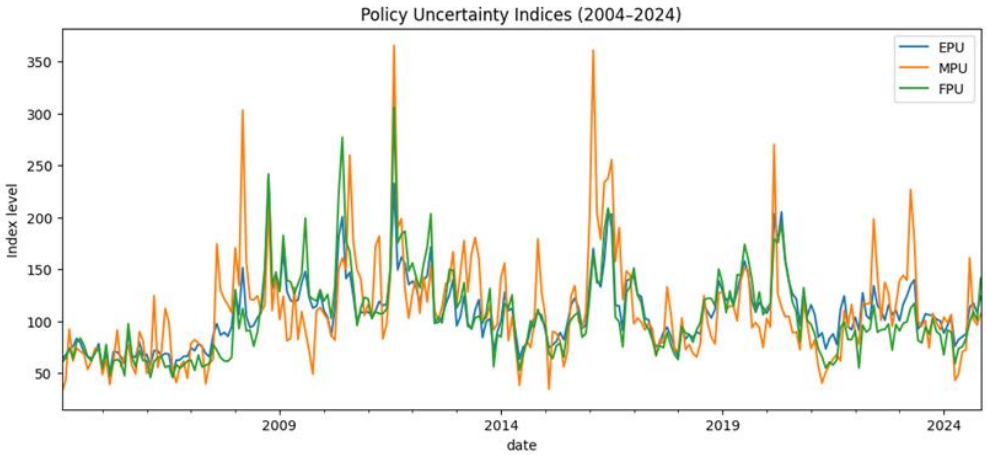

Figure 3: Policy Uncertainty Indices for EPU, MPU And FPU (2004-2024)

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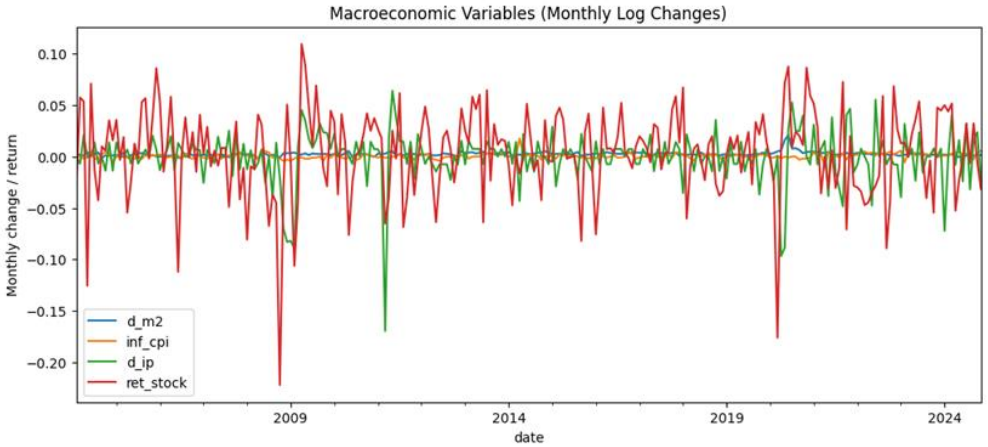

Figure 4: Macroeconomic variables (Monthly Log Changes)

Unit Root and Stationarity Tests (ADF)

Augmented Dickey–Fuller (ADF) tests were conducted to assess the stationarity of all variables. The results indicate that all series are stationary at levels or first differences at the 5% significance level, satisfying the prerequisite conditions for VAR estimation (Appendix A).

Lag Length Selection

To estimate the VAR model, we employ standard lag selection criteria, including the Akaike Information Criterion (AIC), the Bayesian Information Criterion (BIC), the Final Prediction Error (FPE), and the Hannan–Quinn Criterion (HQIC). As reported in Appendix B, all four criteria reach their minimum at lag 1, indicating that a VAR(1) specification provides the best balance between model fit and parsimony. Accordingly, we adopt VAR(1) as our baseline specification. As a robustness check, we also estimate VAR models with two and three lags. The impulse responses, variance decompositions, and diagnostic tests for VAR(2) and VAR(3) are broadly consistent with those of the baseline VAR(1), confirming that our main conclusions are not sensitive to the choice of lag length.

VAR Model Estimation

To analyze how policy uncertainty affects Japan's macroeconomic environment, we estimate a Vector Autoregression (VAR) that includes economic policy uncertainty (EPU), fiscal policy uncertainty (FPU), monetary policy uncertainty (MPU), money supply growth (d_m2), industrial production growth (d_ip), inflation (inf_cpi), and stock returns (ret_stock). The lag length is selected using standard information criteria (AIC, BIC, FPE, and HQIC). As reported in Appendix B, all four criteria reach their minimum at lag 1, so we adopt a VAR(1) specification as our baseline model. All

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variables enter the VAR in stationary form, based on the unit root tests discussed earlier. The estimated VAR(1) system is stable: the inverse roots of the companion matrix lie inside the unit circle, and residual autocorrelation tests indicate no remaining serial correlation. Additional diagnostic checks (normality and ARCH tests) suggest that the residuals are well behaved. The estimated coefficients reveal several statistically significant linkages from policy uncertainty to monetary and real variables, although the magnitude and sign differ across EPU, FPU, and MPU. The following table reports only those lagged coefficients that are statistically significant at the 5% level. The results show strong persistence in the uncertainty indices (EPU, FPU, MPU), as well as significant transmission from policy uncertainty to money supply growth (via EPU), industrial production growth (via EPU and FPU), and inflation (via FPU). Full estimation output is available in Appendix C.

Table 2: Main VAR (1) Results (Constant and Lag 1)

Equation	Regressor (L1)	Coefficient	p-Value
EPU	EPU	0.636391	0.000
FPU	FPU	0.647626	0.000
MPU	MPU	0.474263	0.000
d_m2	EPU	0.000034	0.002
d_m2	d_m2	0.474873	0.000
d_m2	d_ip	-0.015690	0.000
d_m2	ret_stock	0.006052	0.017
inf_cpi	FPU	-0.000033	0.005
d_ip	EPU	-0.000410	0.015
d_ip	FPU	0.000229	0.047
d_ip	d_m2	2.417534	0.004
ret_stock	ret_stock	0.157048	0.021

Impulse Response and Variance Decomposition Analysis

To examine how policy uncertainty affects Japan's macroeconomic environment, we compute impulse response functions (IRFs) from the baseline VAR(1) using orthogonalized (Cholesky) identification. Policy uncertainty is ordered before macroeconomic variables, with EPU placed first. This structure reflects the idea that uncertainty can adjust quickly, while real activity and prices respond more gradually, a standard assumption in macro-finance research.

EPU shock

A positive shock to EPU produces several clear reactions. Money supply (d_m2) rises on impact, consistent with precautionary liquidity behavior or accommodative monetary policy during uncertainty episodes. Industrial production (d_ip) declines, indicating that firms postpone investment and production decisions when uncertainty increases. Inflation

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(inf_cpi) reacts only mildly and with delay, in line with Japan's weak price dynamics. Stock returns fall briefly but quickly revert to baseline, reflecting limited financial-market sensitivity.

MPU shock

Monetary policy uncertainty generates a different pattern. Money supply responds only moderately. Industrial production shows a small and temporary decline. Inflation increases slightly, suggesting that uncertainty around future monetary actions affects price expectations. These results indicate that MPU captures a distinct dimension of uncertainty relative to headline EPU.

FPU shock

Fiscal policy uncertainty mainly affects real activity. Industrial production shows a short-run decline, consistent with uncertainty about government spending or taxation. Money supply and inflation react weakly, indicating that fiscal uncertainty operates more through real-activity channels than monetary transmission. Figure 5 illustrates the IRFs to an FPU shock.

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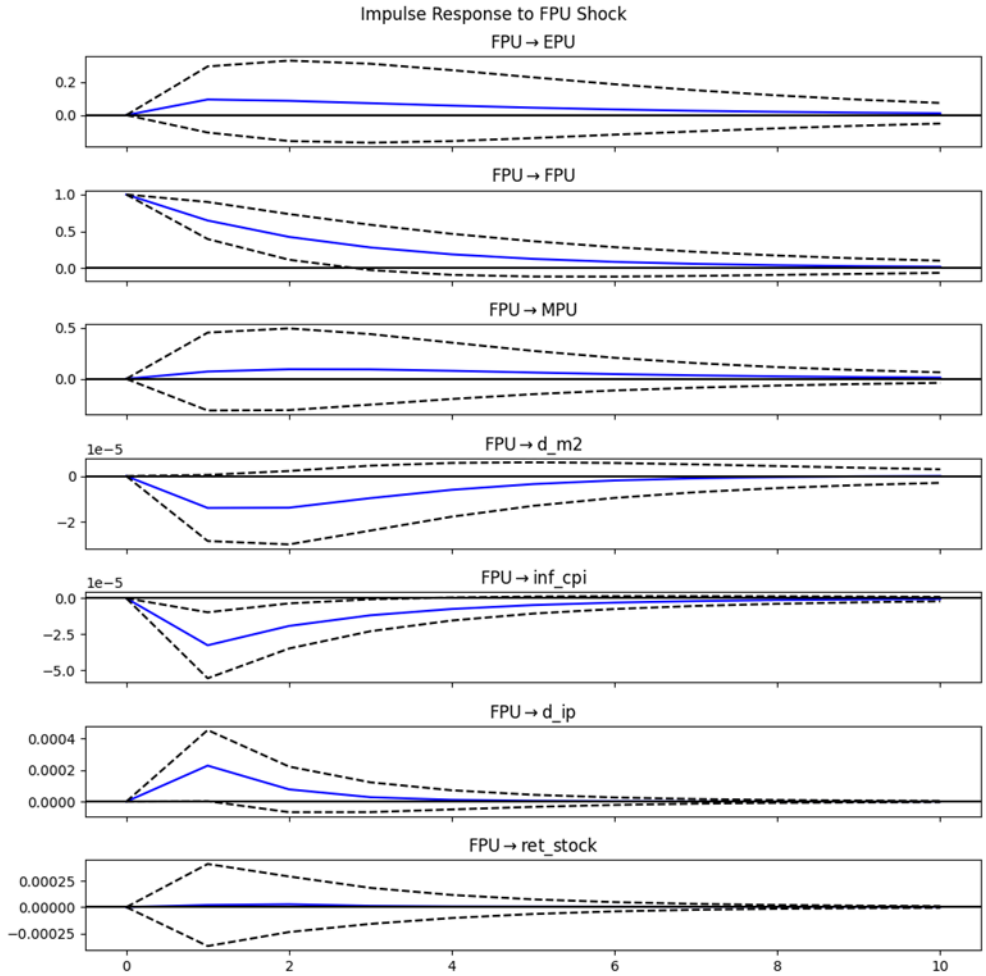

Figure 5: Impulse responses to an FPU shock

Stock-market responses

Across all uncertainty measures, stock-market reactions remain small and short-lived. Returns briefly decline but stabilize quickly, reflecting Japan's relatively resilient financial structure and the limited exposure of domestic equity markets to policy uncertainty.

Variance Decomposition (FEVD)

The 24-month forecast error variance decomposition shows that each variable is primarily driven by its own shocks, especially at short horizons. EPU shocks explain a meaningful share of the variation in money supply growth and industrial production, especially at medium horizons. Contributions of EPU, FPU, and MPU to inflation and stock-return volatility are small, reinforcing the view that policy uncertainty in Japan affects the real

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economy more than financial markets. Appendix C reports the orthogonalized IRFs from the VAR(1) model. The full 24-month IRF grid and the FEVD plots are reported in Appendix D.

Volatility Modeling Results

To assess whether policy uncertainty influences financial-market volatility in Japan, we estimate several GARCH-type models using monthly stock returns. These include a standard GARCH(1,1), a GARCH model with policy uncertainty included in the variance equation, and a GJR-GARCH specification that allows for asymmetric volatility responses. Across all models, the parameters linked to economic policy uncertainty (EPU), fiscal policy uncertainty (FPU), and monetary policy uncertainty (MPU) are statistically insignificant. The explanatory power of the volatility equations remains low, and adding uncertainty measures or leverage terms does not materially improve model fit. Figure 6 compares the conditional volatility produced by the plain GARCH(1,1) model and the GJR-GARCH model with EPU included in the variance equation. The two series overlap almost perfectly, confirming that incorporating uncertainty indicators or asymmetric effects does not meaningfully alter volatility dynamics. This reinforces the conclusion that equity-market volatility in Japan is only weakly affected by policy uncertainty. This pattern is broadly consistent with existing research like Antonakakis et al. (2013), which finds that the uncertainty–volatility relationship in Japan tends to be modest, state-dependent, and often overshadowed by broader institutional and macroeconomic factors.

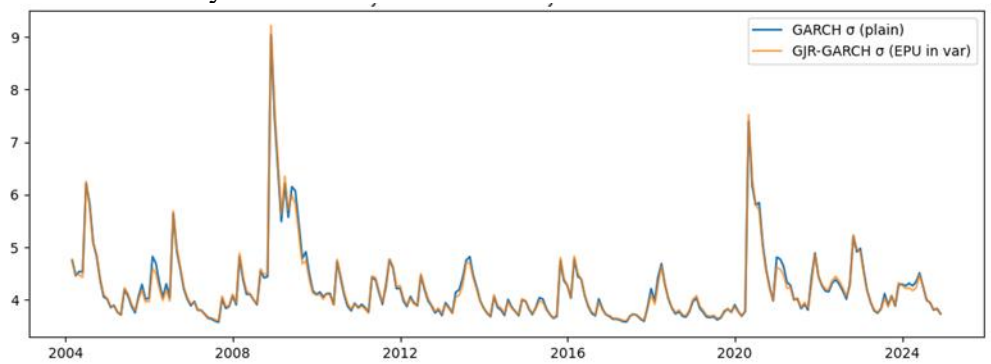

Figure 6: Conditional Volatility of Stock Returns Estimated with GARCH and GJR-GARCH Models

This figure displays the monthly conditional volatility from a standard GARCH(1,1) model and a GJR-GARCH model with EPU included in the variance equation. The two series are nearly identical, indicating weak leverage effects and minimal influence of policy uncertainty on stock-return volatility. Full estimation results for all GARCH specifications, including

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GARCH(1,1), GJR-GARCH, and the OLS(HAC) variance regressions, are reported in Appendix E.

Granger Causality Analysis

To complement the VAR results, we perform Granger causality tests to assess whether policy uncertainty helps forecast key macroeconomic and financial variables. We test whether EPU Granger-causes money-supply growth (d_m2), industrial production (d_ip), inflation (inf_cpi), and stock returns (ret_stock) using 1- and 2-lag specifications. Across all variables and lag lengths, the null hypothesis of no Granger causality cannot be rejected at conventional significance levels. The p-values for all tests exceed 0.15, indicating that lagged EPU does not provide additional predictive power for real activity, monetary aggregates, inflation, or financial returns once other dynamics are accounted for in the VAR. These results reinforce the view that, although uncertainty shocks influence contemporaneous dynamics (as shown in the IRFs), they do not systematically forecast future macroeconomic or financial outcomes. Full Granger test statistics are reported in Appendix F.

Robustness: Alternative VAR Lags and Diagnostic Checks

To verify that our results are not sensitive to the choice of lag length, we re-estimate the system using VAR(2) and VAR(3) models. Across these alternative specifications, the key coefficients linking policy uncertainty to money-supply growth and industrial production remain similar in sign and magnitude, and the impulse-response functions display the same qualitative patterns as in the baseline VAR. Diagnostic tests also support the adequacy of the higher-order models. Both VAR(2) and VAR(3) satisfy the stability condition, with all eigenvalues lying outside the unit circle. Ljung–Box tests indicate little remaining residual autocorrelation, except for a mild rejection in the EPU equation at longer lags. Residuals show non-normality according to the Jarque–Bera test typical for monthly macro-financial data but this does not affect inference, as the impulse-response confidence bands are bootstrapped. ARCH LM tests reveal limited remaining heteroskedasticity, mostly in the money-growth equation, which is addressed separately through the GARCH analysis. To sum up, the VAR(2) and VAR(3) results confirm that the main findings are robust to alternative lag structures.

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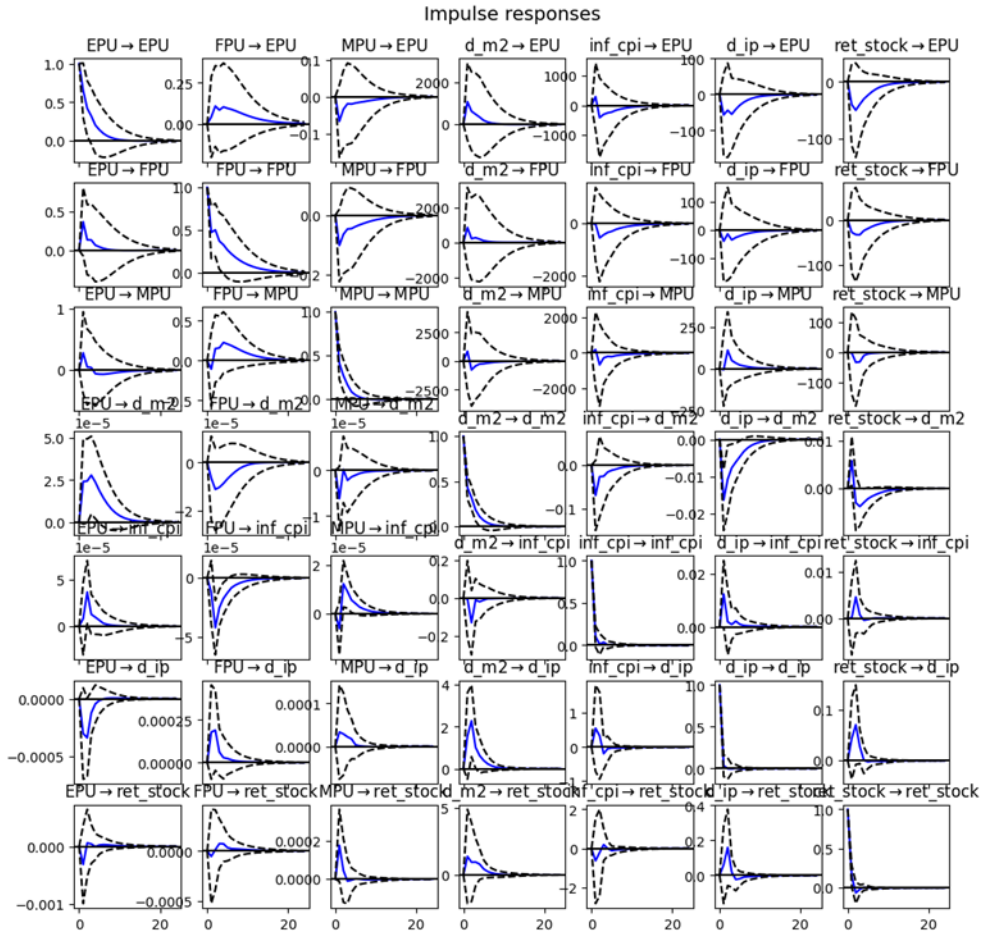

Figure 7: Impulse-Responses

Discussion

The results of this study show that policy uncertainty plays a clear role in Japan's monetary and real economy. Across all VAR models, economic policy uncertainty (EPU) has a strong and significant effect on money-supply growth. This suggests that when uncertainty rises, households and firms adjust their liquidity behavior, holding more cash, delaying spending, or changing precautionary savings. Similar patterns have been reported in earlier research such as Nusair and Olson (2024). Uncertainty also reduces industrial production. The negative and significant coefficients in the VAR indicate that firms become more cautious, postpone investment, and slow down activity when they are unsure about future policy. Studies on other Asian economies, such as Zhu and Yu (2022), report similar effects. Inflation reacts much more slowly. The impact of EPU on inflation is small and only weakly significant, consistent with the idea that price adjustments in Japan are gradual and heavily

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shaped by long-standing low-inflation dynamics. Financial markets respond differently. Stock returns react only mildly to uncertainty shocks, which supports earlier findings by Chiang (2020). The GARCH analysis also shows that uncertainty is linked to higher volatility, but the effect is not statistically strong. This suggests that uncertainty is only one of many factors affecting Japanese financial markets. The evidence indicates that uncertainty mainly affects money supply and real activity, while its impact on inflation and financial volatility is weaker. This pattern reflects Japan's institutional environment, including strong policy communication and unconventional monetary tools that help reduce uncertainty shocks.

Limitations and Directions for Future Research

While this study provides new evidence on the role of economic, fiscal, and monetary policy uncertainty in Japan, several limitations remain. First, the analysis relies on a linear VAR and GARCH model, which may not fully capture nonlinear or regime-dependent dynamics. Future research could apply TVP-VAR, threshold VAR, or structural VAR models to allow uncertainty to affect the economy differently during high- and low-uncertainty periods. Second, the volatility analysis is restricted to univariate GARCH-type models; richer frameworks such as multivariate DCC-GARCH could provide deeper insights into how uncertainty spreads across financial markets. Third, this study focuses only on Japan. Extending the analysis to other advanced Asian economies such as Korea, Singapore, or Taiwan would help evaluate whether Japan's muted volatility response is unique or part of a broader regional pattern. These limitations suggest valuable opportunities for follow-up research.

Policy Implications

The findings have several implications for Japanese policymakers. First, because uncertainty strongly affects money supply and industrial production, the Bank of Japan (BoJ) and fiscal authorities should focus on clear and consistent communication. Reducing uncertainty about future policy can help stabilize expectations and improve monetary transmission. Second, the results show that different types of uncertainty, economic, fiscal, and monetary often move together. This means that policy coordination matters. When fiscal and monetary policies send mixed signals, uncertainty rises and the economy becomes more vulnerable. Third, policymakers should monitor uncertainty indicators in real time. Including EPU, FPU, and MPU in forecasting and decision-making can help the BoJ react more quickly to sudden changes in sentiment. Fourth, although uncertainty does not strongly affect financial volatility, it still plays a role. Regulators can strengthen macroprudential frameworks by including uncertainty measures in stress tests,

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liquidity planning, and countercyclical buffers. In practice, this could involve: providing forward guidance tied to an "uncertainty dashboard", aligning major fiscal announcements with BoJ meetings to avoid confusion, adjusting the yield-curve-control framework during periods of unusually high uncertainty, and integrating EPU-based scenarios in risk assessments. These steps can reduce ambiguity, strengthen credibility, and help stabilize both financial markets and the real economy.

Conclusion

This paper studied how economic policy uncertainty affects Japan's monetary and macro-financial conditions using monthly data from 2004 to 2024. Using a VAR model and a GARCH volatility model, we examined how uncertainty influences money supply, inflation, industrial production, and stock-market volatility. The main results are: Money supply reacts strongly to uncertainty. Higher EPU affects liquidity behavior and monetary transmission. Industrial production declines when uncertainty rises. Firms reduce investment and output when policy becomes harder to predict. Inflation shows only a mild response. Price dynamics adjust slowly and are less sensitive to short-term uncertainty. Financial volatility increases only slightly and not significantly. Uncertainty is not the main driver of market volatility in Japan. These findings add to the existing literature (e.g., Baker et al., 2016; Nusair & Olson, 2024) by showing how uncertainty works in Japan's unique low-interest-rate environment. The results suggest that uncertainty mainly affects the real economy and liquidity, while its effects on volatility and inflation are limited. To conclude, uncertainty remains an important factor for policymakers to monitor. Clear communication, coordinated fiscal-monetary policy, and strong institutional credibility can help soften the impact of uncertainty shocks on Japan's economy.

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Data Availability: All data are included in the content of the paper.

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Appendix A: Augmented Dickey–Fuller (ADF) Unit Root Test Results

Variable	Test Statistic	p-value	1% Critical	5% Critical	10% Critical	Stationarity
EPU	-3.9643	0.0016	-3.4572	-2.8734	-2.5731	Stationary
FPU	-3.0103	0.0339	-3.4580	-2.8737	-2.5733	Stationary
MPU	-6.4197	0.0000	-3.4570	-2.8733	-2.5730	Stationary
d_epu	-5.5055	0.0000	-3.4582	-2.8738	-2.5733	Stationary
d_m2	-4.4498	0.0002	-3.4573	-2.8734	-2.5731	Stationary
inf_cpi	-9.2374	0.0000	-3.4570	-2.8733	-2.5730	Stationary
d_ip	-14.2640	0.0000	-3.4569	-2.8732	-2.5730	Stationary
ret_stock	-11.1931	0.0000	-3.4570	-2.8733	-2.5730	Stationary

Appendix B: VAR Lag Order Selection

Lag	AIC	BIC	FPE	HQIC
0	-19.04	-18.94	5.371e-09	-19.00
1	-20.95*	-20.14*	7.945e-10*	-20.63*
2	-20.90	-19.38	8.403e-10	-20.28
3	-20.74	-18.50	9.908e-10	-19.84
4	-20.72	-17.78	1.011e-09	-19.53
5	-20.69	-17.03	1.055e-09	-19.21
6	-20.62	-16.26	1.137e-09	-18.86
7	-20.44	-15.36	1.387e-09	-18.39
8	-20.36	-14.58	1.530e-09	-18.03
9	-20.16	-13.66	1.928e-09	-17.54
10	-20.02	-12.81	2.290e-09	-17.12

Note: Asterisks indicate the minimum value for each information criterion.
All criteria select a lag order of 1.

Appendix C: Full VAR(1) Estimation Results

Equation: EPU

Regressor	Coefficient	Std. Error	t-Stat	p-Value
const	31.534908	5.633205	5.598	0.000
L1.EPU	0.636391	0.150257	4.235	0.000
L1.FPU	0.094955	0.102363	0.928	0.354
L1.MPU	-0.038524	0.042028	-0.917	0.359
L1.d_m2	791.173298	746.905978	1.059	0.289
L1.inf_cpi	133.028215	564.225046	0.236	0.814
L1.d_ip	-72.573465	56.085847	-1.294	0.196
L1.ret_stock	-21.949991	34.961415	-0.628	0.530

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Equation: FPU

Regressor	Coefficient	Std. Error	t-Stat	p-Value
const	23.640282	7.049850	3.353	0.001
L1.EPU	0.189957	0.188044	1.010	0.312
L1.FPU	0.647626	0.128105	5.055	0.000
L1.MPU	-0.066809	0.052598	-1.270	0.204
L1.d_m2	299.149946	934.738721	0.320	0.749
L1.inf_cpi	-243.942539	706.116986	-0.345	0.730
L1.d_ip	-47.781997	70.190377	-0.681	0.496
L1.ret_stock	-9.667776	43.753551	-0.221	0.825

Equation: MPU

Regressor	Coefficient	Std. Error	t-Stat	p-Value
const	37.242087	10.699869	3.481	0.001
L1.EPU	0.136385	0.285403	0.478	0.633
L1.FPU	0.071679	0.194431	0.369	0.712
L1.MPU	0.474263	0.079830	5.941	0.000
L1.d_m2	-489.152133	1418.694263	-0.345	0.730
L1.inf_cpi	-48.596605	1071.704952	-0.045	0.964
L1.d_ip	-36.881978	106.531037	-0.346	0.729
L1.ret_stock	37.201820	66.406697	0.560	0.575

Equation: d_m2

Regressor	Coefficient	Std. Error	t-Stat	p-Value
const	-0.000361	0.000407	-0.887	0.375
L1.EPU	0.000034	0.000011	3.130	0.002
L1.FPU	-0.000014	0.000007	-1.888	0.059
L1.MPU	-0.000005	0.000003	-1.562	0.118
L1.d_m2	0.474873	0.054005	8.793	0.000
L1.inf_cpi	-0.073744	0.040796	-1.808	0.071
L1.d_ip	-0.015690	0.004055	-3.869	0.000
L1.ret_stock	0.006052	0.002528	2.394	0.017

Equation: inf_cpi

Regressor	Coefficient	Std. Error	t-Stat	p-Value
const	0.000740	0.000641	1.153	0.249
L1.EPU	0.000029	0.000017	1.696	0.090
L1.FPU	-0.000033	0.000012	-2.793	0.005
L1.MPU	0.000002	0.000005	0.377	0.706
L1.d_m2	-0.063419	0.085034	-0.746	0.456
L1.inf_cpi	0.118127	0.064236	1.839	0.066
L1.d_ip	0.008355	0.006385	1.309	0.191
L1.ret_stock	0.004059	0.003980	1.020	0.308

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Equation: d_ip

Regressor	Coefficient	Std. Error	t-Stat	p-Value
const	0.008484	0.006339	1.338	0.181
L1.EPU	-0.000410	0.000169	-2.424	0.015
L1.FPU	0.000229	0.000115	1.984	0.047
L1.MPU	0.000042	0.000047	0.878	0.380
L1.d_m2	2.417534	0.840485	2.876	0.004
L1.inf_cpi	0.597131	0.634916	0.940	0.347
L1.d_ip	0.078763	0.063113	1.248	0.212
L1.ret_stock	0.039200	0.039342	0.996	0.319

Equation: ret_stock

Regressor	Coefficient	Std. Error	t-Stat	p-Value
const	-0.000932	0.010991	-0.085	0.932
L1.EPU	-0.000124	0.000293	-0.421	0.673
L1.FPU	0.000020	0.000200	0.101	0.920
L1.MPU	0.000114	0.000082	1.387	0.165
L1.d_m2	1.230141	1.457264	0.844	0.399
L1.inf_cpi	-0.643794	1.100841	-0.585	0.559
L1.d_ip	0.048297	0.109427	0.441	0.659
L1.ret_stock	0.157048	0.068212	2.302	0.021

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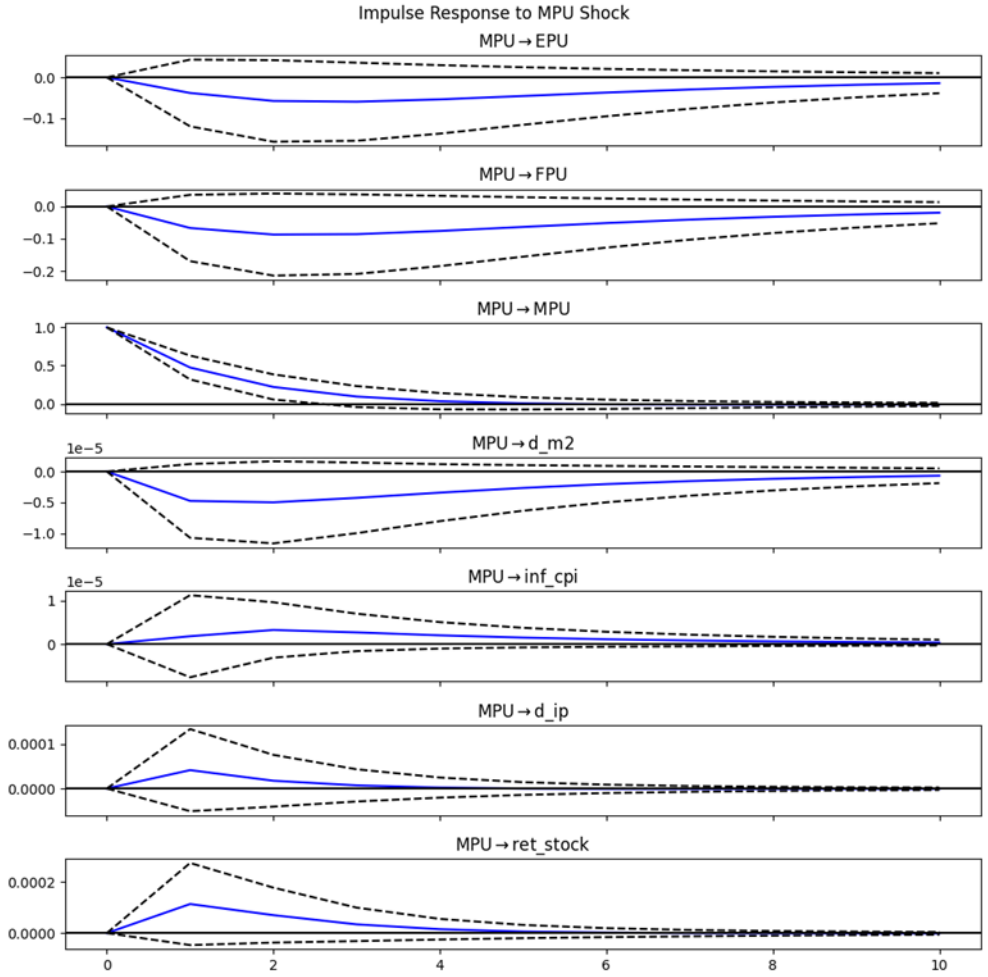
Appendix D: Full 24-month IRF grid and FEVD plots



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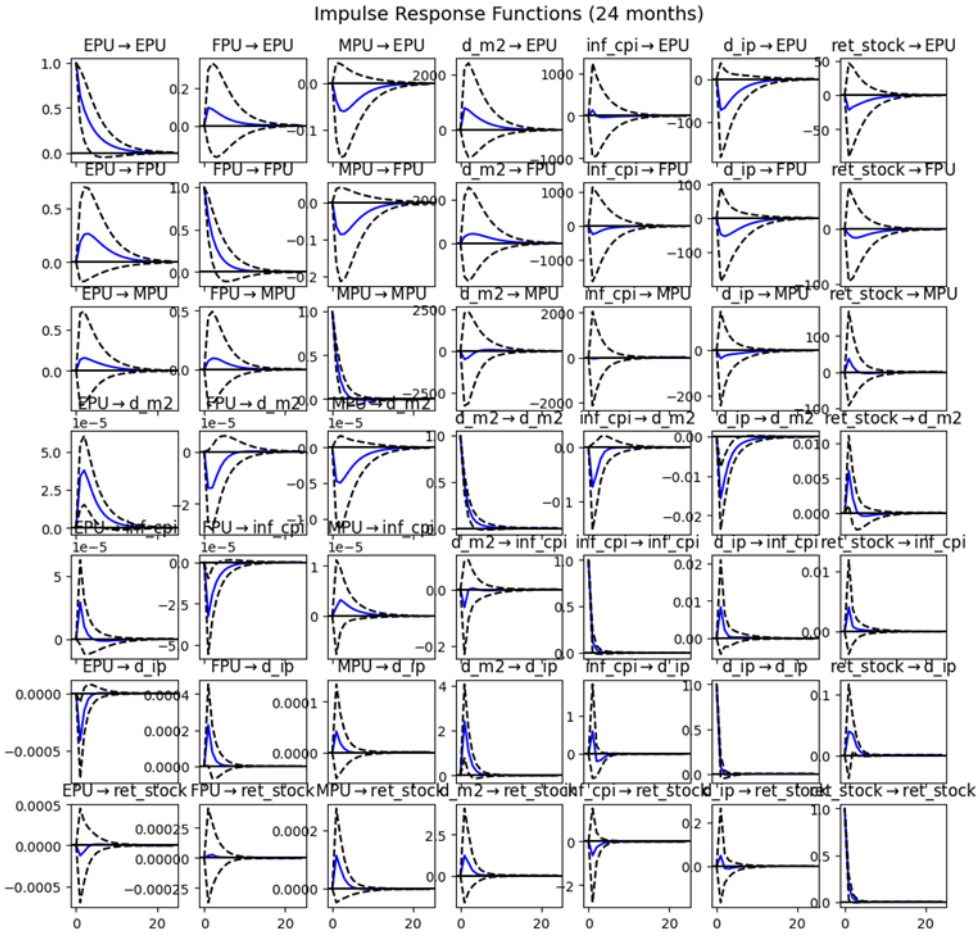

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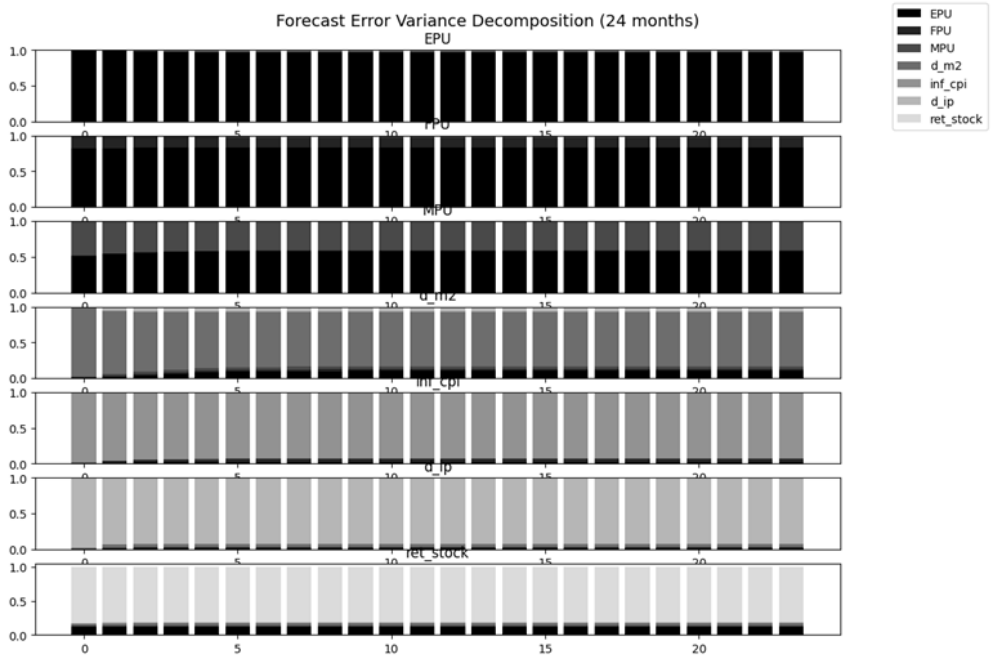

Appendix E: Volatility Modeling Results

Table E1. Plain GARCH(1,1)

Parameter	coef	std err	t	P>|t|	95% Conf. Int.
mu	0.3944	0.311	1.268	0.205	[-0.215, 1.004]
omega	4.9315	3.776	1.306	0.192	[-2.470, 12.333]
alpha[1]	0.1266	0.206	0.615	0.538	[-0.277, 0.530]
beta[1]	0.6052	0.318	1.902	0.05714	[-0.01836, 1.229]

Table E2. GARCH(1,1) with EPU in Variance

Parameter	coef	std err	t	P>|t|	95% Conf. Int.
mu	0.3944	0.311	1.268	0.205	[-0.215, 1.004]
omega	4.9315	3.776	1.306	0.192	[-2.470, 12.333]
alpha[1]	0.1266	0.206	0.615	0.538	[-0.277, 0.530]
beta[1]	0.6052	0.318	1.902	0.05714	[-0.01836, 1.229]

Table E3. GJR-GARCH(1,1) with EPU in Variance

Parameter	coef	std err	t	P>|t|	95% Conf. Int.
mu	0.3796	0.309	1.227	0.220	[-0.227, 0.986]
omega	4.8780	4.689	1.040	0.298	[-4.312, 14.068]
alpha[1]	0.0975	0.211	0.462	0.644	[-0.316, 0.511]
gamma[1]	0.0346	0.155	0.223	0.824	[-0.270, 0.339]
beta[1]	0.6159	0.406	1.515	0.130	[-0.181, 1.413]

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Table E4. GARCH(1,1) with MPU in Variance

Parameter	coef	std err	t	P>|t|	95% Conf. Int.
mu	0.3944	0.311	1.268	0.205	[-0.215, 1.004]
omega	4.9315	3.776	1.306	0.192	[-2.470, 12.333]
alpha[1]	0.1266	0.206	0.615	0.538	[-0.277, 0.530]
beta[1]	0.6052	0.318	1.902	0.05714	[-0.01836, 1.229]

Appendix F: Granger Causality Tests

Table F1. EPU → d_ip

Lags	Test	Statistic	p-value
1	F-test	1.9629	0.1625
1	Chi-square	1.9868	0.1587
1	LR test	1.9789	0.1595
2	F-test	0.9260	0.3975
2	Chi-square	1.8901	0.3887
2	LR test	1.8829	0.3901

Table F2. EPU → inf_cpi

Lags	Test	Statistic	p-value
1	F-test	0.0075	0.9309
1	Chi-square	0.0076	0.9304
1	LR test	0.0076	0.9304
2	F-test	0.6919	0.5016
2	Chi-square	1.4122	0.4936
2	LR test	1.4082	0.4946

Table F3. EPU → d_m2

Lags	Test	Statistic	p-value
1	F-test	1.1193	0.2911
1	Chi-square	1.1330	0.2871
1	LR test	1.1304	0.2877
2	F-test	0.6734	0.5109
2	Chi-square	1.3745	0.5029
2	LR test	1.3707	0.5039

Table F4. EPU → ret_stock

Lags	Test	Statistic	p-value
1	F-test	0.1206	0.7287
1	Chi-square	0.1220	0.7268
1	LR test	0.1220	0.7269
2	F-test	0.5467	0.5796
2	Chi-square	1.1158	0.5724
2	LR test	1.1133	0.5731

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The Impact of Marketing Communications on Consumer Behavior in The Saudi Arabian Telecom Industry

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Abstract

Marketing plays a central role in helping organizations retain existing customers and attract new ones in an increasingly competitive and rapidly evolving environment. Advances in communication technologies have expanded the ability of firms to reach and engage consumers through a mix of traditional and digital channels. This study investigates how Saudi telecom operators leverage these channels to influence consumer behavior, shape perceptions, and stimulate purchasing decisions. A qualitative case study methodology was adopted, incorporating four in-depth, semi-structured interviews with marketing communication and product management specialists from major local telecom operators. These interviews provided rich, practitioner-level insights into strategic communication practices. The primary data were complemented by secondary sources, including industry reports and prior academic literature, and analyzed using thematic analysis to identify recurring patterns and to compare them with established theories of marketing communication and consumer behavior. The results show a strong and purposeful relationship between marketing communication channels and consumer behavioral responses. Telecom operators in Saudi Arabia are increasingly dependent on digital platforms - particularly social media - for targeted engagement, real-time interaction, and influencing consumer motivations at the consideration stage. Meanwhile, traditional channels such as television and outdoor advertising continue to dominate large-scale brand-building campaigns due to their broad reach and credibility. The findings further reveal that communication style, message framing, and cross-channel

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integration play an essential role in shaping consumer attitudes, perceptions, and intentions. Consumers' motivations are driven primarily by utilitarian factors such as pricing, network coverage, and data speed; however, emotional and hedonic elements are strategically incorporated to reinforce brand identity and enhance customer affinity. Overall, the study underscores the critical importance of marketing communication in shaping consumer behavior within the Saudi telecom industry and highlights the deliberate strategic alignment between communication activities and desired behavioral outcomes.

Keywords: Marketing Communication, consumer behavior, Traditional marketing, Digital marketing, and Communication Channels

Introduction

The varied marketing strategies adopted by local Saudi telecom operators make it crucial to inform them about effective marketing communication practices and how to integrate them to alter behavioral patterns. Operators must understand when and how to use specific marketing channels to target different customer groups and send and receive different messages.

Background and Area of Focus

Being an employee in the marketing department in a telecom company that recently has gotten a unified communication license from the Communication and Information Technology Commission CITC, after 10 years of serving the business sector, has opened eyes to work closely with understanding the consumer market, its competitive landscape, and marketing communications activities that are conducted to drive growth in revenues from the consumer sector.

The importance of the marketing communication concept in the telecom sector stems from its ability to influence and shape consumer behavior. In the telecom sector, marketing communication has become an essential part of organizations seeking wealth and success. Telecom organizations recognized the importance of marketing communications channels in influencing consumer behavior to increase revenue, especially after the Saudi initiative to diversify economic sources. Consequently, telecom companies in Saudi Arabia spend billions of riyals on various marketing activities to attract consumers to their products and increase their market share.

In 1990, marketing channels and sources were limited to traditional marketing communications tools such as newspapers, TV, Radio, and Magazines. However, technological development has helped change consumer behavior across different channels. Moreover, it has changed the

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way organizations communicate with consumers. Thus, the increasing number of channels changed how organizations handle different behaviours.

One of the steps is first to understand the relationship between marketing communication and consumer behavior. Hence, this step can be accomplished by an academic dissertation that understands these relationships and emphasizes the models of both marketing communication and consumer behavior in the consumer sector.

Research Question

To identify the local marketing communication models most adopted by telecom operators in Saudi Arabia to influence consumer behavior and motivation toward telecom services, the research will answer the question of how marketing communication impacts consumer behavior in the telecom industry in Saudi Arabia.

Research Objective

The purpose of this study is to identify the relationship between marketing communication and consumer behaviour by highlighting the factors that influence consumer behaviour and the strategies adopted by the marketing communication department in the telecom industry to encourage consumers to buy new products and services. The research aims to analyse the relationship between marketing communication and consumer behaviour.

Theoretical Framework

Various studies have examined the relationship between marketing communication and consumers in general, such as Oancea (2015), who developed a model of Integrated marketing communication and identified the role of influencers in consumer behavior. Keller (2009) identified approaches to building brands in the modern marketing communication environment, and many other scholars in this field identified the factors in consumer behavior that can be influenced and the models of marketing communications that serve to influence behavior in the telecom sector. The theory of planned behavior by Ajzen (1991) shows how human behavior is being shaped, Maslow, (1954) negotiates the hierarchy of human needs that must be taken in consideration when organizations want to deal with humans whether to sell or to announce messages, these theories have helped the researcher to understand what is behind human behavior to understand the complexity of the relationship between marketing communication and consumer behavior.

Method of Research

This research employs a qualitative case study approach and draws on multiple sources of evidence to address the main research question. The

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primary method of data collection consists of semi-structured interviews with staff from the marketing communication and product management departments of major Saudi telecom operators. To complement the primary data, the study also incorporates findings from previous research in the same field, as well as relevant bank and industry reports on telecom operators in the Kingdom.

To address sampling concerns, participants were selected through purposive sampling, targeting individuals with direct involvement in marketing communication planning, campaign execution, and product strategy. This approach ensured that each participant possessed the expertise necessary to provide rich and relevant insights. Four interviews were conducted in total, reflecting representation from different telecom operators. Each interview followed a semi-structured format, using an interview guide covering topics such as communication channel selection, message design, campaign objectives, consumer response, and cross-channel integration. Interviews were conducted either in person or virtually, depending on participant availability. They ranged from 45 to 60 minutes and were audio-recorded (with the participants' consent) and then transcribed verbatim for analysis.

The study applied a thematic analysis framework. The analytical process involved: (1) familiarization with the data through repeated reading of transcripts, (2) generating initial codes reflecting communication practices and consumer behavioral outcomes, (3) grouping codes into broader themes, (4) comparing themes with insights drawn from secondary sources, and (5) interpreting the findings in relation to established theories of marketing communication and consumer behavior.

By detailing the sampling process, interview procedures, and analytical steps, the methodological description now provides sufficient transparency and structure to allow replication and meet qualitative research standards.

Analysis of the Research

Interviews with Saudi telecom operators are recorded, and the findings are analyzed against the literature review and reports on the telecom industry. Quotes of the interviewee are used to identify the differences in strategies among operators. The operator name is not mentioned in the discussion and data analysis chapter; instead, the company name is replaced by codes, for example, the market leader is named as Company A, the second entrant is named as Company B, the third entrant is named as Company C, and Business Provider, an early entrant to consumer segment is named as Company D.

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Key Concepts of the Study

This article examined the relationships among marketing communication, cross-marketing, consumer behavior, and consumer motivation and illustrated that marketing communication is strongly linked to consumer behavior. The study answered the main question: which models are most adopted by telecom players for marketing communication activities. There is a clear sign that local players consider consumer behavior when designing their marketing campaigns. Thus, most of their marketing activities are behavior-driven and aimed at increasing consumers' motives to purchase telecom services. Print media as a marketing channel appears to be dead and replaced by digital blogs and news websites. TV and Outdoor communication channels are still active, though telcos' spending on them has decreased dramatically compared with last year. Social media platforms and video communities have replaced reliance on TV channel advertisements and are primarily used to shape and influence consumer behavior.

Chapter II: Literature review

Introduction

In this literature review, the author will expand on the external and internal factors that influence consumer motivations, thereby informing the design of an effective marketing communication strategy. Additionally, to create marketing content that captures consumers' attention in the telecom sector. However, choosing the right communication channel and style depends on understanding these factors to establish profitable customer relationships through integrated marketing communication (Keller, 2009).

The researcher will discuss the concepts of marketing communication and consumer behavior, focusing on motivation - the motor of human behavior - and on communication style, which is designed to influence consumer behavior. Consequently, different theories and models of marketing communication that profoundly influence consumer behavior to purchase telecom services are explored. The author will identify the various marketing concepts and effects that construct the communication style that governs the relationships between marketing communication and consumer behavior.

Marketing communication style and motivation have been found to interact to shape consumer behavior. The importance of consumer behavior stems from its relation to marketing communication. Thus, understanding it will help in creating an effective marketing communication plan.

Marketing communication

Marketing communication is an efficient way to influence consumer decision-making through the messages they receive from their brands. These messages should be behaviorally driven. According to Blythe (2000),

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communication is the process of converting the original messages into symbols that can be understood by the receiver when shared in a common language.

Schultz, D.E. et al (1993) defined IMC as the strategic framework within the marketing function that plans the various marketing activities to provide clarity, consistency, and substantial impact on consumers, thereby affecting consumer behavior in purchasing telecom products/services. McArthur & Griffin (1997) defined marketing communication as a tool to reach consumers. Duncan & Everett (1993); Duncan & Moriarty (1998) described IMC as a way of communicating with customers using a single voice. Garber & Dotson (2002) defined their role as providing consistent efforts that unify the organization and reduce the risk of consumer choice in the service sector, using all available communication tools. Oancea (2015) defined IMC as the strategic process used by different business types to design, develop, and execute persuasive, measurable marketing messages for potential or existing consumers. Gronstedt (2000) described IMC as the strategic processes organizations use to create healthy, lasting, and profitable relationships with stakeholders.

Howard-Sheth (1969) developed a model that assumes consumers classify the inputs to their buying process before deciding on a purchase. After extensive empirical research, Howard-Sheth identified four types of stimuli that help consumers during the procurement process: external sources of information and critical stimuli that provide information about product characteristics, such as quality, price, and features. Symbolic stimuli that include information transmitted from visuals and symbols to the mind of consumers, and Social stimuli, which involve the social sources of information that can be from family and friends.

Marketing communication, as a result, and by agreement of the previous theories in the field, is considered to be the strategic tool in the marketing function that shows the entire picture of the organization using one uniform voice directed to improve the organizational positioning in the market and influence consumer buying behavior in various ways to accomplish revenue growth.

Communication style

Williams and Spiro (1985) advanced the concept of communication style as a significant factor influencing consumer behavior. Different communication styles - colorful, less colorful, passive, personal, energetic, etc. - can trigger different consumer responses and influence the receiver's behavior. Thus, communication style plays a vital role in transferring messages that reliably represent consumers. Chang (2005) highlighted that the congruence between the marketing message image and the consumer's ideal

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self is directly linked to and influential on consumer behavior toward brands. Marketing messages are designed to trigger changes in consumers' needs, which are shaped by their norms, values, and focus on their cognitive and affective states.

Emotions are feelings that occur and provide information about human relationships with the surrounding environment and explain the interpretations occurring in these relationships (Achar et al., 2016). Jovanovic et al. (2016) explained two main appeals of marketing messages: rational or emotional, depending on the impact marketers seek to produce in consumers' minds. Rational appeals can be called logical or informative. These appeals highlight the main characteristics of a product, its prices, and the benefits consumers gain. In contrast, emotional appeals are directed to influence consumers emotionally. They may be used to provoke fear or stimulate positive emotions, depending on the product type. I disagree with the research by Kazmi and Batra (2009), which found that emotional appeals cannot be used with products with technical characteristics, because emotional appeals can be used in different situations and with a variety of products and brands. It is not only used to stimulate the motive to purchase. I argue that emotional appeals can stimulate consumers' motives to be loyal to brands, or to be more engaged with it. For example, Procter & Gamble created an advertisement that emphasizes the importance of mothers taking care of children participating in the Olympic Games and getting injured to promote their various consumer goods, while also strengthening the brand image in consumers' minds. The same applies to the services sector; emotional styles are used to influence consumers' loyalty to a brand. As a result, it is not necessarily that companies use emotional appeals to spur consumer intention to purchase. However, rational appeals provide information about the brand; their role is only to present facts so consumers can compare marketed products to competitors with the same functionality. Therefore, the use of rational appeals in marketing is primarily intended to provide consumers with information. On the other hand, the role of emotional appeals is to influence the purchase intention or to stimulate and produce feelings towards a product. For example, stimulating social or personal feelings can be achieved by distributing emotional appeals across different marketing channels. Personal feelings include security, safety, fear, love, attraction, excitement, and pleasure. While social feelings occur across various social circles, for example, feelings of belonging, recognition, and respect. According to Jovanovic et al (2016), emotional appeals can be classified into positive and negative appeals. Positive emotional appeals highlight the advantages and benefits of using the product, while negative emotional appeals highlight the dangers and risks of not using it, which spurs a fear motive and emphasizes the need to purchase the marketed product. Schwarz et al (1991) stated that consumers' emotional states influence the

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strategies they use to process received marketing messages, and thus consumers prefer responding to emotionally toned messages. Kang et al (2014) stated that focusing on hedonic benefits when sharing marketing messages - such as fun, enjoyment, and pleasure - will increase consumer engagement and participation with those messages when shared on traditional or non-traditional media. Furthermore, the more energetic and conversational the communication style, the greater the firm's financial benefits. Hence, focusing on consumers' hedonic value will foster a healthy relationship between consumers and brands, thereby increasing customer retention over the long term. This will establish the brand in the customer's mind and memory, enabling positive behaviors.

Use of Cross-Media Channel

The use of cross-media channels by telecom operators to announce marketing messages is essential. Naik & Raman (2003) noted that utilizing different media to publish marketing messages would increase company sales. On the contrary, Dijkstra et al. (2005) highlighted that the use of multi-marketing channels might negatively affect the effectiveness of marketing messages and dissipate consumer attention. Differences in consumer behavioral characteristics and demographic characteristics shape the media choice of consumers.

Information Processing

Understanding how consumers process information for specified marketing messages is crucial for choosing the appropriate marketing option for message announcement and for marketing communication planning. To design marketing communication plans, marketers should consider communication options, though effective, during the processing of information presented, and manage relationships with one another (Batra & Keller, 2016). Furthermore, marketers should be able to understand which marketing option mix is suitable for a particular customer type, brand, etc. They should use distinct yet easily processed marketing options.

MacInnis & Jaworski (1989) argue that the understanding of the different processing mechanisms will help in marketing communication planning. Various information processing models focus on consumers' mental processes and mindsets; they measure consumers' ability to understand marketing communication messages. Marketers should be able to produce knowledge, behavior, and attitude through marketing messages. Once messages can provide insight, precise, continuous, and positive responses and views, they are called compelling marketing messages. Consumers' processing of information depends on the characteristics of the marketing message, such as the amount of knowledge it provides, the feelings, emotions, and judgments

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it elicits. Consequently, communication processing is critical for identifying changes in learning about a particular brand and for determining the effects of the marketing message on consumers, thereby informing subsequent handling. Thus, the content of marketing messages should concentrate on simplifying content processing in the mind of consumers. For example, the design should use different symbols that help convey the message more comfortably in consumers' minds. Using simple words in the content will also simplify consumers' understanding of marketing messages and, therefore, help achieve desirable results.

Knowledge and marketing communication

Knowledge is the basis for understanding consumer behavior, and it is crucial to know how consumers seek information. Newman & Staelin (1972) stressed that understanding search behavior is significant for planning marketing communication strategies. Demographic factors such as education and experience play a significant role in understanding how people search for information. Information technology is a fast-growing field where many products are placed quickly. Surprisingly, consumers love staying up to date with ICT developments. Information and research about ICT products are profoundly affected by education. Donthu & Garcia (1999) highlighted that less educated people will have difficulty searching the internet, indicating they will have trouble understanding ICT products and services, particularly the more complex ones, such as cloud computing. Less experienced researchers tend to be more information seekers than highly skilled professionals.

Furse et al. (1984) stressed that experience negatively impacts the information search. On the other hand, Jacoby et al (1978) found that purchase experience reduces information search. However, by considering individuals' search behavior and the sources of knowledge, organizations can design messages aligned with consumers' search preferences. Whether companies use physical or online stores, understanding human motivations is critical to meeting consumers' demands. Blackwell et al. (2006) highlighted that consumer demand can come from two sources: first, external sources, such as product characteristics that guide consumers toward fulfilling a specific purpose; and second, internal sources that steer consumers toward hedonic benefits, such as experience, attainment, and comfort.

Consumer Behavior

Scholars, social scientists, and psychologists have done extensive research about consumer behavior and the significant predictors of attitudes by innovating consumer behavior-related theories and practices in the different fields of social studies. According to Ajzen (1991), one of the theories that explains the formation of human behaviors, attitudes, and habits

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is the theory of planned behavior, which holds that human behavior is mainly determined by intentions to perform specific actions. Intentions are presumed to capture the motivational factors that drive human behavior. In other words, it is the primary predictor of the efforts humans can make to produce behavior (Ajzen & Fishbein, 1969). The Theory of Planned Behavior is a development of the theory of reasoned action by Ajzen and Fishbein (1969) in the late 60's, which analyzes the relationship between human intentions and behavior. Human intention leads individuals to engage in specific behavior; this is called behavioral Intention.

According to Webster et al. (1994), consumer attitudes can determine behavioral intentions and the subjective norms associated with the behavior, and they are related to personal feelings toward performing a specific action. Thus, the Consumer behavior setting is formed by the antecedent events that led to the behavior in the first place. Learning experiences, punishments for wrong choices, or reinforcements that lead to attainment will influence consumer behavior.

Anderson and Sullivan (1993) and Schiffman & Kanuk (1997) argued that economic theory is the basis for all types of consumer decisions, in which consumers seek to get the most out of organizations at the lowest prices when they intend to purchase products and services. Consequently, organizations should align their products and services with consumers' expectations and perceptions to achieve consumer loyalty and satisfaction. Rubinson (2009) demonstrated that the effectiveness of marketing communication lies in integrating all marketing communication tools across all stages of the consumer purchase decision process. Marketers should direct their messages to consumers in various ways to alter consumer behavior and reveal the efficiency of marketing communication. According to Algesheimer et al. (2005), consumers interpret communication messages differently, so to demonstrate effectiveness, companies should tailor their messages to different audiences through various channels and focus on the most profitable channels. For example, focusing heavily on traditional forms of communication while forgetting the influence of digital channels may not always be a good idea. Thus, we cannot neglect the Importance of digital communication channels. Social media, mobile marketing, email marketing, and web-based marketing are considered less costly than traditional channels and can quickly reach large numbers of targeted consumers. However, content in digital marketing channels should stimulate favorable behaviors. It is not necessarily that content should only contain offers and promotions for telecom services and provide benefits-based content; more importantly, it should focus on stimulating different behaviors that lead to purchase.

Marketing messages should be crafted to manipulate consumer behavior in ways that help organizations grow, enabling companies to plan

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marketing communication strategies that target different behavioral characteristics. Thus, marketers should develop messages that emphasize the actual needs of humans for telecom services by addressing factors that affect human behavior.

Consumer Motivation

The concept of motivation in human behavior is derived mainly from Maslow's hierarchy of needs. Maslow (1954) initiated the humanistic theory, postulating that natural human needs are built up of psychological needs, such as Safety, Hunger, and thirst, which evolve to different levels of needs gradually as required upon completion of basic needs of this hierarchy, and then move toward psychological needs such as belongingness, recognition, love, and esteem. Maslow's theory is the basis of human motivation; the different needs of humans are the primary drivers of their motives to purchase specific products or services. However, at any given time, when motivation arises in a human, one of these need categories will emerge more quickly than the others, a phenomenon called a prepotent need.

Prestont et al (2014) proposed that there are two general categories of motives in humans, ultimate and proximate. Proximate motives are the main reasons for purchasing a product or responding to a marketing message in a particular way. Additionally, all products purchased by consumers are influenced by proximate motives. Such proximate motives include preferences, social norms, values, feelings, and incentives. According to Preston et al (2014), focusing solely on proximate factors of buying behavior is insufficient without an ultimate explanation. The ultimate motives in humans are evolutionary-based; they explain that human behavior is composed of multiple motive systems. The author categorized the motive systems into self-protection, disease avoidance, affiliation, status, mate retention, mate acquisition, and kin care. Each motive system is activated by different events in human life, producing cues that spur human tendencies to act in certain ways. These two categories of motivation are connected, and neither can explain human behavior without the other. Ultimate motives, or, in other words, ancestral motives, are the shaping forces of modern consumer preferences and decision-making.

Understanding motivation requires marketers to question why consumers behave the way they do. Before understanding why consumers act the way they do, we should realize that motivation is the process of satisfying a need that has been aroused in the consumer's mind. However, marketing is the effort to meet these needs by developing products and services that respond to them and create value for customers. Psychologists negotiate the classification of human needs. Bayton (1958) classified psychogenic needs into three broad categories. First, affectional needs - those needs closely

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related to human emotional states - create warmth and compatibility with others. Ego-bolstering needs which create the state of enhancement in human personality, and in another way, these human needs to dominate and control others through personality traits. Ego-defensive needs are the third category of needs classified by Bayton (1958). These needs are the protection of personality when dealing with others and require humans to avoid any psychological harm to their character.

Motivation is the central driver of human behavior derived from personal needs. Therefore, marketers' messages should target these needs to appeal to different consumers' motivation patterns. Bayton (1958) stated that human behavior can be classified into three categories: motivation, cognition, and learning. Motivation is defined as the "urges, wishes, and desires" of an individual to initiate a behavior and is considered the motor of human behavior. Cognition is the mental process that occurs when dealing with specific brands and is mainly based on consumer experiences; these processes can include memory, perception, judgment, and learning. Therefore, these three concepts - motivation, cognition, and learning - are interrelated in a way that one cannot occur without the others. Thus, marketers should be able to extract these factors in their messages to consumers.

The change in consumer behavior was driven by external stimuli. For example, for consumers to be motivated by a message, there should be a prior relationship with the brand in their minds. If this contact did not occur before, consumers should learn about it through external stimuli prepared by organizations, such as advertising.

The source of motivation

Belk, Askegaard, & Scott (2012) assumed that motivation is a social character shaped by desires. Desire is the interaction between the social environment and individuals, composed of wants and needs, and it contributes to a consumer's behavior by satisfying either hedonic or utilitarian needs. Utilitarian needs might be identified by examining the tangible attributes of products. On the other hand, hedonic needs are more evident through products that produce excitement, self-confidence, or fantasy for individuals. Telecom services are considered to meet both utilitarian and hedonic needs, but the messages communicated to consumers emphasize a more utilitarian than a hedonic view of products and services.

Categorizing needs depends on the value it brings to individuals. Some needs relate to power and control over others. While other needs concern people who desire to be different from others, for example, the need for uniqueness. Uniqueness appears in the tangible products arena, such as using a luxury car.I assume the need for specificity is not limited to physical products; it should also apply to messages from telecom services, and most of

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the content written should reveal this attribute to people using telecom services. In the telecom industry, consumers should be differentiated by the messages they receive to purchase the service. Therefore, messages sent to a group must be considered directed to each individual in the group.

Types of Human Motivations

Ryan and Deci (2000) propose that human motivation can be classified into two types: intrinsic motivation and extrinsic motivation. Intrinsic motivation occurs when humans are highly engaged with things that are naturally enjoyable, and there is no need for external stimuli to stimulate their feelings toward them. For example, for a player, it is naturally enjoyable; there should be no external reinforcement. In contrast, extrinsic motivation occurs when external reinforcement or punishment is provided by the surrounding environment. In the telecom services scenario, motivation can be extrinsic through loyalty programs and gift items based on daily usage, or intrinsic through hedonic images in messages communicated to customers to create intrinsically motivated consumers.

The role of motivation in massage Involvement

The strong relationship between consumers and brands is called involvement, and involvement is part of motivation, as motivation is the motor that drives the satisfaction of consumer needs. Consumers ignore information that might not meet their needs, while, on the other hand, they may engage with information that is useful for attaining specific goals; this is called involvement. As mentioned in the marketing communication section, the effort put into seeking information about a brand depends mainly on the level of consumer involvement with a specific name. Different levels of engagement, shaped by consumer motivations to read about some products and services, are highly dependent on access to information about a particular brand. Consumers mainly seek a safer choice over an unknown one because they lack knowledge about unknown products. There are different marketing strategies to increase consumer involvement. For example, engaging consumers in creating the content they like in telecom messages, or developing spectacles that contain joyful substances and fun stories, to spark imagination by telling consumers about the benefits they gain from owning the product. These efforts are said to encourage consumer message involvement and motivate consumers from diverse backgrounds to search for the product and become highly involved with it (Solomon et al. 2016). More emphasis has been put by Sheehan, and Morrison (2009) compared the effectiveness of traditional and online communication channels. They found that the effectiveness of traditional channels has decreased dramatically after the release of online media. This is because consumers became more engaged with

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brands evaluated by friends and family, and thus online reviews have helped the trend of online media evolve more than traditional media.

Consumer Motivation Toward Social Media Marketing

The popularity of social media sites, especially in the Arab world and around the globe, has made it mandatory for companies to use these platforms as marketing communication tools. The high adoption of social media has made it sometimes more powerful than other traditional marketing tools. Hence, companies' investment in social media has risen dramatically compared to other traditional marketing activities due to its lower cost and high reach. Social media sites allow users to present themselves and establish and maintain relationships with others. Kwon et al. (2014) emphasized that there are four primary motivations to follow brands in social networking sites: "to seek incentives, social interaction, usage/ likeability, and information seeking". Other motivational studies have highlighted the main reasons consumers adopt social networking sites. For example, Dholakis et al. (2004) focused on five main reasons to adopting social networking sites: purposive value, self-detection, human social interconnectivity, social enhancement, and entertainment. These five motivations are major drivers of individuals' use and participation in social media sites. The purposive value, such as informational value, has made it clear that companies should establish a social media presence for those motivated by information. Thus, organizations began establishing their presence to share product-related information with followers, considering consumer motivations to attract as many followers as possible. In return, these followers will drive brand popularity with their friends, family members, and community, so the company's products will get high popularity and reachability in a short time.

Social networking sites offer a new landscape for companies' marketing communications activities, where consumers take on the role of marketers and companies act as observers of products and services' messages. Sheehan & Morrison (2009) and Mulhern (2009) suggested that marketing communication practices have changed by social networking from message execution to expanding consumer understanding. Marketing communication on social media has further expanded the purpose of message communication to a view of consumers as content creators rather than viewers. Messages communicated through social media are created after understanding consumers' ambitions and needs. Content is created on social networking sites based on consumers' willingness and attitudes regarding when it should be released.

Gao & Feng (2016) covered 35 countries and concluded that 50% of social media users are connected to brands, 42% communicate with brands on social media, and 36% write posts about brands or companies. However, given

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the large number of people using social media platforms, we should be able to identify the preferred content types for each platform. Facebook and Twitter are the most widely used platforms in the world, attracting businesses, political, non-governmental, and non-profit organizations to use social media as a communication tool for users worldwide.

Facebook and Twitter were text-based services that focused on written content rather than images when they were established. Russmann & Svensson (2016) analyzed how social media evolved to enable people to share videos and images more effectively than Facebook and Twitter. The use of images & Videos, over time, became a necessity for different users and organizations.

A new platform called Instagram has been created to fill this gap. The prevalence of images and videos on Instagram has made it very popular worldwide, including in the Middle East. Organizations increased its spending on Instagram in the Middle East, besides Facebook and Twitter, due to the simplicity of the platform and its visual communication features, that is more effective than other platforms. Russmann & Svensson (2016) emphasized the importance of visual communication to users, as it enhances how information is disseminated and used, and how text is understood. Visual communication is the ability to convey messages in iconic form. It plays a complementary role, helping people understand the text and suggesting a reality that builds consumer trust. Furthermore, the use of images helps users achieve coherence in their communication messages more quickly. Blair (1996) and Fahmy, ey at al (2014) elaborated more on visual communication. They added that the use of images grabs consumers' attention and retention more than text communication. Its eloquent impact on consumers, enabling marketers to create frequent relationships, enhances consumers' views toward different products and services. Additionally, visual communication images help enhance emotional appeals and enlarge brand images in consumers' minds; when used with text, they are suggested to be more effective than standalone images. However, as a visual communication platform, Instagram enables users to upload pictures and videos, with text attached to images and videos only; users cannot post text as a standalone message, which distinguishes Instagram from other social media platforms.

Users of Instagram comprise two groups: posters and followers. Posters are the companies, and followers are the platform's normal users. In the Middle East, Instagram is primarily used by middle-aged women and serves as a marketing channel to showcase companies' products and services.

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Chapter III: Data Analysis and Discussion

Introduction

In this chapter, the researcher will highlight the Saudi telecom market landscape, introduce the cases of local telecom providers in Saudi Arabia, and their marketing communication practices, taking into consideration their presence in Saudi Arabia, year of establishment, service offerings, and their position as market players. For ethical reasons, companies' names will not be revealed, and instead each company will be interviewed, differentiated with a letter as follows:

Company Status	Company Code
Market Leader	Company A
Second Entrant to the market	Company B
Third Entrant	Company C
Business Provider, early entrant to consumer segment.	Company D

Analysis of data collected from interviews and documents will be conducted, and the findings will be further analysed against the earlier literature review to evaluate marketing communication in practice and the extent of its compliance with academic standards. Furthermore, the research will analyse marketing communication on social media in the telecom industry in Saudi Arabia, using local players' channels, including Facebook, Twitter, Instagram, and YouTube, and link these practices to consumer behaviour. Kozinets (2010) proposed a new research methodology that plays an excellent role alongside interviews, focus groups, and other methodological approaches. This methodology is called netnography. Netnography is defined as the analysis of people's natural communication in a digital media context. It is a way of discovering people's responses to different digital posts, thereby enabling the researcher to differentiate between real and fake consumer responses. Additionally, this study will present data on the relationship between marketing communication and consumer behavior, particularly how marketing communication plans incorporate consumer behavior factors.

The data were collected through interviews with local major telecom players in the market. Also, the data collected in this study from research documents were released by other university students who have discussed this topic in more detail. Additionally, the researcher used published reports from banks and financial groups. These three sources of evidence used in the article will help the researcher gain a clearer view of the marketing communication practices of local telecom players. The questionnaire used to research this relationship contains 15 questions. In the findings chapter, the presentation of the results and analysis of all interviews.

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Saudi Telecom Landscape

Al Jazira Capital (2016) noted that the Saudi Telecom sector began 2016 with slow economic growth, driven by weak oil prices, new fingerprint registration requirements for SIM card subscribers, low growth in telecom services, and declining government spending. Mobile subscribers stood at around 54 million, with a 171% penetration rate, while mobile data subscribers stood at 36 million in 2015, driven by low mobile data subscription prices and increased promotional offers following the entry of new mobile operators into the industry. Fixed Broadband subscriptions have shown significant growth in recent years, with a high household penetration rate of 53%. The local telecom providers consist of three main operators, A, B, and C, and Company D is expected to enter the Fixed broadband market as a new entrant in late 2017. Market share is still considered to be a major issue among local operators with company A occupying 49 – 52% of the market, while the remaining 48% of the market is distributed among companies B, C & D according to Jubran, 2016; Abaalkhail, & Potrik 2016) Company C market share stood at 23% depicting a subscriber base of 12.4 million subscribers, leaving company B with around 25 – 28% market share.

Company A

Company A was established in 1998 as the first telecom service provider in Saudi Arabia, expanded to become the number one operator in the Middle East, and now has a presence in more than 9 countries. It serves more than 27 million subscribers in Saudi Arabia. The company demonstrated strong financial stability in 2014, generating more than $12 billion, according to Riyad Bank (2015). After its success in the Saudi market, the company identified strong opportunities in Gulf markets with strong economic and population growth, such as Kuwait and Bahrain. It acquired 100% ownership of a famous telecom company in Kuwait.

According to Nazar (2015), Company A spent approximately $1 billion on marketing activities in 2014 and is forecast to spend $1.84 billion in 2018. Company A utilizes both traditional marketing channels, such as TV, Radio, Magazines, and Outdoor, and digital marketing channels, including Facebook, Twitter, and Instagram. The company began increasing its spending on social media channels during 2015 and 2016, publishing messages mainly on Twitter to attract Saudi consumers, Instagram to attract Female consumers, and Facebook for the expatriate segment. Additionally, it established its presence on YouTube by creating a channel to publish TV-advertisement videos, measuring the effectiveness of its ads and better understanding consumers' reactions to the videos, since the platform is interactive. Company A marketing channels used according to Prince Mohammed bin Fahad

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University study conducted by Al-Dossary et al. (2012), as shown in the table below:

Communication Channels	Percentage of budget for 2012
Advertising	60%
Sales Promotion	25%
Events	10%
Direct Marketing	5%

Company A Marketing channels use (Al-Dossary et al., 2012)

In the same study, the writer concluded that 60% of company A's budget is dedicated to advertising and distributed across different channels, while the sales promotion budget is 25%. The remaining 15% is distributed to direct marketing and events. Accordingly, Company A considers advertising as the primary marketing form for the consumer segment, followed by sales promotions, which were continuously launched throughout the year for voice and data services. Events and direct marketing, however, are used to target business consumers.

According to AlDossary at al. (2012), Company A spent 50% of the dedicated advertising budget on TV, 20% on radio advertising, while on newspapers, magazines, and social networking, Company A spent around 10% for each activity. After the meeting with Company A, it was decided to reduce newspaper advertising, and only a very small amount is spent on it.

I think the company considers TV advertising the baseline for its advertising activities, followed by other channels, because TV and outdoor channels deliver a higher return on investment than other media. According to this study, the company is currently reconsidering social media marketing as an alternative to traditional marketing channels such as newspapers and magazines.

The researcher will investigate Company A's presence in traditional and digital media in the following sections. Additionally, he will analyze how Company A relates its marketing activities to consumer behavior.

Company B

Company B is the second telecom operator in the Kingdom of Saudi Arabia, founded in December 2004, and was granted a telecom license by the Communication and Information Technology Commission. Like Company A, Company B offers voice communication and data services to its consumers. Customers of company B are divided into two segments: business customers and individual consumers. At the beginning, Company B focused on the consumer segment and established its presence through robust marketing communications. Company B began focusing on its competitor's weaknesses, which mainly consist of after-sales services, high prices, and poor customer

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experience. It benefited from consumers suffering for a long time under company A. The entrance of Company B enhanced the telecom industry competitiveness, reduced the prices of voice minutes and data packages, making them accessible to everyone. Company B, four years after its entry, announced that it had deployed telecom infrastructure across the entire kingdom. It was the first provider to offer 3G data packages to consumers (Arab News, 2007). At the start of its operations, Company B faced several challenges, including high debt with local and international banks, poor service quality in some areas of the kingdom, and poor customer experience. However, by that time, Company B had enhanced its quality of service to some extent by focusing on improving customer service quality in its call center.

Company B uses both traditional and digital marketing communication channels. In the beginning, the focus on tradition was high because social media was less prevalent than it is now. TV marketing messages mainly focused on the pain points local consumers face from its only competitor. The TV campaigns launched by Company B at the start of its operations were aimed at attracting competitors' customers by highlighting competitors' weaknesses and shortfalls in providing excellent customer and telecom services. For example, Company B launched TV ads claiming that competitors' routers were of poor quality and transmitted weaker signals than Company B's routers. However, the competition between the two companies through TV advertisements was evident and tough.

Company C

Company C is an international telecom provider based in Kuwait and entered the Saudi market in 2008. The company sells voice and data packages to businesses and consumers. When the company first entered the market, it faced several challenges. It paid the highest license price to enter a market with highly established competitors, which made it difficult for the company to acquire a substantial market share. According to Al Jazira Capital (2016), Company C spent $530 million on its marketing and distribution activities in 2015 and expected to spend around $690 million in 2018. The company promotes its products and services through different marketing channels, including traditional and digital media. In the forthcoming analysis, a detailed overview of the company's marketing practices will be presented. Company D

Company D is a mid-size telecom operator in the Saudi market, mainly focused on business customers. Company D has approximately 1,200 business customers, which account for 90% of its revenue, while consumer customers account for the remaining 10% (Kurdi, 2016). The company is well known to business customers for its data services. The company's marketing communications are limited to a few traditional channels, such as newspapers, business magazines, business emailers, and direct marketing. Moreover, the

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company uses digital marketing channels to a limited extent for business customers. After entering the consumer market in late 2017, the company began using digital channels heavily to advertise its FTTH offerings to consumer segments.

Research Findings from interviews

Research findings is divided into themes to cover the main aspects of this research including, marketing communication structure for each company interviewed, marketing channels that interviewed companies depend on in announcing marketing messages, efficiency of different marketing communication messages in relation to consumer behavior, marketing communication styles used by interviewed companies to influence consumer behavior, consumer motivations toward telecom services, effectiveness of cross-channel communication, the role of unrelated product messages on consumer behavior toward telecom providers, and consumer responses to different content by telecom players. These sections are designed to demonstrate the relationship between marketing communication practices and consumer behavior and to analyze it further in the telecom industry.

Marketing communication structure

The marketing communication department is a fundamental function of the telecom sector in Saudi Arabia. Its main responsibility is to develop, launch, manage, and monitor marketing messages across traditional and digital media channels. Although all companies follow a similar marketing communication structure, each uses this unit in line with its main goals.

> *"Company A marketing communication unit consists of 40 employees and four subunits, which are traditional media, digital media, activation, and retail. Each subunit has its own employees and its own responsibility and plays a complementary role to the department's roles and responsibilities".*

On the other hand, Company D's marketing communication department consists of only seven employees, each responsible for different marketing communication practices and activities. The interviewee commented on the low number of employees in the marketing communication department. He answered:

> *"Our main focus since our establishment has been business. We recently joined the consumer market to provide fiber-to-the-home internet service, FTTH. The need to hire a new marketing communication team was evident, and we started two months ago to hire new team members".*

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As I did not manage to interview the marketing communication manager at Company B, the product manager was interviewed to answer on behalf of the marketing communication manager, since part of his responsibility is to manage the marketing activities for his product in the market.

> *"Company B marketing communication department consists of 20 employees responsible for managing all marketing campaigns", he added, "those employees are responsible for developing and launching marketing messages for all our products in both segments, Business and Consumer."*

The roles and responsibilities of the marketing communication department across the three companies are similar; the differences lie in the number of employees in the department, which is mainly dependent on the number of consumers they serve, the number of channels they use to target different consumer groups, and the marketing budget dedicated to marketing communications. Furthermore, marketing communication is determined by the target customers; for example, Company D serves the business segment more than consumers; therefore, the size of the marketing communication department is smaller than those of Company A and Company B, which serve large consumer segments. The need for marketing channels such as events, conferences, and traditional channels such as print media and digital press by Company D is greater than that of Companies A and B. Company D follows the same approach as Company A regarding business, as mentioned in the Company A overview: their channels include events and direct marketing.

Company C, like other operators, has a marketing communications department responsible for planning, designing, and managing marketing activities.

> *"Company C's marketing communication is divided into two main teams, creative team which is responsible to create advertisements after receiving briefs from the marketing department, the briefs contain the basic information about the advertised products for example new promotion, discounts, extra minutes or extra data offering, the second team in the marketing communication department is the media team which is responsible to identify the target audience for the new product or offering designed for example, gender to be approached, for the outdoor communication we identify the malls that we target for our promotions, sometimes we know that the mall's visitors we would put our outdoor message in are considered Class A, Class B would visit other malls types, so the type of communication and message will focus on prices more than other characteristics. The second responsibility for*

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> *this team is to specify the media type to be used for the offering, whether it's traditional or digital or both."* He added, *"We determine and control the cost of each advertisement on the different channels".*

Although the structure of marketing communication does not differ from other operators, a surprisingly low number of employees in the media team under the marketing communication department is very low in comparison to other operators, and this is due to

> *"Company C has around three people in the media team. The reason behind this is that Company C partners with media agencies to manage the marketing activities for the company, and one of the responsibilities of the media team is to communicate with these agencies to manage the marketing activities for the company".*

The interviewee found that big companies and even companies in other industries follow the same model. Consequently, this shows that Company C's marketing activities are lower than those of other operators due to budget limitations, especially for TV and outdoor. The interviewee clarified that:

> *"TV and Outdoor communication need huge art and production costs, which Company C is trying to eliminate to control costs due to limited budget".*

Company C relies mostly on media agencies to announce its marketing activities, and the marketing communication department's structure is similar to that of other operators. The department's responsibility is to design and manage marketing activities for the external audience.

Marketing communication channels

Company A uses many media channels to announce its products and services, using both traditional and digital.

> *"For some campaigns we only depend on digital channels since the cost of traditional is very high, but on the contrary in big campaigns like 360 campaigns, we use traditional media, when traditional media is activated all other channels will be activated by default, in some cases digital and traditional will not be activated instead we launch our marketing promotions through activation channels available in retail stores". He added, "the activation goes into three steps, we go to retail stores or different malls, Company A rent a place for our booth and put our posters in the mall".*

When the interviewee was asked about their focus on different channels, he said:

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> "*Turnout on TV in Saudi Arabia is less than before due to the revolution in technology, such as smartphones and tablets. We depend heavily on digital media rather than traditional media because it reaches us faster. The cost, production, and preparation of campaigns on traditional media specifically TV is much higher than digital media, on the other hand, digital media is more flexible, lower cost and requires lower production capabilities". He added" traditional media however despite the high-cost factor, provides Company A with higher equity in return, for example when Company A wants to announce new products packages or new promotions, it uses TV and outdoor as the reach to our consumers will be stronger than digital media, TV and outdoor channels are used for big campaigns, and new product launches, while digital media is used to announce small messages that remind consumers of our products and services"*

The use of traditional media by Company A decreased due to high costs and the emergence of digital media tools such as social media and digital magazines; however, the reliance on traditional media remains evident in large campaigns. On the other hand, digital media plays a complementary role in marketing, supporting traditional media content and aiding rapid pervasion. Other companies in the Saudi market, due to limited marketing budgets and a low focus on the consumer segment, prefer digital media, events, and business conferences over traditional media such as TV, Radio, and print. Although Company D used to use print media, they have reduced their budget for it, as it is not an efficient way of communication due to its high cost and low return on investment.

Company B, as the second telecom provider, differs in its marketing communication strategy; it seems that it follows a similar but more organized and clear approach than Company A. Company B follows a structured approach to marketing communication; each campaign has its own objective that the company is willing to achieve, and every post on social media is designed for a purpose. At the same time, Company A uses a random approach to marketing communication, with heavy emphasis on announcing marketing messages at different times, as it has allocated a higher marketing budget than Company B.

Like Company A, Company B uses both media types, but each marketing activity has its own objective, for example, to create product and brand awareness. The company uses outdoor and digital media for communication, while for brand building, it uses TV more often than Outdoor. Social media is used to increase consumer awareness and build the company's brand.

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The Company B interviewee said in the application of different channels and the purpose of using different channels:

> *"Depending on the objective of the campaign we choose our channels, for example if the objective behind a campaign is to build our brand then TV will be our channel of marketing, when we are approaching to increase our consumers' awareness then we use outdoor communication, when company is looking at both perspectives then, the use of social media will be our choice".*

Company C uses both traditional and digital marketing channels to approach different market segments. The focus on digital channels, however, is greater than on traditional channels, since digital is cost-effective and easier to produce.

> *"According to the type of product and type of target segments, we choose the channels; we mostly depend on digital channels, followed by outdoor megacom and in-mall mupi. In digital channels, we use Google AdWords, followed by social media".*

Following what is done and which channels are used by Company C, what drew my attention is the use of Google AdWords as an advertising tool that displays ads based on consumers' most-searched items.

Consequently, by considering individuals' search behavior and knowledge sources, organizations can design messages aligned with consumers' search preferences. Telecom companies must study consumer search behavior to create campaigns that align with search behavior attributes and enhance consumer knowledge through their marketing programs.

Furse et al. (1984) stressed that experience negatively impacts the information search. On the other hand, Jacoby et al. (1978) found that purchase experience reduces information search.

The insights from previous interview quotes are drawn from companies that focus heavily on the consumer segment. Interviewing telecom companies that focus on business customers and have recently joined the consumer market will enable this study to shed light on another area of focus, and Company D is an example.

Company D, which recently joined the consumer segment, uses digital media more frequently than traditional media channels such as TV, Radio, print media, and outdoor. The interviewee concluded that:

> *"We mainly focus on social media, but on the other hand, we utilize traditional media such as print media and Radio. We do not go to TV due to its high cost, but instead we activate less costly media," he added, "Social media channels, Google AdWords are considered to be one of our most used tools".*

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The focus of telecom companies on social media increased, and organizations began using platforms like YouTube, Facebook, Twitter, and Instagram to share messages. They are interactive channels that both companies and consumers use to interact with one another; by contrast, TV and traditional channels lack interactivity, which decreases their efficiency compared to digital channels.

In the telecom industry, channel choice is essential for shaping consumers' opinions about telecom brands; thus, using different channels to build brand image is equally important. Outdoor communication is not a good channel for building the brand because the available message space is limited. Consequently, for building brands, the best channel is TV due to its audio and video features. However, social media is a good channel for building brands, but market leaders can better guarantee original views on TV than on social media. On the other hand, market pioneers can use digital and social media more than traditional channels, as these are less costly and more effective at reaching consumers.

Efficiency of different marketing communication channels

In responding to the question of whether traditional channels are becoming less effective than digital channels, we have different views. The interviewee in Company A said that:

> *"I think that our spending on traditional channels decreased in comparison to the last years, as the results TV campaigns decreased dramatically now, and we can measure our marketing effectiveness through the social media tools, still there is focus on traditional channels when there is big execution for building brand, and increasing awareness marketing campaign, or when there is importance to announce new products or new solutions to the consumers. For example, we are currently working on a major campaign for our company application that enables our consumers to access all services online without visiting a physical branch. In these campaigns, we use both traditional and digital."*

While Company B continues to argue that:

> "*We cannot say that traditional media channels are less effective, but it is used in a lower manner than other media channels. At Company B, we still use traditional media heavily, especially outdoor communication."*

However, Company B sometimes runs social media activities when the company has a limited-time offer and wants to gain its benefits in the short term, an interviewee at Company B commented:

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> *"In case we need to achieve short-term results, for example, increase sales, or increase turnout on internet products, for example, at the beginning we select outdoor as a communication media, and then post reminder campaigns on Social Media about the product that was already known by outdoor communication."*

Outdoor communication is highly effective in Saudi Arabia, especially for food and automotive products; this effectiveness is increasingly evident in the telecom industry. Furthermore, print media began to decline in Saudi Arabia as readers shifted from print to digital newspapers. Although this shift influenced organizations' decisions to decrease marketing their products in print media, we still see some marketing activities on print media by Company D, as the interviewee commented:

> *"We still see an opportunity to market our products and services on print media, especially for business-to-business product offerings, although our spending on print media has receded in comparison to previous years, the use of print media, however, is compensating for our shortage in TV commercials".*

Company C believes traditional marketing channels have become less effective, and companies are increasingly choosing digital channels, especially social media, to market their products and services.

> *"Spending on traditional media is declining year on year, pioneers in the telecom sector are those who utilize digital media channels more frequently than others, before consumers used to watch TV channels four hours a day, instead now consumers especially from age of youth are switching their habits to use social media four hours a day and even more, this trend has influenced the way of marketing communication on different channels."*

As a result, I found that telecom operators in the Saudi market mainly focus on expanding their presence in digital media, as this is a promising channel for them. Although the big two telecom players in the market are still utilizing TV and outdoor channels and see that those two channels are the most influential marketing channels whether to announce different messages to consumer segment, or to promote their products and services, or to build product and brand awareness among consumers, there are however some companies who still focus on print media more often than TV and outdoor for the aim of attracting business customers. The big two companies see that the opportunity to use print media to deliver marketing messages is dying, as people nowadays use the internet more to read the news than traditional newspapers, and that companies should instead use traditional and digital

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communication channels in a smart combination. Moreover, the increasing effectiveness of social media, given its high reach, is becoming a trend for the third entrant to the telecom industry.

The effectiveness of traditional marketing channels can be measured by calculating return on investment for each option and by tracking product and service sales before and after the campaign is launched. The return on investment in traditional channels is still more evident than in social media, suggesting their effectiveness. However, social media is a free space that enables companies to market their products and services in line with their view of the market situation, consumers' habits, and needs. Although tools exist to measure the effectiveness of social media marketing campaigns, evaluating consumer responses and distinguishing between paid, incentivized, and real consumers remains difficult, which can easily impact brand image (Kozinets, 2010).

Marketing Communication Style

Saudi Arabia is a young country with a youth population that constitutes around 70% of the overall population; telecom operators use comedy, educational, mysterious, and formal communication styles. However, Company A as a market leader uses comedy styles to attract young segment, educational styles when the company is willing to explain to consumers how to use specific product or added value services such as the company self-service application or portal, mysterious when company is willing to attract consumers to ask about products and services, and formal when announced to elderly or business segments.In their marketing messages to attract this segment, especially on social media, since most of the social media pioneers are from the young segment.

Company A commented on this:

> *"In most cases, we use the comedy style as there is a high percentage of youth in Saudi Arabia. We sometimes use educational styles using animations or infographics."*

As evidenced by practice, Company A demonstrates its comedic communication style on YouTube; for example, it has released several comedy series to showcase its efficiency. For example, in the History of a Game - Tekken (2017), Rayan, the actor in the video, presents the history of the Tekken game. At the end, he demonstrates the efficiency of Company A's FTTH product in relation to the game. The educational style is used to explain how consumers can use Company A's new service, for example, a video on how to use Quicknet Mifi for the first time (2014). In Other videos, such as (What is Up with (Om Ali, 2017), Company A used a mysterious style of communication; the final message Company A wanted to tell is that they have

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covered all areas of the kingdom with 4G technology in a comedic and mysterious way of communication to attract women consumers. Furthermore, Company A published several videos about unlimited home internet packages, highlighting the benefits of home internet service. This video aims to persuade consumers to adopt fiber-to-the-home internet service, as it brings family members together and builds strong ties among them. Company A tries to market these new products to family members, women, and young consumers. To conclude, most of these videos are published in traditional and digital media to ensure they reach every home in Saudi Arabia. Since competitors launched 4G data packages, Company A has intensified its internet-at-home commercials across all channels to reduce consumer uptake of 4G services, highlighting the unlimited keyword in its commercials, as 4G services are offered in limited packages. The use of game series is ingenious, as young consumers cannot play games on limited data plans.

Company B's style of communication is mainly youthful since the interviewee at Company B highlighted that:

> *"At Company B we are compatible with the market, so I think if young consumers constitute 70% of the Saudi market, 70% of our consumers are young" he added " we use comedy styles with curiosity same like other operators sometimes formal style is combined with our commercials, Other than publishing comedy videos and series, Company B proved youthful in their advertisings and announced the six years' agreement with the famous Saudi sport club Hilal This sponsorship has supported Company B as a youthful brand in the kingdom. The contract between Hilal and Company B was terminated after the period of sponsorship ended. This sponsorship solidifies Company B's brand as a youthful brand in young consumers' minds and encourages establishing the brand name in the Saudi telecom market."*

Animation style was also adopted by Company B to announce messages about internet packages, for example, what can you do with a 300 GB data package? Video (2017), in this video, Company B creates animation videos and publishes it on various channels on the Internet to its customers to learn about the advantages of the packages offered to them. The comedian series style was also adopted by Company B to deliver marketing messages with a comedic flavor, using suspense before the series begins to signal to consumers that the series will be published soon. For example, (Park show series, 2017) in this series, Company B showcases stories happening in the park between actors and passes formal and comedic messages. Company B packages will be announced during the story. Company B's series is more

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indirect than Company A's and, at the same time, sends and establishes the message to consumers, so they will remember it every time they go to the park.

It is essential to have Company C as an example of a company that invents appealing communication styles and combines formality with innocence. In a more charming communication messages appeals Company C chooses to produce advertisements messages with selective songs choosing girls aged between 12 – 15 years old and intensifies its advertisements in the holy month of Ramadan, and choose the TV channels as a media of communication more than other forms of communication that can be used in anytime with less cost restrictions, sends peace with its messages and an emotional style of communication that suite the Arab world and Saudi Arabia specifically (Ramadan Commercial, 2017). This style of communication was chosen by Company C headquarters a long time ago; it is more used to build brand image than to increase sales or promote a product. This has helped establish a strong brand name for Company C in the Gulf region and other Middle Eastern countries. Company C is an example of a company that uses emotional style to establish the brand in consumers' minds. Through these efforts, Company C group aims to build a worldwide brand closely associated with the wonderful world, aiming to make its brand image in consumers' minds more appealing than any other brand in the Middle East. On the other hand, Company C tries to isolate itself from the Company C group by adopting a new style that aligns with Saudi norms, which might be more formal than those in other countries where Company C operates. We will again see the typical commercial styles of other telecom providers in Saudi Arabia. A comedian with some formality is the preferred style.

After interviewing Company C and asking them why it chose other colors in their brands to the light green color instead of green and purple, and the style of communication in Saudi Arabia differs from the headquarters, which is a highly emotional style of communication, he answered:

> *"When we started our business in Saudi Arabia, the company logo was the same of the headquarters logo , but after a while, we discovered that we should be unique in this particular market to be able to compete with the local brands. We chose the color of light green to represent the Saudi flag to attract Saudi attention to the brand."*

About the marketing communication style frequently used by Company C, the interviewee answered.

> "*We tried to be different than other brands that choose comedic style of communication, we rather use informative and formal styles, as being comedy all the time will diminish respect for the brand, we partner with opinion leaders in the Saudi market,*

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such as Faisal Al Saif, who gives technology information such as reviews of smartphones and we put it on our channels"

In my opinion, I don't think that Company C's efforts to isolate itself from the Company C group are a good idea. Adopting a comedic style like other players is not suitable, since their usual style is emotional and attracts different consumer groups. Furthermore, I think Company C changed its communication style in Saudi Arabia because it noticed that what attracts people in this market is the availability of promotions and benefits, especially since its market segments are mostly expatriates rather than Saudis.

Consequently, Company C needs to reach a significant percentage of Saudi consumers, which is the main reason for the transition to the Saudi style of communication. However, this will not be accomplished unless they change their communication style.

After I met with the senior marketing communication manager at Company C, Company D recently entered the consumer market to provide internet services using FTTH technology. However, the generic style of its communication is overly formal.

"We use formal styles most of the time, mysterious style of marketing, and create brand image-related campaigns to build our brand."

Since Company D is a business-oriented company, they concentrate on announcing formal messages to businesses using curious styles to increase fear in business customers, for example announcing an emailer to customer that there are dangerous ransomware attack banks, government, etc., to promote security products Company D understanding to consumer market is still weak and therefore they don't use comedy marketing styles like other players, since they are still new in the consumer market.

The youth nature of the Saudi market has made telecom players adaptable to a humorous, friendly style of marketing communication. They found the most appropriate style to affect their consumers' intentions to purchase telecom services. In my opinion, telecom companies should diversify their styles to meet all consumers' expectations and increase the trustworthiness and likability of ads launched across different channels.

Consumer motivations toward telecom services

Consumers' motivations toward telecom services are intrinsically enjoyable, driven by the need to communicate with other people and a necessity to connect to the world via the internet, and extrinsically, because sometimes people need stimuli from the surrounding environment to use it at its optimum level. People need external reinforcement to use it and enjoy it, and to get more benefits than usual - for example, extra GB of data or extra call minutes to friends. Consumers should apply for offers and promotions that

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grant these benefits. Likewise, Telecom services are treated as hedonic and utilitarian. Hedonic as it is, especially after the emergence of the internet, people became more familiar with online applications such as YouTube and social media sites. These services became a necessity in consumers' lives. On the other hand, although utilitarian motives are more focused on tangible attributes of the product, telecom services are still considered utilitarian because they are linked to tangible products, and telecom companies sometimes bundle tangible products, such as mobile devices, with their services. Thus, companies should not focus on one variable more than the other. Company A meets these consumer motives by targeting young segments and using different communication channels that appeal to both young and elderly consumers. A representative of Company A said in the interview:

> *"When sending a message to the youth segment, we should be friendly in designing the messages. We consider the color of our images, which are highly attractive, and we generally design our messages to help our audience remember our ads even though they have not yet decided to purchase the service. He added, " According to our different segments' needs and motives we design our messages on different channels, for example, we use Instagram to attract women segment and we create videos and images for them, we use Facebook to attract expatriates and we post different messages to them about our brand, and we use twitter to attract Saudi's using mainly images posts. On the other hand, we create TV commercials for elderly people who are not famous users of social media".*

However, depending solely on these channels, without taking into account the types of content used in the different commercials and promotions, will not deliver high value to the brand and will only repeat the products' features, showing consumers that the only motive driving them to purchase is the promotional campaigns.

Company B, as a telecom player, used to run campaigns that drove consumer motives, but they made it when they first entered the market. They typically use promotional campaigns on different communication channels to increase sales. Company B said:

> *"Before taking into consideration the type of campaigns run by Company B, in telecom services there are few factors that will grab the attention of consumers, for example, internet services effectiveness can be measured by coverage, speed of the internet and the price, competitors will always play at the price level, so if Company A discount their prices, we at Company B will consider prices discounts, and so on."*

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While company C has a similar point of view that the main motive to telecom services is the price and size of data provided by the service.

> *"Company C sees that the main motivations toward telecom services are the data services, price, and promotions."*

From the previous quote, we can say that the main motive for consumers to use telecom services is internet speed. Once the coverage factor is met, consumers will compare their internet speeds and then compare the prices of the offerings. Thus, we will find that telecom players focus more on price and features in their social media advertisements than on other factors. Therefore, Saudi operators focus on utilitarian motives more than hedonic.

Beyond utilitarian motives, which are evident in an operator's infrastructure, price is a strong factor influencing consumer decision-making to purchase a brand. Most telecom consumers in the Saudi market prioritize price over other features; therefore, promotions and price discounts are a major driver of consumer purchase of telecom products and services. As a result, prices should be included in most telecom operators' campaigns.

Effectiveness of Cross-Channel Communication

Chatterjee, P (2012) proposes that "the increase in sensory modes increases the probability on ad to be processed and increases the effectiveness of an ad". Sensory modes here refer to modes that can be read and heard, or heard and viewed. Local telecom operators publish their ads and promotions across all media at the same time to remind consumers of their products and services. Some channels, like social media, will play a supporting role to traditional marketing channels. For example, Company A uses cross-media marketing when launching a major campaign.

> *"We are currently working on the Company A Application to reduce the turnout on our physical branches and increase the Company A installed base. We will activate outdoor communication, together with social media communication, and the effect of outdoor with social media will be more powerful than using Outdoor only."*
>
> *However, Company B launches 4 major campQaigns per quarter, each using our full capacity. During the year, we keep on posting them on social media to remind our consumers of our products and promotions."*

As a telecom leader, Company A used to activate cross-media channels such as TV and Radio. According to Chatterjee (2012), this practice will lead to effective synergies between ads, even when sensor modes remain the same, by facilitating consumer processing and increasing memory effects in subsequent ads. Furthermore, increasing or decreasing information across different media will gradually lead to synergy among ads.

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In most cases, cross-media channel communication should be favored by all operators and implemented. Due to budget limitations, some operators may use certain channels more frequently than others. Consequently, this act may impact the effectiveness of marketing campaigns.

Unrelated product messages

Saudi telecom players may sometimes produce messages that do not necessarily belong to its products and services, but at the same time, they represent their brand image and personality. With the aim of increasing consumer knowledge, enhancing its brand image, and improving its social responsibility, Company A continuously posts information about historical sites and mosques. After asking Company A's interviewee about such activities, he said:

> *"This is the Saudi Arabia campaign, which consists of a history of old places in Saudi Arabia posts, videos, and images, while at the end we pass a coverage message."*

Demers (2014) posted on Forbes an article titled "why your company blogs shouldn't be about your company" (page 1) and concluded that consumers do not like companies that post related products and services information all the time, and companies feel that their investment on their social media pages about products and services fails, because they do not simply post unrelated product information that enriches consumers' knowledge and bring benefits to consumers rather than products and services.

Company B, at its entrance, began doing what Company A is doing now to inform its customers that it has covered the entire kingdom with its network. Company B said:

> *"We stopped doing such practice, and I don't know why. I believe it is a good strategy, but we stopped it, I can't say that Company A is wrong by doing so."*

At the end, this type of post relates indirectly to telecom services, but I believe we need to emphasize posting pure information that is entirely unrelated to products and services, and to become a source of knowledge rather than a source of product and service information. This has not been achieved so far by local telecom operators. Furthermore, these practices will enrich the information-seeking motives of social media pioneers, as seeking information is one of the main drivers of social media use among consumers. Ramadan campaigns by local telecom players mostly consist of unrelated product messages. Company A emphasizes this month on Islamic religious principles, such as charity and forgiveness (Company A Video on YouTube, 2017). This is an unrelated product message that represents the brand's image and personality, enhancing brand perception among its consumers and further motivating them to choose the brand over others. However, Company B

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enhances its brand image during Ramadan by highlighting Saudi cultural traditions.

> *"Most of the time in Ramadan, our messages on different channels are brand image-related more than product and services information."*

On the other hand, Company C posts unrelated product messages on its social media platform, like Company A, but in a less prominent manner. Company C answers that by:

> *"We choose occasions such as the national day to post unrelated product messages, and sometimes we post information about cities in Saudi Arabia. We use the taste of emotion when posting unrelated product messages, especially in the National Day event."*

By this Company, Company A, Company B, and Company C use emotional appeals in their communication messages during Ramadan to attract consumers through hedonic motives rather than utilitarian motives, thereby improving brand image.

Enhancing consumer knowledge by posting unrelated product information to improve brand image and perceptions of the telecom brand is essential. Only one telecom company in Saudi Arabia is practicing this; competitors who don't will be seen as market followers, while those who do will be seen as market leaders. However, I think enhancing consumer knowledge with other creative ideas will develop their brand position in the market.

Consumer feedback on social media telecom marketing messages

Customer feedback varies depending on the type of content and how it is posted on different channels. Often, customer feedback is different from published content. Some customers have a questionable reaction, that is, a query about other services. In other situations, the reaction is a positive one when the consumer is not satisfied with the services provided. Company A tells about their consumer responses as:

> *"We can say that 60% of our consumer responses to our posts on social media are positive and 40% are negative comments, you can never satisfy all"* he added *"choosingthe advertisements timing is important to avoid negative feedback, for example avoid posting related product messages after football match or after negative royal orders, comments on these posts during these situations will be negative"*

The answer of Company A contradicts the answer of Company C, which said:

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> *"Globally, we can say that feedback on telecom and other services provided on social media by consumers is negative; we rarely find that there is positive feedback, most of the comments are unrelated to the messages posted, and consumers mostly write their problems on the posts launched on social media pages."*

This comment generalized that negative feedback on social media platforms outweighs positive feedback, since those who are happy with the service will not comment but will only rate the company based on their satisfaction with the brand.

However, these reactions by consumers affect how other consumers view the brand. For example, when Company D receives positive feedback, it will likely affect how other consumers view the company. Usually, when consumers are happy with the service, they are more motivated to share positive experiences with the brand. The interviewee in Company D, when asked a question about customer reactions to a post on social media, said:

> *"Of course, when posts on social media get positive feedback, this portrays or exposes us as a good brand; some consumers send their thanks and appreciation through social media."*

Consumer behavior on social media shapes how other consumers perceive the brand, enhances positive brand perception, and encourages others to use telecom services from specific companies. However, companies must continually work to achieve customer satisfaction, as it is a key to enhancing brand image, since social media is a platform that reflects consumer behavior towards different products and services. Furthermore, when companies announce social media posts as marketing messages, they should be confident in their consumers' opinions by providing the best customer service and avoiding, as much as possible, any dissatisfaction, as this will affect the company's image and negatively impact marketing communication practices on social media.

Positive word of mouth on social media platforms benefits companies. However, not all comments on social media can necessarily be considered when evaluating a telecom brand, because there may be some fake comments and likes, and distinguishing between these types is hard. Thus, telecom companies should not trust all comments on their social media posts and should be able to differentiate between consumers' comments.

Conclusion

This study aimed to investigate the relationship between marketing communication and consumer behavior within the Saudi telecom industry, a sector characterized by rapid technological advancements, intense competition, and an increasingly young and digitally active population.

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Drawing on academic theories of communication, motivation, and consumer decision-making, and supported by qualitative data from interviews with major telecom operators, the research provides clear evidence that marketing communication plays a central role in shaping consumer perceptions, motivations, and purchasing intentions.

The findings reveal that telecom operators in Saudi Arabia are increasingly shifting from traditional communication channels toward digital platforms, reflecting broader changes in consumer media consumption habits. While television and outdoor advertising remain influential - particularly for large-scale campaigns aimed at building brand equity - digital channels such as social media have become indispensable due to their lower cost, interactivity, and ability to reach specific demographic segments with tailored messages. The effectiveness of these channels is heightened when used in integrated or cross-media strategies, which reinforce message retention and improve overall campaign impact.

The study also confirms that communication style is a powerful determinant of consumer engagement. Operators strategically adopt styles ranging from comedic and youthful to formal and informational, depending on the target audience and campaign objectives. The youth-heavy demographic of Saudi Arabia has pushed most operators toward comic, energetic, and visually engaging content - especially on social media. However, emotional and culturally resonant messages remain vital during key events such as Ramadan and National Day, helping companies strengthen brand image and foster deeper emotional connections with consumers.

Motivation emerged as a critical driver of consumer behavior. Consistent with theories of intrinsic and extrinsic motivation, the research shows that consumer decisions about telecom services are influenced by both utilitarian factors - such as price, data size, and network quality - and hedonic factors linked to lifestyle, entertainment, and social identity. However, operators tend to emphasize utilitarian motives in their communication, suggesting an untapped opportunity to leverage hedonic appeals more intentionally to enhance loyalty and long-term engagement.

Moreover, the study highlights the growing importance of content that is not directly tied to product offerings. By sharing culturally relevant, educational, or socially meaningful content, operators can enhance brand credibility, increase consumer trust, and strengthen their position as meaningful contributors to the community. This approach aligns with global best practices in content marketing and reflects a more mature understanding of consumer expectations in the digital era.

Consumer reactions on social media further demonstrate the complex relationship between communication practices and brand perception. While negative comments are common for telecom operators globally, the study

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suggests that positive word of mouth - when present - can significantly influence public perception. This reinforces the need for operators to maintain high service quality, respond effectively to consumer feedback, and design communications that anticipate public sentiment.

In summary, the study concludes that marketing communication in the Saudi telecom sector is deeply intertwined with consumer behavior. Operators that combine strategic channel selection, culturally attuned communication styles, motivational insights, and integrated media approaches are more likely to achieve strong consumer engagement and competitive advantage. The research contributes to a deeper understanding of how marketing communication can be effectively used to influence behavior in a rapidly evolving market. Future studies may build on this work by investigating quantitative measures of communication effectiveness, examining emerging platforms such as TikTok, or exploring behavioral differences across specific demographic subgroups within the Kingdom.

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The Impact of Corporate Financial Disclosure Quality on Banks' Loan Risk Assessment: A Case Study of Uzbekistan

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Abstract

Corporate financial disclosure quality plays a decisive role in banks' loan risk assessment, particularly in emerging markets where reporting practices remain uneven. In Uzbekistan, the ongoing expansion of IFRS (International Financial Reporting Standards) and the shift toward risk-based banking supervision have increased the need for accurate, timely, and comparable borrower financial information. However, disclosure quality, especially among SMEs (Small and Medium-sized Enterprises), remains inconsistent, limiting banks' ability to conduct cash-flow-based analysis and increasing reliance on collateral. This study examines how disclosure quality affects banks' credit risk assessment in Uzbekistan using a conceptual mixed-method approach. Due to the scarcity of standardized borrower-level datasets and inconsistent audited reporting, econometric analysis is not feasible; instead, the study synthesizes existing empirical and regulatory evidence to identify key disclosure risk channels. Drawing on international research and Basel III requirements for data integrity, the paper shows that weak disclosures undermine reliable PD (Probability of Default) and LGD (Loss Given Default) estimation, distort risk-weighted asset calculations, and reduce the effectiveness of supervisory review and market discipline. The study concludes that improving financial reporting quality, advancing practical IFRS adoption for SMEs, and enhancing enforcement and digital data infrastructure are essential for strengthening risk assessment accuracy and reducing credit misclassification in Uzbekistan.

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Keywords: Corporate financial disclosures, credit risk assessment, emerging markets, Uzbekistan, IFRS, financial transparency, SMEs, Basel III

Introduction

Corporate financial disclosure is a fundamental input for banks' credit risk assessment because it provides the information required to evaluate a borrower's profitability, liquidity, solvency, and cash-flow capacity (Khushnud & Qingjie, 2020; Khasanovich, 2025). When disclosures are accurate, complete, and timely, banks can more reliably assess repayment ability and determine appropriate lending terms. In contrast, weak or inconsistent reporting increases information asymmetry, limits analytical depth, and raises the likelihood of misclassification of credit risk.

The significance of corporate financial disclosure in banks' risk assessment

Corporate financial disclosure is a means by which banks assess the risk associated with lending to companies. In addition, banks are able to take into consideration factors such as profitability, liquidity, and solvency based on these disclosures, which play a major role in determining the borrower's capacity to repay the loan. However, in a country where the use of IFRS is already compulsory, such as Kazakhstan, it remains unclear whether this requirement will actually result in improved accounting quality (Kim, 2025). One wonders about the effectiveness of IFRS application in Uzbekistan, considering that the problem of transparency of financial transactions in the country remains unsolved.

Lack of financial reporting credibility is another aspect that makes assessing credit risk a demanding undertaking. According to Khasanovich (2025), commercial banks in Uzbekistan face difficulties in assessing risk due to the absence of unified standards and clear, reliable financial data from companies. Without high-quality and frequent disclosures, banks must typically assess the financial well-being of loan applicants using alternative methods, such as collateral-based appraisals, which are generally unlikely to reflect the borrower's true financial position (Burkhanov, 2023).

Problem - financial reporting in emerging markets: the case of Uzbekistan

Emerging economies have several problems with regard to transparency and the quality of corporate financial disclosures. In Uzbekistan, these issues are especially relevant as the country continues its transition toward a market-oriented financial system, where commercial banks remain the dominant providers of financing for corporate borrowers and SMEs (Tadjibaeva, 2019; Burkhanov, 2023). As a result, the financial reporting of

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the majority of Uzbek companies is neither regular nor reliable, making it difficult to determine the true financial performance of loan applicants. Khushnud and Qingjie (2020) observe that low-quality financial disclosure considerably hinders banks' ability to assess the risks associated with providing credit to SMEs, which can make a notable contribution to the country's economic development. The adoption of IFRS is considered one of the key measures for improving the quality of financial reporting, but the challenges of its implementation have not been fully eliminated (Kadirovich & Rabbimovich, 2021).

The banking sector in Uzbekistan has been dramatically reformed to improve the level of risk management (Khasanovich, 2025). However, there are still some issues with financial reporting in the country. Uzbekistan continues to operate a dual financial reporting framework, which contributes to substantial variation in the quality and comparability of corporate disclosures. According to the IFRS Foundation's jurisdictional profile, IFRS is mandatory for joint-stock companies, commercial banks, insurance organisations, large taxpayers, and state-owned or state-invested enterprises included in the annual list approved by the State Assets Management Agency, while other entities, including the majority of SMEs in the country, prepare their financial statements in accordance with national accounting standards „milliy buxgalteriya hisobi standartlari" (NAS) issued by the Ministry of Finance (IFRS Foundation, 2024).

Implementing global accounting standards is challenging and burdensome for most businesses, particularly SMEs, which in many cases lack the capacity and consistency in reporting needed to support reliable risk analysis (Khushnud & Qingjie, 2020). In addition, Tadjibaeva (2019) notes that the capitalization of SMEs in Uzbekistan remains at an early stage, and the inability to access credible financial information is one of the factors that makes it difficult for banks to provide credit. A way forward is to implement IFRS and strengthen corporate governance standards so that banks can make more accurate estimates of credit risk.

These disclosure limitations also have broader prudential implications. Effective implementation of Basel III requirements, particularly those related to credit risk measurement, internal risk governance, and market discipline, depends on the availability of reliable borrower-level information (BCBS, 2011; BCBS, 2017; BCBS, 2018). Weak financial reporting undermines the accuracy of risk-weighted asset calculations, complicates supervisory evaluation of internal risk processes, and reduces the reliability of banks' own public disclosures. For Uzbekistan, improving disclosure quality is therefore essential not only for strengthening lending practices but also for aligning the banking sector with international regulatory standards.

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Although individual studies have examined SME financing, IFRS implementation, and risk management in Uzbekistan, their findings have not been synthesized to explain how disclosure quality shapes banks' risk evaluation practices in a Basel-aligned environment (Khushnud & Qingjie, 2020; Khasanovich, 2025). This study addresses that gap by examining the main channels through which disclosure quality affects banks' credit assessment processes and the broader regulatory context in which these issues arise.

Objectives of the study

The study aims to:

- examine the effects of corporate financial disclosures on the risk management practices of banks in Uzbekistan and assess whether these disclosures have led to the desired outcomes;
- investigate the impact of International Financial Reporting Standards (IFRS) on the transparency and reliability of the financial information used by banks in Uzbekistan;
- identify the issues that commercial banks in Uzbekistan face when assessing credit risk based on the quality of financial disclosures; and
- examine how disclosure weaknesses limit alignment with Basel III requirements and identify priority areas for policy improvement.

Research questions

The research questions of the study are determined as follows:

- What is the effect of the quality and transparency of corporate financial reporting in Uzbekistan on the ability of banks to assess the riskiness of loan applicants?
- How does the adoption of IFRS in the banking sector of Uzbekistan affect the quality of financial disclosure?
- What practical challenges do banks encounter when assessing borrowers with weak or incomplete financial disclosures?
- How do disclosure limitations constrain the effectiveness of Basel III-aligned credit risk measurement and supervisory expectations?

Structure of the paper

The paper is organized as follows: the first part introduces the topic and provides the background of the research, the objectives, and the research questions that have to be answered. The second part reviews the existing literature on disclosure quality, IFRS adoption, SME reporting capacity, digitalization, and Basel III requirements. The third section outlines the conceptual mixed-method approach and discusses data limitations. The fourth

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part presents the key findings while discussing implications for banks and policymakers. The last section concludes with recommendations and areas for future research.

Literature Review

The quality of corporate financial disclosure is of vital importance for banks' ability to assess the riskiness of their loan applicants, especially in emerging markets. The importance of financial disclosures in banks' risk assessment is reinforced by the fact that emerging economies face difficulties in harmonizing their financial reporting principles with international standards. This literature review discusses corporate financial reporting and banks' risk assessment practices in relation to the development of Uzbekistan's financial system, the adoption of IFRS, and the overall efficiency of the risk management system in the banking industry.

The corporate financial disclosures and risk assessment in banks

Corporate financial disclosures are highly significant to banks as a source of information because they help in assessing the financial standing of loan applicants. These disclosures generally include financial statements, which provide information on the profitability, liquidity, solvency, and financial stability of an organization. As Khushnud and Qingjie (2020) note, the Uzbekistan banks that support the banking needs of small and medium-sized enterprises (SMEs) rely on financial statements to determine the creditworthiness of the borrowing organizations. However, in many cases, the financial reports prepared by companies are neither fully accurate nor comprehensive, which increases the likelihood of incorrect risk-related decisions.

Lending decisions taken by banks require high-quality and transparent financial information (Khasanovich, 2025). In emerging markets where financial reporting practices are still in their formative years, the absence of clear and accurate disclosure makes banks more subjective in their evaluation of risks. Such practices can include overreliance on collateral or personal guarantees, which are not always reliable indicators that a borrower is financially sound. This dependency on unreliable financial data could contribute to financial instability and loan defaults within the banking system.

IFRS adoption and financial reporting quality

The implementation of IFRS has been regarded as one of the main measures for enhancing the quality and comparability of corporate financial reporting in emerging economies. According to Mamadiyarov et al. (2024), there is a necessity of introducing IFRS in Uzbekistan to increase the transparency and consistency of financial reporting. The adoption of the IFRS

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has, however, been a gradual process, with the main setbacks being a lack of trained personnel, which has led to resistance to change by the businesses. The mandatory use of the IFRS reporting standard has had both positive and negative outcomes in Kazakhstan, where Kim (2025) concluded that IFRS usage has increased the quality of accounting, but there was a small effect on financial transparency because the country had an undeveloped regulatory framework.

Similarly, in Uzbekistan, the adoption of IFRS is essential for enhancing the credibility of corporate financial disclosures, which can strengthen the reliability of banks' risk assessments. Kadirovich and Rabbimovich (2021) mention that the work to change the financial reporting practices in Uzbekistan is underway, and although certain steps have been taken, more efforts are required to fully align the financial reporting practices with the international standards. According to Tadjibaeva (2019), the absence of harmonization between local financial reporting standards and international standards is also one of the major obstacles on the way to the desired level of financial transparency.

Financial reporting of SMEs: Problems

SMEs are an important sector of the Uzbek economy, but they face many difficulties in accessing funding. As Tadjibaeva (2019) points out, SMEs typically lack the resources and expertise to prepare high-quality financial reports, which hampers their chances of attracting investment or securing bank loans. Such challenges are compounded by the fact that international financial reporting standards are difficult for many SMEs to adopt because of the high costs of compliance and the limited availability of trained accountants. Khushnud and Qingjie (2020) also state that the quality of financial disclosures in the Uzbek SME sector is low, and banks cannot determine credit risk properly.

According to Khamdamov et al. (2024), the problem can be addressed, at least in part, through the digitalization of credit decisions. Using digital means, banks will be in a better position to assess the financial well-being of SMEs, despite the lack of optimal financial disclosure. These tools can help banks assess a wider range of risk factors, which is particularly important when financial data are limited or unreliable, including market conditions and borrower behavior. Empirical evidence shows that structured, standardized financial statements significantly improve the predictive accuracy of credit risk models, which underscores the importance of reliable financial disclosures for SME lending (Altman & Sabato, 2007).

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Regulatory oversight and its role in improving financial transparency

The regulatory bodies are also instrumental in the process of ensuring that the corporate financial disclosures and reports are of the necessary quality and transparency. The Central Bank in Uzbekistan has undertaken several reforms to enhance financial reporting practices, but effective regulation and enforcement remain challenging. Khasanovich (2025) notes that these reforms lack a proper approach to enforcement and do not have a unified framework to regulate financial disclosures. This weakness in regulatory control undermines banks' ability to properly evaluate risk based on the financial data presented by loan applicants.

Kurtbedinov (2009) explains that the reforms of corporate governance in transition economies such as Uzbekistan play an important role in enhancing the quality of financial reporting. He says that robust governing systems with the backing of good regulatory systems can make financial disclosures true and correct, allowing banks to better assess risk. Nevertheless, according to Kadirovich and Rabbimovich (2021), such reforms are still underway, and more work is required to establish trust in financial disclosures. For instance, recent government policy will require all Public Interest Entities to adopt IFRS from 2026, which is expected to expand the share of standardized and audited reporting in key sectors of the economy (PwC Uzbekistan, 2024). This dual framework results in structural differences in disclosure quality, where larger and regulated firms tend to produce more comprehensive and comparable information, while SMEs typically operate under simplified or capacity-constrained reporting systems. Such a regulatory structure creates heterogeneous reporting practices across the corporate sector and affects the availability, depth, and reliability of financial information accessible to banks for credit risk assessment.

Functions of digitalization in risk assessment

Besides enhancing financial reporting, the digitalization of banking services is regarded as a means of improving risk assessment processes. According to Khamdamov et al. (2024), digital tool application in credit decisions can assist banks in processing more types of data, such as alternative financial indicators, which are especially applicable in incomplete or unreliable financial disclosure markets. These online applications may combine information about a loan applicant from multiple sources (such as transaction history and non-financial data) to provide a better view of their creditworthiness.

Digital technologies can also assist in making the process of loan application simpler, thereby lowering the administrative load of both banks and customers. In turn, this can enhance the effectiveness of the risk evaluation process and accelerate loan provision. Yet, to make digital risk assessment

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tools successful in Uzbekistan, substantial investments in technology and infrastructure will be required, along with training for bank employees (Khamdamov et al., 2024).

The literature review indicates that the relationship between corporate financial disclosure and banks' risk assessment practices in Uzbekistan is complex. Although the implementation of IFRS can enhance financial transparency, much remains to be done regarding the quality and consistency of corporate financial reporting, especially in the SME sector. The rate at which regulatory reforms are being achieved is also slow, and the absence of mechanisms that effectively enforce the rules also makes it hard to ensure the banks can gauge risk appropriately. Nevertheless, there is a chance of promoting better risk assessment practices through digitalization, even though optimal financial disclosures are not in place.

Academic insights on Basel III data requirements and credit risk measurement

The effectiveness of Basel III credit risk measurement depends fundamentally on the quality, consistency, and reliability of borrower-level financial information. Capital regulation under Basel frameworks requires banks to calculate risk-weighted assets using either standardized risk weights or internal ratings-based (IRB) models, both of which rely on accurate estimates of key credit risk parameters. The theoretical foundation for these models demonstrates that banks cannot produce reliable probability of default (PD), loss given default (LGD), or exposure at default (EAD) estimates without standardized and verifiable financial disclosure from borrowers. Blundell-Wignall and Atkinson (2010) argue that Basel III capital and liquidity standards cannot function effectively without improvements in financial reporting transparency, especially in emerging markets.

Further evidence connects disclosure quality with the credibility of internal risk models. Gordy (2003) shows that the mathematical foundation of IRB capital rules assumes high-integrity borrower-level data. When disclosures are inaccurate or incomplete, internal risk weight calculations lose reliability, causing incorrect capital allocation. In the SME context, Altman and Sabato (2007) show that PD modeling requires structured and consistent financial information; otherwise, banks' estimated risk levels become systematically biased.

Disclosure quality is also central to Basel III Pillar 3 market discipline. Nicolò and Pelizzon (2008) highlight that Pillar-3 disclosures only produce effective market discipline when backed by credible borrower information feeding into banks' own reported risk indicators. Studies of emerging markets further emphasize that weak accounting infrastructure limits Basel III implementation capacity (Adesina, 2019; Barth et al., 2013).

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Taken together, the academic literature reinforces the core argument of this study: weak corporate disclosure quality undermines Basel III risk measurement, capital adequacy, and market transparency, making disclosure reform essential for risk governance in Uzbekistan.

Table 1: Summary of the literature review on corporate financial disclosures and bank risk assessment

Author(s)	Year	Study Focus/Objective	Key Findings	Relevance to Current Study
Kim, O.	2025	Impact of mandatory IFRS reporting on accounting quality in Kazakhstan	IFRS adoption improved financial transparency and accounting quality, but challenges in implementation persist.	Demonstrates the impact of IFRS adoption on financial disclosures, relevant for understanding similar challenges in Uzbekistan.
Burkhanov, S.	2023	Relationship between corporate lending and economic growth in Uzbekistan	High-quality corporate disclosures positively affect lending outcomes and economic growth, especially for SMEs.	Provides insight into how better financial disclosures improve loan access and economic stability in Uzbekistan.
Khasanovich, M. M.	2025	Improving risk management systems of commercial banks in Uzbekistan	Risk management improves with better-quality financial data and disclosures.	Highlights how financial disclosure quality enhances risk assessment in the banking sector of Uzbekistan.
Khushnud, Z. & Qingjie, Z.	2020	Banks' risk assessment of financing SMEs in Uzbekistan	Lack of transparency in financial reports leads to higher lending risks, especially for SMEs.	Directly ties to the study's focus on SMEs and how inadequate disclosures hinder risk assessments.
Tadjibaeva, D.	2019	Small and medium-sized enterprise finance in Uzbekistan	SMEs face significant challenges in accessing finance due to poor financial reporting practices.	Focuses on the SME sector and how financial reporting affects credit risk assessments in Uzbekistan.
Mamadiyarov, Z. T. et al.	2024	Impact of IFRS on microfinance services	IFRS adoption improved financial reporting in microfinance institutions, enhancing credit evaluations.	Relevant for understanding the broader impact of IFRS on financial institutions, including banks.
Kurtbedinov, E.	2009	Corporate governance in transition economies	Strong corporate governance and financial disclosures enhance risk	Relevant for understanding the role of corporate governance and

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			management, particularly in transitioning economies.	financial transparency in banks' risk management practices.
Kadirovich, R. N. & Rabbimovich, K. K.	2021	Transformation of financial reporting to international standards in Uzbekistan	Implementation of IFRS significantly improved financial reporting, but gaps in enforcement remain.	Offers a direct connection to the ongoing transformation of financial reporting in the banking sector of Uzbekistan.
Muhabbat, H. & Jakhongir, S.	2024	Harmonization of IFRS and valuation standards	Harmonization of IFRS and valuation standards is crucial for improving financial transparency and risk assessment.	Discusses the alignment of international standards, essential for understanding the regulatory changes needed in Uzbekistan.
Bagirov, M. et al.	2025	Impact of bank activities on economic dynamics in Uzbekistan	Improved financial reporting systems lead to more stable banking activities and economic development.	Highlights how enhanced financial reporting systems directly influence banking operations and economic stability.
Blundell-Wignall & Atkinson	2010	Global critique of Basel III	Basel III cannot function without reliable, transparent financial data.	Demonstrates need for data quality for Basel governance.
Gordy, M. B.	2003	Foundations of IRB models	PD/LGD/EAD models require high-integrity borrower data.	Establishes a mathematical link between disclosure and capital rules.
Altman & Sabato	2007	SME credit risk modeling	SME PD estimation requires structured financial information.	Shows poor SME reporting undermines risk modeling accuracy.
Nicolò & Pelizzon	2008	Pillar 3 disclosure effectiveness	Pillar 3 is only credible when backed by accurate underlying borrower data.	Supports the argument that weak disclosure reduces market discipline.
Adesina, K.	2019	Basel III implementation in emerging markets	Weak reporting and low enforcement reduce Basel III effectiveness.	Provides emerging-market evidence similar to Uzbekistan's context.
Barth, Caprio & Levine	2013	Global bank regulation effectiveness	Supervisory strength and reporting accuracy drive risk outcomes.	Reinforces the importance of data quality for prudential oversight.

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Methodology

This study adopts a qualitative mixed-method design that integrates multiple qualitative analytical techniques to examine how corporate financial disclosure quality affects banks' credit risk assessment in Uzbekistan. This approach is consistent with the original research framework and addresses reviewers' recommendations to clarify methodological structure while avoiding unsupported quantitative claims. A qualitative mixed-method design is appropriate because Uzbekistan does not have publicly available borrower-level financial datasets or standardized credit risk indicators (such as PD, LGD, or EAD) that would allow for robust econometric modelling. As a result, the analysis relies on triangulating evidence from regulatory documents, academic literature, and institutional practices to generate a contextually grounded understanding of disclosure-related challenges in the banking sector. The qualitative design ensures methodological coherence while enabling the study to capture the institutional, regulatory, and conceptual dimensions of disclosure quality and credit risk assessment.

Research design and rationale

The qualitative mixed-method approach used in this study consists of three integrated components:

1. Regulatory and institutional document analysis, examining financial reporting requirements (IFRS, NAS), corporate governance rules, and Basel III supervisory expectations relevant to credit risk measurement. Document analysis is a well-established qualitative method for extracting structured meaning from policy and regulatory texts (Bowen, 2009).
2. Thematic synthesis of academic literature.
   Peer-reviewed studies on disclosure quality, IFRS implementation, SME reporting capacity, and Basel-aligned credit risk assessment are reviewed and coded to identify recurring theoretical and empirical patterns. This follows structured literature review practices used to build conceptual frameworks in management and finance research (Webster & Watson, 2002).
3. Comparative analytical evaluation.
   Findings from the regulatory and literature analyses are benchmarked against international reporting and supervisory expectations to identify gaps between formal standards and practical disclosure realities. Triangulation across these methods strengthens validity and reduces reliance on any single source stream (Denzin, 2012).

A qualitative approach is methodologically justified because the data required for empirical modelling, such as borrower-level financial statements,

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financial coefficients, and comparable SME disclosures, are not publicly available in Uzbekistan. Any attempt to construct econometric models would therefore produce unreliable or non-generalizable findings. A qualitative mixed-method design allows the study to maintain analytical depth through triangulation of documentary sources and scholarly literature, while remaining consistent with resource and data constraints inherent to the regional financial context (Denzin, 2012; Miles, Huberman, & Saldaña, 2014).

Data collection methods

The study relies exclusively on secondary qualitative data, collected through three structured channels: regulatory and institutional documents, academic literature, and publicly available sectoral analyses. This data collection strategy is consistent with the qualitative mixed-method design and reflects the limited availability of standardized borrower-level financial information in Uzbekistan.

First, regulatory and institutional documents form the core dataset. These include:

- IFRS and related implementation guidance;
- National accounting standards of Uzbekistan;
- Financial reporting and audit regulations issued by the Ministry of Finance and the Agency for State Assets Management;
- Prudential and supervisory documents published by the Central Bank of Uzbekistan, including Basel III-related guidelines;
- IFRS Foundation jurisdictional profiles and official communications related to mandatory IFRS adoption.

These sources provide authoritative evidence on reporting obligations and the institutional drivers of disclosure quality. Collection and use of such materials are consistent with qualitative document-analysis protocols (Bowen, 2009).

Second, academic literature was collected systematically from peer-reviewed journals, conference papers, and recognized academic databases. The review focused on research addressing disclosure quality, corporate transparency, IFRS implementation in emerging markets, SME reporting constraints, and the dependence of credit risk modelling frameworks on reliable financial data. The search and selection process follows structured literature-review logic emphasizing conceptual relevance and synthesis (Webster & Watson, 2002). Foundational theoretical studies, such as Gordy (2003), and empirical SME credit risk research, such as Altman and Sabato (2007), were included to inform the conceptual framework.

Third, supplementary sectoral analyses and professional publications, such as reports by international audit firms, financial institutions, and

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multilateral organizations, were included to obtain additional insights into Uzbekistan's reporting landscape and its alignment with global standards.

Across all three categories, documents were selected through purposive sampling to ensure relevance to disclosure quality, financial reporting regulation, and credit risk assessment practices. No primary data collection (e.g., interviews or surveys) was conducted, reflecting the study's reliance on documented institutional sources and established academic evidence.

Data analysis techniques

The analysis follows a structured qualitative analytical framework combining thematic coding, regulatory analysis, and comparative evaluation. This approach aligns with the qualitative mixed-method design of the study and enables systematic interpretation of regulatory texts, academic research, and institutional documents.

First, a thematic analysis was conducted to identify patterns and themes in the data based on their relevance to the research questions. Documents were read iteratively, and themes were coded into categories such as "transparency", "completeness", "comparability", "timeliness", "audit reliability", "SME reporting constraints", and "Basel III data dependencies". These codes were then grouped into higher-order themes to develop a structured understanding of how disclosure practices influence credit risk assessment. This follows established thematic analysis procedures (Braun & Clarke, 2006) and qualitative coding guidance for analytical rigor (Miles et al., 2014). Thematic analysis, according to Khamdamov et al. (2024), is particularly helpful when financial decision-making is complex in emerging markets and banks face multiple challenges in interpreting financial information.

Second, a regulatory content analysis was applied to financial reporting standards and supervisory documents. Document interpretation followed systematic qualitative document-analysis practices (Bowen, 2009). This involved examining consistency between Uzbekistan's National accounting standards, IFRS adoption requirements, and Basel III supervisory expectations. Attention was given to areas of convergence and divergence, such as mandatory IFRS use among regulated entities versus simplified reporting practices among SMEs. This analysis helped clarify how institutional rules shape the availability and quality of financial information used by banks.

Third, a comparative analytical technique was used to benchmark Uzbekistan's disclosure environment against international norms. By comparing local practices to the expectations embedded in IFRS and Basel III credit risk frameworks, the study identified structural gaps that impact the

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validity of bank risk assessments. This comparative approach strengthened the conceptual link between reporting practices and credit risk measurement, particularly in the context of borrowers that do not produce standardized disclosures.

Finally, triangulation was used across themes and all analytical components to enhance credibility and internal consistency of interpretations (Denzin, 2012). Findings from the thematic literature review were compared with insights derived from regulatory documents and benchmarking analysis. Areas of convergence increased confidence in the validity of interpretations, while discrepancies highlighted institutional constraints and areas requiring reform.

Together, these analytical techniques provided a rigorous, multi-layered qualitative assessment of how financial disclosure quality affects credit risk evaluation in the banking sector of Uzbekistan, aligning with the objectives of the paper.

Ethical considerations

This study is based exclusively on secondary sources, including regulatory documents and peer-reviewed academic literature. No primary data were collected, and no human participants were involved. Accordingly, the research does not raise issues of informed consent, privacy, or confidentiality associated with interviews or surveys. Ethical compliance in this context focuses on responsible use of documentary evidence, transparency in interpretation, and accurate attribution of all sources (Flick, 2014; Patton, 2015). The analysis remains strictly within the boundaries of publicly available information and does not claim access to confidential bank or borrower data. Citations and references are provided in accordance with academic integrity standards and APA guidelines (Creswell & Plano Clark, 2018).

Limitations of methodology

This research faces limitations typical of qualitative studies in data-constrained emerging markets. First, Uzbekistan does not provide publicly accessible, standardized borrower-level disclosure datasets, particularly for SMEs, nor open access to internal bank risk parameters (PD, LGD, EAD) or supervisory credit risk files. These constraints prevent robust econometric testing and justify reliance on qualitative triangulation (Creswell & Plano Clark, 2018; Patton, 2015). Second, the national reporting environment remains heterogeneous: IFRS is compulsory only for specific categories of entities, while most SMEs report under NAS (IFRS Foundation, 2024). This dual system reduces cross-firm comparability and limits the feasibility of uniform risk-measurement validation. Third, recent regulatory changes

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expanding IFRS coverage to Public Interest Entities from 2026 may alter disclosure practices over time, meaning current conclusions should be interpreted as reflective of the present transition stage (PwC Uzbekistan, 2024). Finally, because credible Basel-aligned credit risk estimation depends on high-integrity borrower financial data, weaknesses in disclosure quality constrain model-based verification of risk classifications (Gordy, 2003; Altman & Sabato, 2007).

Despite these limitations, the study's multi-source qualitative design remains appropriate for identifying institutional mechanisms and policy-relevant implications in settings where reliable quantitative datasets are unavailable (Flick, 2014; Miles, Huberman, & Saldaña, 2014).

Results

Corporate disclosure quality and banks' loan risk assessment

Among the fundamental results of the research is the substantial role of high-quality, accurate, and transparent financial disclosures in banks' capacity to evaluate the credit risk of loan applicants. Banks utilize financial statements, including balance sheets, income statements, and cash flow reports, in order to establish the financial standing of the borrower. In such cases, the banks would make informed decisions based on the financial position of the company, which is important in minimizing loan defaults and non-performing loans (NPLs).

Poor risk assessment is directly associated with the absence of transparency in financial disclosures because, as Khushnud and Qingjie (2020) put it, banks cannot effectively assess the financial soundness of borrowers. The authors did find that the quality of the disclosure received by banks is associated with a lower rate of loan default. This observation aligns with Tadjibaeva's (2019) claim that financial reporting in Uzbekistan, especially for SMEs, has a significant impact on banks' lending decisions and tends to make them more prudent in their credit risk evaluations.

Conversely, weak, inconsistent, or inaccurate financial disclosures are a significant challenge to banks. The inability of loan applicants to provide detailed financial statements or inconsistencies in such documents compels banks to make assumptions and use less reliable risk assessment methods. Banks are often forced to rely on proxies and judgmental assessments, such as collateral values, personal guarantees, or qualitative impressions of management, rather than analysis of the financial performance of borrowers (Khushnud & Qingjie, 2020; Tadjibaeva, 2019).

This pattern leads to two interrelated problems. First, it increases misclassification risk: viable borrowers may be treated as high risk due to information gaps, while financially weak firms may appear acceptable if they can pledge collateral. Second, it reinforces conservative and collateral-

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dominant lending, which restricts credit access for firms that lack collateral but have solid business models. According to Burkhanov (2023), the misrepresentation of financial data is common among SMEs in Uzbekistan, which makes it difficult for banks to effectively assess credit risk.

IFRS adoption and disclosure quality in Uzbekistan

Improving the quality of corporate financial disclosures in Uzbekistan critically depends on the adoption of International Financial Reporting Standards. The adoption of IFRS assists in standardizing financial reporting and thus enables banks to easily compare the financial status of loan applicants in various sectors. The study also established that the financial data reported by the firms complying with IFRS is more reliable, consistent, and transparent. This contributes to the capability of banks in measuring credit risk effectively (Mamadiyarov et al., 2024; Kadirovich & Rabbimovich, 2021).

According to Mamadiyarov et al. (2024), one of the critical measures to enhance the comparability and transparency of financial statements is the implementation of IFRS. The findings also indicate that commercial banks in Uzbekistan that base their reporting on IFRS achieve better outcomes in terms of the quality and consistency of risk assessment. When financial disclosures are prepared in international standards, banks can gain confidence in the measurement of key risk indicators, including profitability, the level of debt, and liquidity ratios.

Nevertheless, the research also reveals considerable problems associated with the complete adoption of the IFRS in Uzbekistan. The disclosure environment remains structurally uneven because IFRS applies only to specific categories of firms, while most SMEs continue reporting under national standards (IFRS Foundation, 2024). This dual system produces persistent differences in disclosure depth and comparability across borrower groups, limiting banks' ability to apply uniform analytical criteria in risk assessment (Tadjibaeva, 2019; Khushnud & Qingjie, 2020). These obstacles include the cost of switching to IFRS, inexperienced accountants, and insufficient knowledge of international reporting standards (Kadirovich and Rabbimovich, 2021). Even the mandatory nature of the IFRS requirements on reporting, as was the case with Kazakhstan, as noted by Kim (2025), will only partially enhance the quality of accounting, provided that the firms do not have the capacity to apply the standards successfully. The paper indicates that, in most cases, banks can enhance their risk management procedure in the event that loan applicants comply with IFRS.

This point is directly relevant to Uzbekistan, where SMEs face similar barriers, including high transition costs, limited IFRS expertise, and weak audit coverage (Kadirovich & Rabbimovich, 2021; Tadjibaeva, 2019).

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Practical challenges for banks under weak borrower disclosure

The research finds that many SMEs in Uzbekistan fail to provide financial disclosures that enable proper risk assessment. The article by Tadjibaeva (2019) addresses the current obstacles encountered by SMEs in producing high-quality financial reports and states that many SMEs lack the financial skills and resources to prepare detailed financial statements. This leads to the lack of completeness or thoroughness in reporting, and banks find it hard to gauge the actual financial status of applicant.

The results indicate that banks are more likely to use less reliable risk assessment practices, such as relying on collateral or third-party guarantees, when they receive poor financial disclosures from SMEs, and such collateral or guarantees are less reliable predictors of financial stability, even if the common minimum required collateral coverage is 125% of the loan amount (Hamkorbank, 2025).

Another recurring constraint is the partial informality of SME operations, where financial reporting may not fully capture revenue cycles, cost structures, or contingent obligations. When disclosures fail to reflect operational realities, stress testing and forward-looking evaluation become significantly less reliable (Khushnud & Qingjie, 2020; Burkhanov, 2023). International evidence reinforces that SME PD estimation becomes systematically biased when statements lack structure or consistency, implying that disclosure gaps translate directly into higher assessment error risk in SME portfolios (Altman & Sabato, 2007).

There is also a problem of a lack of standardization in financial reporting practices across various sectors. Lack of standardized accounting practice challenges banks in comparing financial disclosures made by various applicants, making it hard to establish the level of risk. According to Khasanovich (2025), financial reporting standardization plays a critical role in enhancing an accurate and consistent risk assessment. Nonetheless, because of the lack of a solid regulatory framework, the majority of companies in Uzbekistan continue to file reports of inferior quality to those that are internationally acceptable, which complicates the risk management of banks.

These disclosure constraints have clear operational consequences for bank lending. First, banks respond to informational uncertainty by shifting toward collateral-dominant credit evaluation, using guarantees and asset coverage to compensate for weak cash-flow evidence (Khushnud & Qingjie, 2020; Burkhanov, 2023). While collateral reduces loss severity, it does not resolve uncertainty about repayment capacity, so credit grading remains conservative and may exclude economically viable borrowers (Tadjibaeva, 2019).

Second, weak disclosure quality complicates loan pricing and covenant design. Banks must add risk premiums when financial information

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is incomplete or inconsistent, which increases borrowing costs and reinforces credit rationing for SMEs (Khushnud & Qingjie, 2020; Burkhanov, 2023). Third, monitoring existing loans becomes harder because banks cannot rely on periodic borrower reporting for early warning signals; this reduces the effectiveness of proactive restructuring and increases the likelihood that credit deterioration is detected late (Khasanovich, 2025).

Overall, the practical challenges identified confirm that weak borrower disclosures constrain not only initial lending decisions but also ongoing portfolio supervision, reinforcing the structural linkage between disclosure quality, credit access, and loan performance in Uzbekistan's banking system.

Basel III–aligned credit risk measurement constraints

The findings indicate that progress toward Basel III–aligned credit risk measurement in Uzbekistan is structurally constrained by borrower-side disclosure weaknesses. Basel III credit risk frameworks, whether under standardized risk weights or internal ratings-based logic, depend on credible borrower financial information to classify exposures, evaluate repayment capacity, and compute risk-weighted assets (BCBS, 2011; BCBS, 2017). Where disclosures are uneven in quality, risk parameters embedded in credit assessment become unreliable, weakening the precision of risk weights and the credibility of capital adequacy metrics.

The theoretical foundations of ratings-based capital rules underscore this dependence on high-integrity borrower data. Internal ratings require stable and standardized inputs to produce reliable estimates of probability of default (PD), loss given default (LGD), and exposure at default (EAD). When borrower reports are incomplete or distorted, model outputs lose robustness and risk weights become unstable, leading to misallocation of regulatory capital and reduced accuracy of risk measurement (Gordy, 2003). In the Uzbek context, the continued dominance of NAS reporting among SMEs and limited audit penetration in that segment generate precisely these data-integrity limitations, restricting the practical depth of Basel III-consistent credit risk estimation.

These data constraints also weaken Basel III supervisory effectiveness and market discipline channels. Supervisory evaluation of banks' internal risk governance assumes that key risk indicators are built on credible borrower disclosures. When corporate reporting is unreliable, particularly among SMEs, banks are forced to rely on collateral and judgmental proxies, which reduces the transparency and comparability of risk classifications across portfolios. This limits the extent to which supervisory review can validate internal risk processes against Basel expectations (BCBS, 2017; BCBS, 2018).

In addition, SME-specific evidence shows that borrower disclosure quality is not a marginal issue but a direct driver of default risk estimation

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accuracy. Credit risk modelling research demonstrates that PD estimation for SMEs improves materially when financial statements are structured and consistent; when SME disclosures are weak, PD models become systematically biased, and classification error risk rises (Altman & Sabato, 2007). This implies that, in Uzbekistan, strengthening corporate and SME disclosure quality is a prerequisite not only for improved lending decisions but also for credible Basel III implementation, more reliable supervisory assessment, and stronger Pillar 3 transparency outcomes.

The impact of digitalization on risk assessment practice

The influence of digitalization on risk assessment procedures in the banking sector of Uzbekistan is another important finding of the study. According to Khamdamov et al. (2024), by relying on digital technologies in credit decision-making, banks can examine a wider set of information as opposed to the extent of data available through financial disclosure. The research finds that digital platforms implemented by banks are associated with more effective risk assessment and faster loan issuance. The use of digital tools can help banks better evaluate loan applicants by drawing on available information when financial disclosures are missing or incomplete, thereby lowering lending risk.

Nevertheless, despite the potential of digitalization, the study also identifies obstacles to its widespread adoption in Uzbekistan. The results indicate that even though the use of digital tools to improve the processes of risk assessment by certain banks is on the rise, the widespread use of digital technologies is still challenging in the banking industry in the country.

Besides, digitalization functions mainly as a complement rather than a substitute for standardized financial reporting. Alternative data streams cannot fully replace the role of audited, comparable financial statements in long-term cash-flow assessment, covenant design, and portfolio monitoring. Without reliable accounting disclosures, banks still face limits in validating profitability sustainability, leverage dynamics, and true debt-service capacity, which remain central for accurate credit grading (Khushnud & Qingjie, 2020; Khasanovich, 2025).

Regulatory issues and their influence on financial disclosure

The paper also emphasizes the role of regulatory controls in determining the quality of financial disclosures made by corporations. Although the Central Bank of Uzbekistan has implemented several reforms to enhance the risk management system and financial reporting standards, these reforms are not properly enforced. As Khasanovich (2025) notes, some companies do not implement mechanisms that ensure high-quality financial disclosures, which compromises banks' risk assessment systems.

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The study found that stronger regulatory control in a given area is associated with higher-quality financial disclosures received by banks, which in turn result in more precise risk evaluation. Nonetheless, in areas where enforcement is weaker, financial institutions have greater difficulty accessing accurate financial information and profiling the risk of loan applicants.

Overall, digitalization and enforcement act as enabling conditions for all preceding findings: digital tools can narrow disclosure gaps operationally, while stronger enforcement improves the underlying quality and comparability of borrower reporting needed for IFRS effectiveness and Basel III-aligned credit risk measurement.

To overcome these issues, this paper proposes that the regulatory framework within Uzbekistan must be strengthened. The quality of financial disclosures would improve if better enforcement of financial reporting standards were followed, as well as if more companies and banks were trained on the issue. Given the suggestions provided by Kadirovich and Rabbimovich (2021) on enhancing regulatory oversight and adherence to IFRS, it will be necessary to improve the quality of risk assessment conducted by banks and minimize loan default risk.

Summary of results

The findings of this research indicate that corporate financial disclosures are crucial to the risk assessment process of banks in Uzbekistan. IFRS adoption improves disclosure where firms have capacity and enforcement is effective, but its aggregate effect remains limited by the IFRS–NAS dual system and persistent SME reporting constraints. These gaps create operational challenges for banks in credit grading, pricing, and monitoring, and they also undermine Basel III–aligned risk measurement because reliable RWA and PD/LGD/EAD estimation requires high-integrity borrower data. Digitalization also offers an opportunity to improve risk measurement through the use of alternative information, yet obstacles to its adoption still exist. Lastly, enhanced regulatory control and policing of financial reporting standards play a vital role in facilitating the improvement in the overall quality of financial reporting and the precision of risk measurement in the banking industry in Uzbekistan.

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Table 2: Summary of results

Factor	Key Findings	Impact on Risk Assessment
Quality of financial disclosures	High-quality, accurate, and transparent financial disclosures allow banks to assess credit risk effectively.	Lower loan default rates and non-performing loans (NPLs) due to informed decision-making.
Inaccurate financial disclosures	Poor or incomplete disclosures result in banks relying on collateral-based assessments, which are less accurate.	Increased loan defaults and NPLs due to poor risk assessments based on unreliable disclosures.
Adoption of IFRS	IFRS adoption standardizes financial reporting, improving transparency, consistency, and comparability.	Enhances the accuracy of risk assessments, reduces risk premiums, and improves financial stability.
Challenges in IFRS implementation	SMEs in Uzbekistan face challenges in adopting IFRS due to cost, lack of expertise, and limited resources.	SMEs often present inconsistent or incomplete disclosures, complicating risk assessments.
SME reporting challenges	SMEs struggle to provide complete and accurate financial reports due to resource and skill limitations.	Banks rely on less reliable risk assessment practices, such as collateral, leading to higher risk.
Dual reporting system (IFRS vs NAS)	Coexistence of IFRS reporting for selected entities and NAS for most SMEs creates structural heterogeneity in disclosure quality.	Limits cross-borrower comparability and uniform credit criteria; complicates portfolio-level risk consistency.
Basel III data requirements	Basel III-aligned risk measurement depends on high-integrity borrower data for reliable PD/LGD/EAD estimation and RWA calculation.	Weak borrower disclosures constrain credible Basel III implementation and prudential risk measurement accuracy.
Digitalization of risk assessment	Digital tools enhance the ability of banks to assess a wider range of data, including incomplete or missing financial information.	Improves risk assessment accuracy and speeds up loan issuance, though adoption is slow.
Regulatory framework	While some reforms have been introduced, enforcement of financial reporting standards is inconsistent.	Weaker enforcement leads to poorer-quality disclosures, affecting banks' risk evaluation.
Recommendations for regulatory strengthening	Improving regulatory oversight and training for companies and banks on IFRS adherence will improve financial disclosures.	Strengthening regulations will improve disclosure quality, leading to better risk assessments.

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Discussion

The findings reinforce the central argument that corporate financial disclosure quality is a structural driver of banks' loan risk assessment in Uzbekistan. Consistent with disclosure theory and empirical evidence from emerging markets, reliable reporting reduces information asymmetry and enables banks to base lending decisions on forward-looking cash-flow capacity rather than on collateral proxies (Khushnud & Qingjie, 2020; Tadjibaeva, 2019; Khasanovich, 2025). In the Uzbek context, where bank credit remains the main source of external finance for firms, this linkage is especially consequential: disclosure weaknesses do not merely affect individual loan files but shape portfolio-wide risk grading discipline and, over time, the level and volatility of non-performing loans (Burkhanov, 2023). The practical pattern identified is stronger analytical confidence when disclosures are robust and more conservative, collateral-dominant decisions when disclosures are weak, suggesting that disclosure quality functions as an upstream determinant of credit allocation efficiency.

A major implication of the findings is the uneven effect of IFRS adoption. The evidence indicates that IFRS improves reporting comparability and transparency among entities where implementation is mandatory, and capacity exists (Mamadiyarov et al., 2024; Kadirovich & Rabbimovich, 2021). However, the broader system impact remains partial due to two reinforcing factors. First, Uzbekistan maintains a dual reporting environment: IFRS applies to a defined set of public-interest and regulated entities, while most SMEs report under NAS, with lower disclosure depth and weaker note-based transparency (IFRS Foundation, 2024). Second, even in mandatory settings, adoption alone is insufficient if firms lack the institutional capacity to apply IFRS effectively. Evidence from Kazakhstan shows that compulsory IFRS yields only partial improvements where expertise, systems, and governance are weak (Kim, 2025). Applied to Uzbekistan, this indicates that IFRS expansion without parallel capacity-building risks widening formal compliance while leaving the real informational content of financial statements uneven, particularly in the SME sector.

The SME channel is therefore critical to interpret the results. SMEs are not only numerically dominant in the borrower base but also represent the segment where disclosure weaknesses are most acute. The findings align with international SME credit risk literature showing that structured and consistent SME statements significantly improve default risk estimation, whereas weak SME reporting produces systematic prediction bias (Altman & Sabato, 2007). In Uzbekistan, persistent SME constraints, such as limited accounting capacity, cost barriers, and weak audit penetration, explain why banks often rely on collateral and guarantees for risk mitigation (Tadjibaeva, 2019; Khushnud & Qingjie, 2020). While collateral reduces potential loss severity,

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it is a backward-looking safety net and cannot substitute for the forward-looking assessment of business viability. This creates a policy tension: without disclosure improvement, banks will continue to restrict SME credit or price it conservatively, even when firms are economically viable, reinforcing a credit-constraint cycle.

From a prudential perspective, the discussion highlights why disclosure reform is integral to Basel III alignment. Basel III risk measurement frameworks assume credible borrower financial inputs for exposure classification, risk-weighted asset accuracy, and the reliability of internal assessments. The theoretical foundation of ratings-based capital rules shows that PD, LGD, and EAD estimation is only as strong as the integrity of borrower data fed into models (Gordy, 2003). When borrower disclosures are incomplete or inconsistent, model outputs lose robustness, which affects both capital allocation and the comparability of risk indicators across banks. The results, therefore, imply that in Uzbekistan, Basel III implementation cannot be treated solely as a bank-side technical reform; it is equally dependent on borrower-side disclosure quality and the institutional infrastructure that supports it (BCBS, 2011; BCBS, 2017; BCBS, 2018). Strengthening reporting quality is thus a precondition for credible prudential modernization.

Digitalization emerges as a complementary but limited mitigation channel. The findings suggest that alternative data sources and digital scoring tools can partially reduce information gaps where disclosures are weak, especially for SMEs, by incorporating transaction histories, tax flows, and payment behavior into screening (Khamdamov et al., 2024). On the other hand, digital tools cannot resolve comparability and transparency deficits that stem from inconsistent accounting standards and weak audit credibility. Over-reliance on alternative data without standardized financial reporting may improve short-term screening speed but still leaves banks exposed to uncertainty in long-term cash-flow evaluation and monitoring. Therefore, digitalization should be interpreted as an enabling input that raises efficiency at the margin, not as a substitute for accounting disclosure reform.

The final institutional implication concerns enforcement. Reporting reforms and IFRS expansion in Uzbekistan have created a stronger formal framework, but inconsistent enforcement can neutralize expected gains. Without credible supervision, audit discipline, and incentives for accurate reporting, the informational value of financial disclosures remains weak, limiting both credit risk assessment reliability and regulatory modernization (Kadirovich & Rabbimovich, 2021; Khasanovich, 2025). This finding is consistent with broader evidence in transition economies that disclosure quality improves only when standard-setting is matched with practical enforcement and professional capacity.

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Finally, the discussion supports a clear agenda for future research. Once borrower-level datasets become more standardized through broader IFRS rollout, digital reporting systems, and more consistent auditing, future studies could test the disclosure risk relationship empirically using panel methods, credit risk modelling, or sector-based comparative designs. Such work would allow estimation of the magnitude of disclosure effects on PD/NPL outcomes and validate whether the conceptual mechanisms identified here hold quantitatively in Uzbekistan's evolving reporting environment.

Conclusion

This study examined the impact of corporate financial disclosure quality on banks' loan risk assessment in Uzbekistan using a qualitative mixed-method design grounded in regulatory analysis, thematic synthesis of prior research, and comparison with IFRS and Basel III expectations. The findings confirm that disclosure quality is a structural determinant of credit risk evaluation. When borrower reporting is timely, complete, and credible, banks can conduct cash-flow-based analysis and assign risk grades more accurately. Where disclosures are weak, most notably among SMEs, information asymmetry rises, banks shift toward collateral-dominant assessment, and the likelihood of risk misclassification increases, with implications for portfolio quality and non-performing loan dynamics.

The results further show that IFRS adoption improves transparency and comparability among entities mandated to use IFRS, but the overall effect remains partial because Uzbekistan operates a dual reporting environment and many firms, especially SMEs, lack the capacity to implement IFRS effectively. As a consequence, disclosure quality remains uneven across borrower groups, limiting cross-firm comparability for lenders. From a prudential perspective, these borrower-side limitations constrain credible Basel III alignment: accurate risk-weighted asset calculation and robust PD/LGD/EAD estimation depend on high-integrity borrower data, which is not consistently available under current reporting practices. Digitalization can narrow information gaps at the margin through alternative data, but it cannot replace standardized, audited financial statements for long-term risk measurement and monitoring.

By integrating disclosure quality, IFRS implementation capacity, and Basel III data dependence into a single conceptual framework, the study clarifies why borrower-side transparency is a precondition for improving lending accuracy and strengthening prudential risk governance in Uzbekistan. Future research should test these mechanisms empirically as reporting standardization, audit coverage, and data availability expand.

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Recommendations

The following recommendations should be interpreted in light of the data and methodological limitations discussed in the Limitations section of the paper:

1. **Strengthen SME disclosure capacity and reporting infrastructure.** Because SMEs constitute the weakest disclosure segment, targeted capacity-building is necessary. This includes nationwide training programs for SME accountants, dissemination of practical NAS to IFRS bridging guidance, and subsidized access to qualified advisory support. Improving the ability of SMEs to produce structured, consistent statements would reduce information asymmetry and enable banks to rely less on collateral-dominant assessment.
2. **Expand audit reach and improve audit quality control.** Disclosure reliability depends on credible external assurance. Audit coverage for SMEs should be widened through tiered audit requirements, incentives for voluntary audits, and stricter professional oversight to ensure consistency with IFRS and national standards. Stronger audit discipline would directly increase the trustworthiness of borrower data used in credit risk evaluation.
3. **Enhance supervisory enforcement of reporting standards.** IFRS expansion and national disclosure rules will not translate into real quality gains without consistent enforcement. Regulatory bodies should apply clearer compliance monitoring tools, impose proportionate penalties for material misreporting, and build supervisory expertise in IFRS-based review. This would raise disclosure credibility across borrower categories and support more stable risk classification in banks.
4. **Promote gradual convergence between NAS and IFRS disclosure requirements.** The dual reporting system fragments disclosure comparability. A phased convergence starting with disclosure notes, revenue recognition clarity, related-party reporting, and cash-flow presentation for high-impact SME sectors would reduce analytical discontinuities for lenders and improve cross-borrower comparability without imposing full IFRS costs immediately on SMEs.
5. **Integrate digital risk tools with verified financial reporting.** Digitalization should be developed as a complement to accounting disclosures. Banks and regulators should support the secure integration of alternative data (tax flows, e-invoices, transaction histories) with standardized financial statements and audit confirmations. This would improve screening efficiency while preserving the integrity needed for long-term risk modelling.

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6. **Align Basel III implementation with borrower-side transparency reforms.** Basel III modernization should be pursued in parallel with disclosure reforms. Implementation roadmaps should explicitly recognize that credible PD/LGD/EAD estimation and RWA accuracy depend on borrower reporting quality. Coordinating prudential reform with disclosure-quality upgrades will make Basel alignment practically achievable rather than formalistic.

These recommendations follow directly from the study's findings and are designed to improve both micro-level lending accuracy and macro-level prudential resilience in Uzbekistan's banking system.

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Supply Chain Management Practices in Response to Ecosystem Challenges – A Narrative Literature Review

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Abstract

In recent years, there has been a widespread awareness of issues affecting the ecosystem, such as climate change. It is, in fact, a universal reality that affects human life, business activities, and the environment. In this context, companies are required to master the functioning of a dynamic and risky ecosystem where logistics play a very important role in meeting sustainable development objectives. **Purpose:** The objective of this article is to identify the main supply chain management practices that enable companies to address the challenges of the ecosystem and their impact on the environment and global performance, with a focus on the implications of climate change. This research aims to analyze the impact of these practices on business performance. **Methodology:** This research adopts a narrative review of the literature based on scientific databases, using a search equation incorporating keywords. Articles were selected according to clearly defined inclusion and exclusion criteria to ensure the relevance and quality of the work analyzed. **Results:** The results show that adopting green practices in the supply chain, such as responsible sourcing, flow optimization, and the use of sustainable

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technologies, enables companies to respond to ecosystem challenges, better cope with the risks posed by climate change, and improve global performance. **Implications:** This study offers a comprehensive and up-to-date overview for researchers wishing to further explore the link between green supply chain practices and adaptation to ecosystem challenges. The results highlight the importance for companies to quickly adopt sustainable practices in order to preserve the ecosystem, strengthen their resilience, and contribute to the transition to more responsible supply chains. **Originality/value:** This review provides an integrated view of the supply chain practices used to respond to the challenges of climate change. It highlights their role in improving environmental performance and offers ideas for sustainable logistics management in a changing ecosystem.

Keywords: Supply chain management, Climate change, Green supply chain, Resilience, Sustainability, Environmental performance

Introduction

The ecosystem represents the totality of interactions between living beings and their natural environment, and its balance depends on the rational use of available resources. Human activities have made the ecosystem increasingly fragile. Deforestation, chemical waste production, and excessive consumption of energy and natural resources have led to major environmental problems such as drought, soil degradation, erosion of biodiversity, air and water pollution, etc. (Rockström et al., 2009). One of the most pressing issues of the current century is climate change, which poses a real threat to the continuity and stability of the ecosystem. Since the beginning of the industrial revolution, humans have neglected the fact that the atmosphere, despite its abundance, is in reality extremely fragile. They have considered it to be an unlimited reservoir capable of absorbing all gas emissions. These emissions are increasingly aggravating the greenhouse effect, causing global warming, which has serious consequences such as rising sea levels and other environmental changes that impact the entire planet. With globalization, our planet has been transformed into a place of increasingly intense exchange of capital, goods, and information. But this economic globalization abuses the free emission of greenhouse gases and jeopardizes the atmosphere's ability to maintain its balance (Perthuis & Delbosc, 2009). As a result, climate change is undoubtedly the greatest challenge of the century. Studying its link with the economy and performance is therefore an urgent priority that requires governments and businesses to develop a range of actions and programs that Ghadge et al. (2020) refer to as “mitigation strategies” in order to avoid future disasters. Specifically, the adoption of such strategies is necessary in the supply chain management of large companies, which are considered to be the

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largest emitters of GHGs. It is estimated that the supply chain of a typical consumer company generates social and environmental costs that exceed those of its own operations, accounting for more than 80% of greenhouse gas emissions and 90% of the impact on air, land, water, biodiversity, and geological resources (Bové & Swartz, 2016). Companies are therefore under intense pressure to reduce their carbon footprint and adapt to climate disruption (Aykut, 2020). Diagnosing the supply chain is essential in order to identify all the anomalies that cause CO2 emissions. Transforming supply chain processes (procurement, production, and distribution) is becoming a necessity to ensure the sustainability of operations and achieve optimal performance. When analyzing the link between climate change and SCM, a mutual influence seems to emerge. On the one hand, companies are being called upon more than ever to review their supply chain activities in order to reduce gas emissions and contribute to the well-being of the environment, societies, and countries. On the other hand, climate change caused by extreme weather conditions has a significant impact on food production, natural resources, and transportation around the world (Ghadge et al., 2020). This involves a range of risks that companies must be able to analyze, identify, and manage.

Overall, companies are forced to adopt a sustainable supply chain (or green supply chain) that is also concerned with producing and distributing goods in a sustainable manner, taking environmental and societal factors into account (Kammas, 2016). It is therefore relevant to address the following issue: "***What supply chain management practices can be adopted to address the challenges of climate change***?" This central question can be subdivided into two sub-questions to achieve the objectives assigned to this research:

- What are the ecological practices that enable companies to optimize the supply chain and combat climate change?
- To what extent will the adoption of these practices improve the environmental performance of companies?

To answer these questions, this research will be structured around three main sections. First, we will attempt to highlight the implications of climate change for supply chain management. Second, we will explore the green practices related to SCM that can be adopted. Finally, we will examine the impact of these practices on optimizing environmental and global performance.

Literature review

Over the past decade, industrialized countries have seen continuous growth in logistics services dedicated to international and regional supply chains due to the globalization of trade, strategies to consolidate and relocate

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production centers, and the distribution of consumer products. The adoption by companies of just-in-time production and distribution models and the search for very low-cost production sites are not enough to cope with disruptions such as health crises, natural disasters, and climate change. It is at the level of supply chain management that rapid and effective practices must be adopted (Choumert, 2022). Supply chain management is not a new concept; it is constantly evolving, with more than 25 million web pages containing the term "supply chain management" (Le Moigne, 2013), which illustrates the existence of multiple definitions. SCM includes the planning and management of all activities related to supplier sourcing, purchasing, inventory, and coordination between supply chain players, including suppliers, service providers, and customers. According to Colin (2005), supply chain management efficiently and effectively plans, implements, and controls product flows and storage using associated information in order to meet customer needs.

Today's supply chain faces several challenges, including environmental issues related to climate change. The latter has an impact on the various activities of the supply chain, including production, transport, and distribution. These economic, regulatory, and physical implications represent new challenges for companies that must ensure both economic and environmental performance (Dasaklis & Pappis, 2013; Ivanov, 2022).

Implications and challenges of climate change

Climate change affects production and economic systems through extreme weather events such as storms, floods, droughts, cold spells, and heat waves, which directly impact natural resources, logistics platforms, and the functioning of the entire supply chain (Qarahasanlou et al., 2024). The effects of climate change on the supply chain are manifested in the stoppage and slowdown of physical flows, the degradation of resources, increased costs, and the entanglement of logistics networks.

Companies are affected by the risks posed by climate change, including standards put in place to reduce CO2 emissions, the demands of environmentally conscious customers, and damage to physical assets caused by climatic events. The purchasing decisions of customers and investors are now influenced by a company's environmental record. The risk for the supply chain is that environmental regulations can lead to increased costs for components, energy, and carbon, with suppliers passing these increases on to customers (Lash & Wellington, 2007).

More specifically, Dasaklis & Pappis (2013) consider that each link in the supply chain contributes to environmental and climate degradation through greenhouse gas emissions, and conversely, the supply chain is exposed to the

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risks of climate change. The table below presents examples of the possible impacts of climate change on the supply chain :

Table 1: Climate change impacts on supply chain links

Supply Chain Stage	Climate Change–Related Impacts and Risks
Manufacturing	Damage or complete destruction of assets Disruption of factories and production lines Laws related to carbon emissions Impacts on production process efficiency High costs for energy and maintenance activities Investments in renewable energy projects and increased demand for biofuels Development of diversified low-GHG-emission products
Transportation	Deformation of rails and roads and Delivery delays Overhead cables knocked down due to strong winds
Warehousing and Storage	Infrastructure vulnerability Disruptions caused by extreme weather events
Retail/Trade	New regulations regarding product labeling Increased production costs and prices Decrease in demand
Customer	Need for product design that improves sustainability

Source: Dasaklis & Pappis, (2013)

Physically, climate change impacts delivery and production conditions and reduces the availability of raw materials, which affects supply security, especially in the energy and agri-food sectors, as specified by Yun & Ülkü (2023). Climate issues can lead to disruptions in road, rail, and port infrastructure, delivery delays, damage to goods, and increased logistics costs. According to Ivanov (2022), from an economic perspective, these disruptions have an impact on production costs, energy prices, and more complex inventory planning. Therefore, in order to mitigate the risk of supply disruptions (Christopher & Peck, 2004), they emphasize the importance of strengthening the resilience of logistics networks, relocation, diversification of suppliers, and digitization for effective traceability.

Finally, on the regulatory front, pressure from international environmental policies is forcing companies to review their production and distribution models (Negri et al., 2021). Customers, investors, and stakeholders are also putting pressure on companies to increase the transparency of their environmental practices. The regulatory, physical, and commercial constraints arising from climate change pose threats to supply chains (Dasaklis & Pappis, 2013). As a result, several implications for supply chain management must be taken into account. The figure below presents the implications of climate change for supply chain management.

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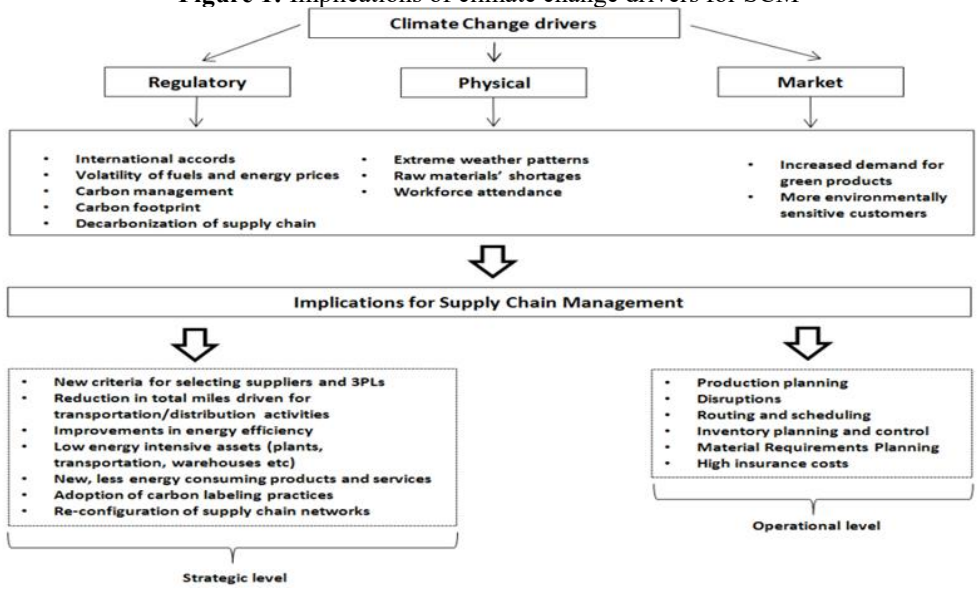
Figure 1: Implications of climate change drivers for SCM



Source: Dasaklis & Pappis (2013)

Climate change causes disruptions in supply chain activities, leading to delivery delays and significant downtime costs. Climate change causes disruptions in supply chain activities, leading to delivery delays and significant downtime costs. These implications require changes in the way supply chains are managed and industrial planning is carried out. Companies that do not take environmental issues into account are viewed negatively by customers. The effects of climate change create new strategic and operational challenges for supply chain management. Companies are forced to develop more flexible, sustainable, and resilient supply chains that can anticipate disruptions and adapt quickly to uncertainties. Pressure from governments and consumers is pushing companies towards environmentally friendly management practices such as recycling, reducing their carbon footprint, and inter-organizational collaboration (Herrmann et al., 2021).

Several authors have studied the challenges of the supply chain from a general perspective. The main challenges of supply chain management are cost reduction, meeting deadlines, quality, flexibility, and control of reverse logistics (Bentalha, 2023). From a more specific perspective, SCM also faces challenges related to climate change. According to Choumert (2022), three major challenges have been identified that require significant efforts on the part of companies: the challenge of supply chain resilience, the challenge of energy efficiency in freight transport and emissions reduction, and the ethical and social challenge. The figure below shows the challenges facing supply chain management in the context of climate change:

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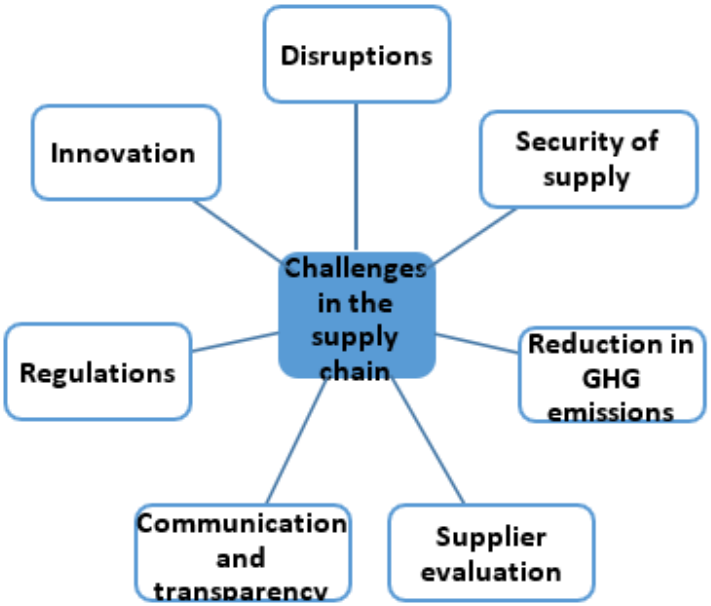
Figure 2: Challenges in the supply chain



Source: Authors

The adoption of green supply chain practices represents a strategic solution to environmental challenges (Chatzoudes & Chatzoglou, 2023). However, implementing a green supply chain is not easy and faces several obstacles, such as resistance to change, lack of technology, and high investment costs (Balkumar et al., 2024). Climate change is therefore acting as a factor pushing companies to transform their logistics management methods by adopting more environmentally friendly practices that enhance long-term sustainability and competitiveness.

Supply chain resilience

The challenges facing the supply chain in relation to climate change, associated regulations, and customer pressures have made supply chain management more complex. The concept of supply chain resilience is relevant for analyzing the ability of physical and information flows to adapt to uncertainties (Samuel & Ruel, 2013). Supply chain resilience is defined as the ability to anticipate impacts, survive, adapt quickly, and grow in the face of turbulent change (Gunasekaran et al., 2015). Resilience is a proactive approach that aims to improve the ability of companies to control risks and cope with unexpected shocks (Serghini, 2022); it is the ability to stabilize a disruption.

We note that the word capacity is repeated frequently in definitions of "supply chain resilience." Capacity in this sense means the ability to

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anticipate, change, respond, recover, and learn. Supply chain resilience enables preparation, resistance, and recovery from disruptions, and contributes to the management of risks that may affect the supply chain (Negri et al., 2021).

Figure 3: Supply chain improvement process

Source: (ESCAP, 2013)

Strategies for improving supply chain resilience focus on preventing and minimizing the impact of disruptions, and are therefore either proactive or reactive in nature (Ali et al., 2017). Proactive strategies involve anticipating disruptions that may be caused by climate change. These strategies include assessing the impact of climate change on the supply chain, increasing collaboration between stakeholders, strengthening human skills, designing a green supply chain, segmentation, decentralization, adopting new technologies, implementing information systems (Samuel & Ruel, 2013), and, most importantly, establishing a culture of resilience and sustainability.

According to Lücker & Seifert (2017) and Rajesh (2019), resilience practices for supply chain management in times of disruption include agility, responsiveness of supply chain actors, additional inventory to avoid shortages, adoption of flexible transportation solutions, security measures to protect operations and assets, supplier diversification, consolidation of customer demand to optimize resources, and postponement of critical decisions until the situation stabilizes.

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Reactive resilience strategies aim to recover from the negative effects of climate change disruptions and learn lessons to respond better next time. These reactive practices include: planning for business continuity in the event of disruptions, building social capital by expanding the company's network, implementing action plans to protect the company's market share, knowledge management and information sharing, and involving employees in resilience strategies (Ali et al., 2017).

Gunasekaran et al. (2015) propose indicators for assessing supply chain resilience, which are flexibility in sourcing, flexibility in manufacturing, flexibility in order fulfillment, efficiency, adaptability, anticipation, collaboration, market position, security, and financial capacity.

In summary, the resilience of the supply chain in the face of climate change risks is very important for mitigating impacts, ensuring the continuity of supply chain activities, performance, and sustainability.

Methodology

Our research is based on a narrative review approach that aims to interpret and identify key supply chain management practices in response to climate change. A narrative review is a type of literature review that synthesizes existing research on a topic using interpretive and qualitative analysis to highlight trends and perspectives in a field of study (Theile & Beall, 2024). Our research objective is to highlight green supply chain practices that can be adopted to address climate change-related disruptions while reducing the supply chain's impact on the environment, and to study the impact of these practices on supply chain performance. This purely theoretical approach requires in-depth reading to understand key concepts such as supply chain management, green supply chains, resilience, performance, ecosystems, and climate change.

Documentary research approach:

To deepen our knowledge and answer our research questions, we opted for keyword searches such as "supply chain management," "climate change," "green supply chain, " "resilience," "sustainability," and “environmental performance” in French and English in recognized scientific databases such as Scopus, Science Direct, and Google Scholar. This allowed us to find as many articles as possible published between 2000 and 2024, a period that saw increased environmental pressures and the gradual emergence of green supply chain practices. We conducted our research in the various databases using the following equation: (supply chain management“ OR ”green supply chain“) AND (”climate change“ OR ”sustainability“ OR ‘resilience’) AND (”environmental performance")

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This method enabled us to collect and synthesize existing knowledge related to our issue and organize it around three themes:

- The implications and challenges of climate change for the supply chain
- The practices adopted by companies
- The impact on performance

Article selection criteria and process:

To refine the results of the literature review, we defined inclusion and exclusion criteria. We excluded strictly technical articles, non-academic documents, dissertations, and theses, and included only articles from scientific journals in the fields of management science and supply chain management.
The articles collected were critically reviewed. Titles, abstracts, and keywords were analyzed comprehensively to assess their relevance to the objective of our research. Subsequently, the selected articles underwent a four-step selection process to determine their final inclusion in the analysis.

- **Step 1**: Removal of duplicates
- **Step 2**: Reading titles and abstracts to determine their relevance to the review
- **Step 3**: Reading and analyzing the full text
- **Step 4**: Qualitative assessment

This process resulted in a final selection of 48 articles, constituting the main corpus of the review, which explored the implications and challenges of the supply chain in the era of climate change.
Analysis of this work identified the role of the green supply chain and the main practices adopted to mitigate the effects of supply chain activities on the ecosystem through the reduction of CO2 emissions, energy consumption, and climate disruption management.

Results and discussion

Analysis of existing research shows that there is a reciprocal relationship between climate change and supply chain activities. Studies show that companies have begun to adopt green practices in supply chain management in order to address the challenges of climate change, reduce environmental impacts, and improve global performance.

This analysis has yielded relevant findings on the green supply chain practices implemented to reduce the effects of the supply chain, as well as on the impact of these practices on company performance. The results presented below are based on an analysis of 48 articles selected using the selection process described in the methodology. The results have been summarized in two areas: the practices adopted by companies to respond to the challenges of climate change, and their impact on performance in the current context.

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Supply chain practices in the face of climate change

Supply chain management practices are all the activities carried out upstream and downstream in the logistics chain that enable effective supply chain management. Supply chain management practices include integration and coordination of supply and demand in order to respond to customers in a cost-effective and efficient manner. Among the practices most widely used by companies is supplier evaluation (Ibrahim & Hamid, 2014). According to Haddouch et al. (2020), there are four SCM practices: integration, which consists of cooperation with key downstream customers and coordination with upstream suppliers; partnership management with suppliers, which aims to limit the number of suppliers and involve them in product development; customer relationship management, which aims to manage customer complaints, improve customer satisfaction, listen to customer needs, and personalize offers; and the last practice is information sharing, which allows for a better understanding of customer requirements, adaptation to market developments, and better planning and coordination between the different parties.

According to Roy et al. (2006), good practices that can be implemented for supply chain management include creating a communication structure between all supply chain stakeholders and a performance evaluation system to eliminate non-value-added activities and synchronize replenishment activities with customer needs, integration, adoption of VMI and CPFR (Collaborative Planning, Forecasting and Replenishment), and reducing inventory. Supply chain management must focus on the strategic aspect; high-performing supply chains are those that focus on agility and adaptability (Ketchen Jr & Hult, 2007).

Agility refers to the ability to respond quickly to unexpected changes in supply and demand, and to identify internal and external uncertainties and respond to them through effective integration of relationships in the supply chain (Abrigach & Al Meriouh, 2019) It can be achieved by developing cultural competitiveness based on entrepreneurship, innovation, and learning (Ketchen Jr & Hult, 2007). Adaptability means the willingness to orient chains according to changing consumer needs. Adaptable supply chains rely on information systems, supplier change, and outsourcing. Adaptability sometimes requires setting up more than one supply chain for the same product to ensure distribution (Ketchen Jr & Hult, 2007).

According to Roy & Beaulieu (2013), best practices in supply chain management focus on four areas: network configuration, which involves choosing the location of distribution sites and defining the transport plan; the integration of information systems to streamline information sharing with the company's internal and external partners, collaboration, which consists of sharing responsibility for planning, executing, and evaluating an activity

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between two or more companies (Roy et al., 2006), and the optimization of activity processes in terms of time and costs. The main challenge for business leaders is to lower supply chain costs while minimizing the impact of their activities on climate change and complying with environmental constraints. The green supply chain is considered a better solution to these challenges. Srivastava (2007) defines green supply chain management as "the integration of environmental considerations into supply chain management, including product design, procurement and material selection, manufacturing processes, delivery of the final product to customers, and the end of life of the product after its decline." Green supply chain management encompasses all activities implemented by companies to reduce their impact on the environment (Rachid & Talmenssour, 2020).

The green supply chain requires close collaboration with suppliers, which is very useful for reducing costs, improving efficiency, and promoting innovation. The four main reasons that drive companies to implement green supply chains are: regulation, the search for a competitive advantage to stand out in the market, pressure from stakeholders, and innovation (Hmioui et al., 2022). According to Nikbakhsh (2009), green supply chain management offers numerous financial, operational, and environmental benefits. Waste elimination, resource conservation, and the adoption of green practices at various stages of the supply chain can strengthen companies' competitiveness and improve their environmental and operational performance.

The table below shows the benefits of implementing a green supply chain for businesses and the environment:

Table 2: Benefits of green supply chain management practices

Advantages of GSCM Practices	**Details**
Cost reduction	Costs of raw materials and energy, insurance costs
Risk reduction	Waste-related fees and pollution fines, shortages of water and/or energy
Productivity improvement	Use of natural light and ventilation
Increase in property value	Reduction in operating costs
Improvement of public image	Increased sales, better public perception, and community support
Creation of healthier environments	Fewer toxins and cleaner air, less hazardous production processes

Source: Nikbakhsh (2009)

Barriers to implementing a green supply chain can be either internal or external. Internal barriers are related to high costs, especially for SMEs with fewer resources and limited means, corporate culture, and resistance to change. External barriers include poor relationships with suppliers and regulations, which can be both a driver of development and a barrier to innovation in sustainability (Walker et al., 2008). As mentioned above, most researchers agree that the main objective of the green supply chain is to reduce waste and negative impacts on the ecosystem. Green supply chain management practices must be applied at all levels in order to tackle climate

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change. According to Pourhejazy & Kwon (2016), the different disciplines of green supply chain management are: eco-friendly product design, which takes social and ecological aspects into account from the design stage onwards; raw material processing, which involves a set of activities aimed at making the factory safer, reducing costs, minimizing environmental and health risks, and improving product quality. The second discipline of the green supply chain is responsible sourcing, which involves purchasing with less impact on the environment. It puts pressure on suppliers to provide environmentally friendly services and products that can be recycled, with optimal packaging and fewer toxic substances. Green marketing is a sales process that influences purchasing decisions. It presents the product to the customer as environmentally friendly, with an eco-friendly production process and environmentally friendly packaging. The last discipline of green logistics is considered the most important in the supply chain, as it is logistics activities that have a negative impact on climate change.

Transportation is the most environmentally damaging link in the chain and contributes significantly to climate change. It is the most important element for the sustainability of the supply chain (Rachid & Talmenssour, 2020). In order to reduce the impact of this link in the supply chain on climate change, Kammas (2016) proposes to consolidate loads and eliminate empty return trips, and to use less polluting modes of transport (rail, river, and electric vehicles). Several green supply chain management practices are cited in the literature review. They have been adopted by global leaders (Apple, Dell, IBM, DHL Express), leading to positive results and a beneficial impact on climate change. These practices can also be deployed by Moroccan companies. Blanchard (2021) identified best practices in green supply chain management that can be applied to three activities: transportation, warehousing, and distribution. We have summarized these practices cited by Blanchard (2021) in the table below:

Table 3: Best practices in green supply chain management

Activity	Best Practices
Warehousing and Distribution	- Integrate energy-saving strategies in the warehouse to reduce dependence on GHG-emitting sources. - Set energy-reduction targets and conduct annual audits to ensure progress. - Use low-voltage lighting and install motion sensors or timers on lighting systems. - Integrate real-time visibility of warehouse inventory to reduce unnecessary movement and stock obsolescence. - Leverage technology to streamline and improve the accuracy of inventory levels. - Create a closed-loop system for reporting and reconciling inventory levels with front-office systems.

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Distribution	- Establish regional distribution centers to serve customers based on demand. - Optimize distribution networks by requiring fewer trips and reducing overall delivery costs. - Optimize and consolidate routes to reduce the number of shipments
Transportation	- Align inbound and outbound shipments to reduce carbon emissions by using less fuel. - Connect with customers in real time to synchronize returns with maximum fleet utilization. - Coordinate supplier shipments to consolidate freight costs and negotiate better rates. Automate transportation management systems. - Synchronize with warehouse operations to increase efficiency. - Monitor routes, fuel consumption, and idling time. - Improve driver training with courses that enhance driving skills and teach simple techniques to reduce fuel consumption.

Source: Blanchard (2021)

These green supply chain practices reduce carbon footprints, optimize energy consumption, and make the supply chain more resilient to weather disruptions. The adoption of technological tools such as blockchain, artificial intelligence, and the IoT offers the possibility of risk prevention, transport optimization, and traceability (Dubey et al., 2025).

Impact on performance

The global performance of a company is not only concerned with financial performance, but also with environmental and social performance. According to Hmioui et al. (2022), global performance includes social performance, which manifests itself in equal treatment, respect for human rights, a good working environment, economic performance, and environmental performance. Global performance focuses on stakeholder satisfaction while achieving the three main economic, social, and environmental goals. The performance that can be achieved through the green supply chain can therefore be classified into three categories: economic, environmental, and competitiveness (Huang et al., 2017). Green supply chain practices contribute to environmental performance by minimizing GHG emissions and waste (Tseng et al., 2019).

Several factors can be used to assess the impact of green supply chain practices on economic performance, including cost savings, new markets acquired, and profitability. The integration of green supply chain practices in the textile sector can lead to up to 20% in revenue gains (Roy et al., 2006). The results of a 2020 survey of 141 service companies on the impact of green supply chain management on global performance show that the global performance desired by Moroccan companies focuses on improving financial profitability and social and organizational performance. The survey shows that

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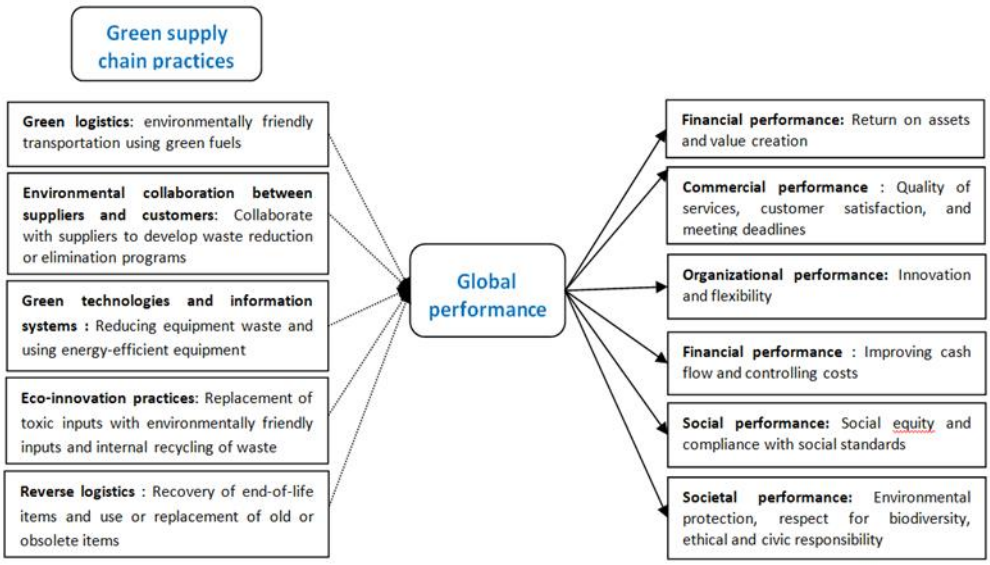
there is a strong correlation between the two variables of green supply chain management and global performance (Hmioui et al., 2022). Responsible sourcing, reverse logistics, and eco-design have a direct impact on environmental performance, while responsible sourcing also impacts economic performance. All other green supply chain practices have a positive influence on social performance.

The Japanese IT and electronics multinational Fujitsu Ltd has adopted a number of green supply chain management practices, including streamlining its distribution sites, optimizing transport distances, reducing the number of trucks, and modal shift, which have resulted in improved environmental performance in terms of lower transport-related emissions. For the American company Apple, green supply chain practices have resulted in energy savings of 30% in its data centers, facilities, and retail stores, and it was also able to reduce its CO2 emissions by 59% in 2013 compared to 2012 (Pourhejazy & Kwon, 2016).

Existing research shows that GSCM practices impact various aspects of performance, including economic, environmental, social, and societal performance. In order to structure these results, the figure below presents the main ecological practices cited in the literature as well as the various aspects of global performance.

Figure 4: Impact of GSCM on global performance



Source: Authors

We can therefore consider that there is an interrelationship between supply chain management practices, overall company performance, and climate change. All research conducted to date shows that adopting the supply chain contributes significantly to protecting the environment and limiting the

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impact of climate change. Supply chain performance can be measured using an effective evaluation system characterized by inclusiveness, measurability, and consistency. It must cover the entire supply chain and be universal. The measures must be compatible with the objectives of the supply chain (Agami et al., 2012). There are several measures of supply chain performance, such as on-time delivery, supplier certification, customer satisfaction rates, inventory levels, etc. (Taidi, 2020).

Performance measurement is necessary for the success of the green supply chain. Performance evaluation systems aid decision-making, the identification of areas for improvement, and the implementation of corrective actions (Agami et al., 2012). The evaluation of green supply chain performance is based on specific indicators and methods that take into account strategic environmental, economic, and social objectives. There are three approaches to measuring supply chain performance: the process-centered approach (ABC), the perspective-centered approach (Balanced ScoreCard and Supply Chain Operation), and the hierarchical-level approach (Elgharbaoui, 2020). Effendi et al. (2019) propose the SCOR method for evaluating green supply chain performance. The SCOR model is considered the most credible. It is based on reliability, responsiveness, agility, logistics costs, and asset management, and helps to identify the appropriate performance indicators for the company and analyze supply chain performance by focusing on four elements: processes, performance, best practices, and staff competence (Elgharbaoui, 2020). The table below presents the main KPIs for monitoring the performance of the green supply chain selected using the SCOR method:

Table 4: Green supply chain KPIs

Activity	Objective	KPI
Green Purchasing	Minimize hazardous materials	- Percentage of hazardous materials in inventory
Green Manufacturing	Minimize the use of resources, energy, fuel, and wasteImprove customer satisfaction	- Energy consumption - Water consumption - CO_2 emissions - Hazardous waste rate
Green Distribution	Enhance customer satisfaction and optimize packaging and storage	- Percentage of customer complaints - Percentage of damaged products in the warehouse
Reverse Logistics	Maximize reuse and recycling	- Percentage of materials that can be recycled/reused - Reusable waste rate

Source: (Effendi et al., 2019)

The adoption of green supply chain practices is therefore not limited to environmental issues, but also contributes to the global performance of the company.

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Conclusion

The aim of this study was to analyze supply chain practices that can address the challenges of climate change. Through a narrative review of the literature, we highlighted the extent to which the ecosystem is suffering from the repercussions of human and industrial activities. Analysis of existing work shows that adapting supply chain management processes in this era of climate change is necessary in order to strengthen resilience, reduce CO_2 emissions, and move towards more sustainable logistics chains.

The results of the literature review analysis identified several green supply chain practices, such as responsible sourcing, massification of flows, eco-design, and digitalization. The review of studies shows that these practices are effective levers for reducing environmental impact, anticipating climate risks that may influence supply chain activities, and improving global performance. The best-performing companies are those that adopt best practices to manage their supply chains. Furthermore, the majority of researchers agree that these practices have a positive impact on environmental performance by reducing negative effects on the ecosystem, but also on the global performance of companies by lowering costs and gaining more competitive advantages.

This review also highlights that environmental and economic benefits are systematically linked to companies' ability to integrate these practices into an overall sustainability strategy.

However, this study has certain limitations. Being based on a narrative review, it does not provide exhaustive coverage of all existing publications, nor does it assess the methodological quality of each study included. On a theoretical level, this study helps to identify the main green supply chain practices and their link to climate challenges. On a managerial level, it offers companies a set of practices that enable them to strengthen their resilience, reduce their carbon footprint, and improve their performance.

In terms of research prospects, it would be relevant to develop a conceptual model integrating the identified practices and their effects on performance. In addition, conducting an empirical study would provide further insight into how companies perceive and adopt these practices in the face of ecosystem challenges.

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Assessment of the Impact of GDP, Employment, and Unemployment on the Human Development Index (HDI) for Western Balkan Countries (2006-2023)

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Abstract

This study analyzes and presents the concrete relationships that emerge from the reciprocal linkages between the Human Development Index (HDI) and GDP per capita (constant 2015 US$), Unemployment, total (% of total labor force) (modeled ILO estimate), and the Employment-to-population ratio, 15+, total (%) (modeled ILO estimate), for Western Balkan countries during the period 2006-2023. The study also examines the correlation between the ranking positions of GDP and HDI for each Western Balkan country. Based on regression analyses, the results indicate that the upward trend of GDP per capita (constant 2015 US$) is significant for the upward tendencies of HDI, but is not a sufficient condition on its own to explain HDI growth patterns. Moreover, deviations-although not substantial-from annual ranking positions display a highly significant correlation. The weight of GDP's impact on HDI, despite varying among the Western Balkan countries, ranges between 71.38% (Albania) and 88.02% (Bosnia and Herzegovina), while the rank correlation coefficients between these two variables range from 0.875 to 0.980. Additionally, it can be stated that the (positive) impact weight of the Employment-to-population ratio, 15+, total (%) (modeled ILO estimate), on HDI also differs noticeably across Western Balkan countries, ranging from 27.67% to 72.11%. Meanwhile, the negative impact of unemployment on HDI likewise shows evident variation among countries. Separate analyses were

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conducted for each Western Balkan country included in the study, as well as a comprehensive comparative analysis.

Keywords: Human Development Index (HDI), Gross Domestic Product (GDP), Employment, Unemployment

Introduction

Evaluating the trajectory of a country's economic and social development is conceptually linked to indicators of economic growth and indicators that assess human well-being.

From a macroeconomic perspective, comparative assessments (typically presented annually) rely on indicators that reflect the internal dynamics of a country's development, while also enabling cross-country comparisons. GDP (Gross Domestic Product) is one of the most fundamental indicators used in macroeconomics to measure the magnitude of economic capacity capturing the total value of goods and services produced within a country during a given year (Bryniuk, 2023).

One representation of GDP is GDP per capita, which indicates the average amount of production or income attributed to each individual. GDP per capita is also used to compare average income levels across countries. The aim of assessing developmental progress is not merely to depict economic output or national income indicators, but also to evaluate improvements in overall human well-being. GDP may signal economic growth, but not necessarily quality of life. By its nature, GDP cannot measure human well-being (Stiglitz et al., 2009). Components related to individuals' ability to live long and healthy lives, access to education, and secure adequate living standards are not reflected in GDP. This limitation extends to its inability to capture income inequality. A country may demonstrate high GDP while still having segments of the population living in poverty, which may also be influenced by environmental factors. The extent of the informal economy likewise varies across countries (Stiglitz et al., 2009; Sen, 1999).

These limitations of GDP led the United Nations Development Programme (UNDP) in 1990 to introduce the foundational concepts of the Human Development Index (HDI) (United Nations Development Programme**,** 1990), inspired by the ideas presented in (Sen, 1999). HDI defines thresholds for low and high levels of human development. Countries are classified as having low human development when the HDI value is less than 0.550; medium human development when the index ranges from 0.550 to 0.699; high human development when the HDI is between 0.700 and 0.799; and very high human development when the index ranges from 0.800 to 1(United Nations Development Programme, 2025).

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According to UNDP methodology, the Human Development Index (HDI) is structured across three core dimensions:

1. Health, which reflects access to healthcare services and overall living conditions;
2. Education, which evaluates both mean years of schooling and expected years of schooling;
3. Standard of living, measured by GDP per capita adjusted for purchasing power parity (PPP).

The HDI offers a clearer and more comprehensive representation of the qualitative dimensions of social development, providing a balanced framework for assessing human well-being. As such, it serves as an essential tool for policymakers in shaping strategies aimed at enhancing educational outcomes, strengthening healthcare systems, and promoting social equity. These three dimensions collectively constitute a pivotal foundation for addressing global development challenges, including increased employment opportunities, poverty reduction, lower unemployment levels, and the capacity to adapt to advances in innovative technologies that support efficient resource utilization and improved living standards.

The contemporary literature documents a consistent relationship between human development and economic growth. Shome & Tondon, (2010) investigate the equilibrium between human development and economic expansion for selected ASEAN countries during 2000-2009. Pham et al. (2016) assess the impact of HDI on economic growth for the period 1999-2014 across 30 countries-13 of which were classified as developed and 17 as underdeveloped countries. In the study, the authors, in addition to the GDP variable, also evaluated three variables—the percentage of workers, physical capital (investment), and the Human Development Index (HDI)—and concluded that, alongside the mutual effects of each variable on GDP, HDI exerted a substantial influence on economic growth and stability. Furthermore, they emphasize the importance of capital investment, which should also be directed toward the human factor, given that the Human Development Index (HDI) represents one of the key indicators influencing economic growth and promoting economic stability.

Elistia & Syahzuni (2018) examine the correlation between HDI and economic growth during 2010-2016 for 10 countries. In the study, the authors conclude that there is a significant and reciprocal relationship between the two variables, GDP and the Human Development Index (HDI).

Taqi et al. (2021) conduct a long-term analysis of the HDI–economic growth relationship for the period 1980-2018, identifying a strong and statistically significant correlation. The authors examine and assess the causal relationships and reciprocal effects observed between GDP and the Human

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Development Index (HDI), where HDI is evaluated as a significant factor in the trajectory of economic development. Furthermore, Singh et al. (2025) investigate the determinants of the Human Development Index using regression analysis, concluding that GDP per capita exerts a positive influence on HDI while recognizing that social determinants such as healthcare and education remain critical factors in improving human development outcomes. Jednak et al., (2018) provide a comparative evaluation of development patterns in Southeast European countries by scrutinizing the relationship between HDI and economic growth indicators. The authors of the study emphasize the highly significant effects of the Human Development Index (HDI) on the economic empowerment and stability of each country included in the study.

In addition to studies on the relationship between the impact of GDP per capita to HDI, empirical research also examines the effects of additional socioeconomic determinants including unemployment and poverty on HDI levels (Priambodo, 2021; Damayanti & Asmara, 2025; Arianto & Cahyono, 2025, Dhanyalakshmi & Sandhya, 2025; *Giyasova et al., 2025*). In contemporary literature, there are numerous articles and scientific publications that study the reciprocal effects of the Human Development Index (HDI) on economic factors.

The present study provides an analytical assessment of Western Balkan countries, evaluating the relationships and impact magnitudes between HDI and GDP per capita, as well as estimating the relative weight (in percentage terms) of GDP's contribution to HDI formation. The analysis further investigates the rank correlation between these two variables to detect long-term tendencies, interdependencies, and deviations in their annual trajectories. The study covers the period 2006-2023. In addition, the influence of employment and unemployment on HDI performance across the Western Balkans is examined.

When viewed through the lens of economic development, Western Balkan countries continue to lag behind the economic performance of European Union member countries. In the 2023 HDI ranking, Western Balkan countries occupy positions ranging from 48th to 74th, while in terms of GNI per capita, they rank between 62nd and 87th out of 193 countries. By contrast, all EU member states hold substantially higher rankings. Investment levels in education and healthcare in Western Balkan countries also remain considerably lower than EU averages. This disparity underscores the pressing need for more comprehensive and structured reforms aimed at advancing both economic and social development across the region.

The fundamental objective of this study is to conduct a comprehensive and detailed research analysis in order to examine the interrelationships and mutual effects among selected economic development variables conditioned

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by the human factor (including GDP per capita; the Human Development Index (HDI); the percentage of workers; employment; and unemployment). Furthermore, the study seeks to present the empirical findings alongside appropriate recommendations that may be derived from the results. In line with the fulfillment of this objective, the following hypotheses are proposed.

- H1: A statistically significant and positive correlation exists between HDI and GDP per capita in the Western Balkan countries included in the study.
- H2: A positive correlation exists between HDI and employment levels in the Western Balkan countries.
- H3: A negative correlation exists between HDI and unemployment, accompanied by notable cross-country variation within the Western Balkans.
- H4: A strong rank correlation exists between annual GDP per capita rankings and annual HDI rankings for the period 2006-2023.

Methodology and Empirical Results

The methodological framework of the study consists of the following stages:

- Step 1: Identification of the variables under examination, the study period, and the selected Western Balkan countries. Corresponding data tables for each variable are presented.
- Step 2: Formulation of the research hypotheses derived from the proposed analytical model.
- Step 3: Specification of the empirical models, determination of the conditions required for their application, and selection of the statistical tests to be employed.
- Step 4: Practical implementation of the models and analytical evaluation of the empirical results, including hypothesis testing for each estimated model across all Western Balkan countries.

Finally, the study presents the concluding findings and implications.

The empirical analysis employs two main methodological approaches: linear regression and rank correlation analysis are applied separately to each Western Balkan country. The independent variables (X) included in the regression models are:

1. GDP per capita (constant 2015 US$)
2. Employment to population ratio, 15+, total (%) (modeled ILO estimate)
3. Unemployment, total (% of total labor force) (modeled ILO estimate) *(Data source: World Development Indicators, last updated 7 October 2025.)*

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The dependent variable (Y) of the study is the: Human Development Index (HDI) *(Data source: https://hdr.undp.org/data-center/human-development-index#/indicies/HDI, extracted on 25 October 2025.)*

Data were collected for each Western Balkan country for the period 2006-2023. The application of linear regression requires compliance with the assumptions of the Gauss-Markov Theorem, including: linearity of the relationship between variables, independence of errors, normality of residuals, homoscedasticity of residuals, and absence of multicollinearity.

To assess the normality of the residuals, the Shapiro-Wilk test and the Jarque-Bera test are applied. Homoscedasticity is examined using the Breusch-Pagan test, while autocorrelation is evaluated through the Durbin-Watson test. Each regression model is estimated for a pair of variables (X, Y). For each model examined in the study, the number of observations (18 observations) relative to the number of independent variables satisfies Evans' Rule, which suggests that $n/k \geq 10$ (where n is the number of observations and k is the number of independent variables), requiring at least ten observations per predictor.

For each regression model applied to the respective Western Balkan countries, the correlation between the independent variable and the dependent variable was examined to determine the existence of a relationship between them, using Pearson's correlation coefficient and the Student's t-test to assess the significance of the Pearson coefficient.

For the assessment of rank correlation, examined separately based on the rankings of GDP and HDI over the period 2006-2023, the Spearman rank correlation coefficient was used.

Numerical Application

Table 1 presents the statistical indicators of the variables included in the study for each Western Balkan country over the period 2006–2023.

Table 1: Statistical summary of variables

Variable	Statistical indicators	Country				
		Albania	Bosnia and Herzegovina	North Macedonia	Montenegro	Serbia
HDI	Min.	0.732	0.701	0.726	0.785	0.753
	Max.	0.810	0.804	0.815	0.862	0.833
	Average	0.784	0.758	0.781	0.830	0.795
	Median	0.797	0.767	0.792	0.836	0.799
	Std Dev	0.023	0.032	0.027	0.021	0.022
GDP per capita (constant 2015 US$)	Min.	2894.36	3418.76	3866.75	5435.89	5016.41
	Max.	5444.93	6493.22	6393.77	8304.26	8210.55
	Average	4045.85	4761.34	5168.92	6604.90	6236.86
	Median	3932.68	4536.82	5158.22	6389.33	5768.43
	Std Dev	694.04	937.38	756.06	790.01	881.16
	Min.	43.78	35.51	33.87	36.19	38.12

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Employment to population ratio, 15+, total (%)	Max.	54.32	44.16	45.66	46.30	52.77
	Average	49.13	38.87	39.72	41.09	44.80
	Median	44.865	36.47	39.48	42.75	41.93
	Std Dev	3.411	2.542	3.605	2.626	4.603
Unemployment, total (% of total labor force)	Min.	10.11	10.67	13.17	14.62	8.27
	Max.	18.06	31.11	36.39	24.79	24.00
	Average	13.70	22.63	25.73	17.94	15.63
	Median	17.62	27.61	27.31	17.80	18.44
	Std Dev	2.300	6.370	7.731	2.486	5.186

Table 2 presents the average values of the variables by sub-periods for the Western Balkan countries included in the study.

Table 2: Average values of variables over the given period

Countries	a, b, c, d	2006-2010	2011-2015	2016-2020	2021-2023
Albania	a	0.750	0.792	0.799	0.803
	b	3277.06	3810.83	4376.27	5168.18
	c	46.69	47.01	51.01	53.58
	d	14.48	15.59	12.90	10.57
Bosnia and Herzegovina	a	0.715	0.753	0.782	0.795
	b	3773.40	4322.17	5282.12	6271.91
	c	37.58	36.69	40.00	42.78
	d	26.98	27.66	19.18	12.74
North Macedonia	a	0.747	0.782	0.802	0.802
	b	4277.50	4919.86	5668.89	6236.44
	c	35.55	38.50	42.06	44.80
	d	34.21	29.25	20.47	14.48
Montenegro	a	0.802	0.830	0.843	0.852
	b	5851.13	6224.30	7015.42	7811.35
	c	38.56	40.72	44.13	40.84
	d	20.02	18.95	16.40	15.34
Serbia	a	0.768	0.792	0.811	0.822
	b	5490.47	5761.30	6494.20	7844.54
	c	42.91	40.02	47.07	52.14
	d	17.58	21.20	12.17	8.85

a-HDI; b- GDP per capita (constant 2015 US$); c-Employment to population ratio, 15+, total (%) (modeled ILO estimate); d-Unemployment, total (% of total labor force) (modeled ILO estimate)

Table 3 presents the frequency distribution of HDI values across the specified intervals.

Table 3: Frequency distribution of HDI values in given intervals

Countries Intervals	Albania	Bosnia and Herzegovina	North Macedonia	Montenegro	Serbia
[0.700-0.725]	-	5-years	-	-	-
[0.726-0.750]	3 -years	2-years	2-years	-	-
[0.751-0.775]	2-years	3-years	5-years	-	5-years

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[0.776-0.800]	9-years	7-years	6-years	2-years	4-years
[0.801-0.825]	4-years	1-year	5-years	5-years	7-years
[0.826-0.850]	-	-	-	8-years	2-years
[0.851-0.875]	-	-	-	3-years	-
[0.875-0.900]	-	-	-	-	-

The results obtained for each Western Balkan country, applying the model with GDP per capita (constant 2015 US$) as the independent variable and HDI as the dependent variable, are presented in the following tables for each country.

Table 4(1): Summary of regression model Statistics, **Albania**

R	R Square	Adjusted R square	Std. Error	F	df1	df2	Sig. F	regression equation
0.8449	0.7138	0.6959	0.0131	39.9009	1	16	1.02E-05	$\hat{Y}$ = 0.6668+3E-0.5 x GDP

Regression coefficients

Variable	Coefficient	Std. Error	t-statistic	p-value	95% Confidence Interval	
Intercept	0.6668	0.0188	35.4591	1.23E-16	[0.626917245	0.706643606]
GDP	2.896E-05	4.58451E-06	6.3167	1.02E-05	[1.92403E-05	3.86778E-05]

The Pearson correlation coefficient, $\rho = 0.8449$, indicates a very strong positive relationship between HDI and GDP per capita. The significance test of the correlation coefficient (Student's *t*-test) shows that $t = 6.3178 > t_{0.025,16} = 2.120$. . From Table 4(1), R^2 indicates that 71.38% of the variance in the dependent variable Y is explained by GDP. This suggests that the model fits the data well. The F-value, $F = 39.9009 > F_{0.05,1,16} = 4.49$, and Sig.F= 1.02E-05 < 0.01 indicate that the model is statistically significant; in other words, GDP has a substantial effect on the dependent variable Y. The regression equation is: HDI= 0.6668 + 2.896E-05 x GDP. The validity of the model was verified using the following tests:

Residual Normality Tests:
Shapiro-Wilk $p > 0.05$, indicating that the residuals are normally distributed.
Jarque-Bera $p > 0.05$ indicating no deviations from normality.
These results confirm that the normality assumption is satisfied.

Homoscedasticity Test (Breuch-Pagam): p-value > 0.05, indicating no evidence of heteroskedasticity; thus, the variance of the residuals remains constant.

In conclusion, the model can be considered statistically robust and valid for economic interpretation, where an increase in GDP per capita is associated with a significant and consistent rise in HDI.

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Table 4(2): Summary of regression model Statistics, **Bosnia and Herzegovina**

R	R Square	Adjusted R square	Std. Error	F	df1	df2	Sig. F	regression equation
0.9382	0.8802	0.8727	0.0117	117.5356	1	16	8.8E-09	$\hat{Y}$ = 0.6017+ 3E-05 x GDP

Regression coefficients

Variable	Coefficient	Std. Error	t-statistic	p-value	95% Confidence Interval	
Intercept	0.6017	0.0146	41.0952	1.18E-17	[0.570663938	0.632741884582004]
GDP	0.000033	0.0000030	10.8414	8.82E-09	[2.63E-05	3.91E-05]

The Pearson correlation coefficient, $\rho = 0.9382$, indicates a very strong positive relationship, and the significance test of the correlation coefficient (Student's *t*-test) shows that t = 10.842 $> t_{0.025,16} = 2.120$. From Table 4(2), R^2 indicates that 88.02% of the variance in the dependent variable Y is explained by GDP. This suggests that the model fits the data well. The F-value, F = 117.5356 $> F_{0.05,1,16} = 4.49$, and Sig.F= 8.8E-09 < 0.01 indicate that the model is statistically significant; in other words, GDP has a substantial effect on the dependent variable Y. The regression equation is: HDI = 0.6017 + 3E-05 x GDP.

All assumptions of the linear model (normality, homoscedasticity, linearity) are fully satisfied.

Therefore, the model can be considered statistically robust.

Table 4(3): Summary of regression model Statistics, **North Macedonia**

R	R Square	Adjusted R square	Std. Error	F	df1	df2	Sig. F	regression equation
0.8851	0.7835	0.7700	0.0128	57.8984	1	16	1.05E-06	$\hat{Y}$ = 0.6191+3E-05 x GDP

Regression coefficients

Variable	Coefficient	Std. Error	t-statistic	p-value	95% Confidence Interval	
Intercept	0.6191	0.0215	28.7860	3.28E-15	[0.573500707	0.664685175]
GDP	0.0000313	4.119E-06	7.6091	1.05E-06	[2.2612E-05	4.01E-05]

The Pearson correlation coefficient, $\rho = 0.8851$, and the significance test of the correlation coefficient (Student's *t*-test) show that t = 7.609 $> t_{0.025,16} = 2.120$. From Table 4(3), R^2 indicates that 78.35% of the variance in the dependent variable Y is explained by GDP, suggesting a good fit of the model to the data. The F-value, F = 57.8984 $> F_{0.05,1,16} = 4.49$ and Sig.F = 1.05E-06 < 0.01, indicate that the model is statistically significant. The regression equation is: HDI = 0.6191 + 3E-05 x GDP.

All assumptions of the linear model (normality, homoscedasticity, linearity) are fully satisfied.

Therefore, the model is considered statistically robust.

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Table 4(4): Summary of regression model Statistics, **Montenegro**

R	R Square	Adjusted R square	Std. Error	F	df1	df2	Sig. F	regression equation
0.8837	0.7808	0.7671	0.0100	57.0080	1	16	1.16E-06	$\hat{Y}$ = 0.676 +2E-05 x GDP

Regression coefficients

Variable	Coefficient	Std. Error	t-statistic	p-value	95% Confidence Interval	
Intercept	0.675962	0.020472	33.0188	3.79E-16	[0.632563477	0.719361144]
GDP	2.32E-05	3.08E-06	7.55036	1.16E-06	[1.67193E-05	2.97728E-05]

The Pearson correlation coefficient, ρ = 0.8837, and the significance test of the correlation coefficient (Student's *t*-test) indicate that t = 7.550 > $t_{0.025,16}$ = 2.120. From Table 4(4), R^2 shows that 78.08% of the variance in the dependent variable Y is explained by GDP, indicating a good fit of the model to the data. The F-value, F = 57.0080 > $F_{0.05,1,16}$ = 4.49 and Sig.F = 1.16E-06 < 0.01, demonstrate that the model is statistically significant. The regression equation is: HDI = 0.676 + 2E-05 x GDP.

All assumptions of the linear model (normality, homoscedasticity, linearity) are fully satisfied. Therefore, the model is considered statistically robust.

Table 4(5): Summary of regression model Statistics, **Serbia**

R	R Square	Adjusted R square	Std. Error	F	df1	df2	Sig. F	regression equation
0.8687	0.7547	0.7393	0.0112	49.2138	1	16	2.92E-06	$\hat{Y}$ = 0.6601 + 2E-05 x GDP

Regression coefficients

Variable	Coefficient	Std. Error	t-statistic	p-value	95% Confidence Interval	
Intercept	0.660146	0.0194591	33.9248	2.46E-16	[0.618895386	0.701398415]
GDP	2.1684E-05	3.09102E-06	7.0153	2.92E-06	[1.51316E-05	2.8237E-05]

The Pearson correlation coefficient, ρ = 0.8687, and the significance test of the correlation coefficient (Student's *t*-test) indicate that t = 7.016 > $t_{0.025,16}$ = 2.120. From Table 4(5), R^2 shows that 75.47% of the variance in the dependent variable Y is explained by GDP, indicating a good fit of the model to the data. The F-value, F = 49.2138 > $F_{0.05,1,16}$ = 4.49 and Sig.F = 2.92E-06 < 0.01 demonstrate that the model is statistically significant. The regression equation is: HDI = 0.6601 + 2E-05 x GDP.

All assumptions of the linear model (normality, homoscedasticity, linearity) are fully satisfied. Therefore, the model is considered statistically robust. Ultimately, for all five Western Balkan countries, the first hypothesis is confirmed: there is a significant positive correlation between HDI and GDP per capita for the countries included in the study.

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Table 5 presents the rankings of GDP and HDI throughout the period 2006-2023 for all countries included in the study. For each Western Balkan country, the Spearman rank correlation coefficient was calculated.

Table 5: Rankings of GDP and HDI by year for each Western Balkan Country

Year	Country									
	Albania		Bosnia and Herzegovina		North Macedonia		Montenegro		Serbia	
	GDP Ranking	HDI Ranking	GDP Ranking	HDI Ranking	GDP Ranking	HDI Ranking	GDP Ranking	HDI Ranking	GDP Ranking	HDI Ranking
2006	18	18	18	18	18	18	18	18	18	18
2007	17	17	17	17	17	17	17	17	17	17
2008	16	16	16	16	16	16	11	16	13	16
2009	15	15	15	15	15	15	16	15	16	15
2010	14	14	14	14	14	14	15	14	15	14
2011	13	13	13	13	12	13	13	13	12	13
2012	12	12	12	12	13	12	14	12	11	12
2013	11	11	11	11	11	10	12	11	10	11
2014	10	7	10	10	10	9	10	10	14	10
2015	9	7	9	9	9	7	8	8	9	9
2016	8	7	8	8	8	6	7	9	8	8
2017	7	5	7	7	7	4	6	5	7	6
2018	5	4	6	4	6	2	4	4	6	4
2019	4	3	4	3	4	5	3	3	4	3
2020	6	9.5	5	5.5	5	8	9	6	5	5
2021	3	9.5	3	5.5	3	11	5	7	3	7
2022	2	2	2	2	2	3	2	2	2	2
2023	1	1	1	1	1	1	1	1	1	1
Spearman's rho	ρ_{sp} = 0.913		ρ_{sp} = 0.980		ρ_{sp} = 0.875		ρ_{sp} = 0.948		ρ_{sp} = 0.947	

From the table of critical values for Spearman's rank correlation coefficient (ρ) at α = 0.05 (two-tailed), for n = 18 observations, we have $|\rho_{sp}| > \rho_{critical} = 0.467$, indicating that the correlation is statistically significant. This conclusion holds for each country included in the study. The results in Table 5 show that Hypothesis H4 is satisfied: there is a strong rank correlation between the annual rankings of GDP per capita and the annual rankings of HDI for the period 2006-2023.

The tables below present a summary of regression model statistics for the relationships between employment, unemployment, and HDI. Model 1 shows the relationship between employment and HDI, while Model 2 presents the relationship between unemployment and HDI for the countries included in the study.

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Table 6(1): Summary of regression model Statistics of (HDI, Employment-Model 1) and (HDI, unemployment-Model 2); **Albania**

Model	R	R Square	Adjusted R square	Std. Error	F	df1	df2	Sig. F	regression equation
1	0.52599	0.27666	0.23146	0.02086	6.11973	1	16	0.02495	$\hat{Y}$ = 0.6037 + 0.0037 x X_1
2	0.3456	0.1194	0.0644	0.0230	2.1696	1	16	0.1602	$\hat{Y}$ = 0.8329 - 0.0036 x X_2

Regression coefficients

Model	Variable	Coefficient	Std. Error	t-statistic	p-value	95% Confidence Interval	
1	Intercept	0.6037	0.0730	8.2694	3.6E-07	[0.448970598	0.758515986]
	X_1	0.0037	0.0015	2.4738	0.0250	[0.000524748	0.006811287]
2	Intercept	0.8329	0.0337	24.7253	3.56E-14	[0.761503555	0.904328955]
	X_2	-0.0036	0.0024	-1.4730	0.1602	[-0.008719326	0.00157004]

X_1 −Employment to population ratio, 15+, total (%); X_2 - Unemployment, total (% of total labor force)

Table 6(2): Summary of regression model Statistics of (HDI, Employment-Model 1) and (HDI, unemployment-Model 2); **Bosnia and Herzegovina**

Model	R	R Square	Adjusted R square	Std. Error	F	df1	df2	Sig. F	regression equation
1	0.7080	0.5013	0.4701	0.0238	16.0831	1	16	0.0010	$\hat{Y}$ = 0.4034 + 0.0091 x X_1
2	0.7934	0.6296	0.6064	0.0205	27.1914	1	16	8.5E-05	$\hat{Y}$ = 08498 – 0.0041 x X_2

Regression coefficients

Model	Variable	Coefficient	Std. Error	t-statistic	p-value	95% Confidence Interval	
1	Intercept	0.4034	0.0885	4.5582	0.0003	[0.21579	0.591017532]
	X_1	0.0091	0.0023	4.0104	0.0010	[0.004295156	0.013928034]
2	Intercept	0.8498	0.0183	46.3528	1.76E-18	[0.810959192	0.888691239]
	X_2	-0.0041	0.0008	-5.2145	8.51E-05	[-0.005732147	-0.002418575]

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Table 6(3): Summary of regression model Statistics of (HDI, Employment-Model 1) and (HDI, unemployment-Model 2); **North Macedonia**

Model	R	R Square	Adjusted R square	Std. Error	F	df1	df2	Sig. F	regression equation
1	0.8492	0.7211	0.7036	0.0146	41.3625	1	16	8.3E-06	$\hat{Y}$ = 0.5307 + 0.0063 x X_1
2	0.8106	0.6571	0.6356	0.0162	30.6567	1	16	4.5E-05	$\hat{Y}$ = 0.8533 - 0.0028 x X_2

Regression coefficients

Model	Variable	Coefficient	Std. Error	t-statistic	p-value	95% Confidence Interval	
1	Intercept	0.5307	0.0391	13.5739	3.38E-10	[0.447781525	0.613532034]
	X_1	0.0063	0.0010	6.4314	8.30E-06	[0.004227218	0.008384182]
2	Intercept	0.8533	0.0136	62.7963	1.40E-20	[0.824527182	0.882141693]
	X_2	-0.0028	0.0005	-5.5368	4.51E-05	[-0.003882175	-0.00173248]

Table 6(4): Summary of regression model Statistics of (HDI, Employment-Model 1) and (HDI, unemployment-Model 2); **Montenegro**

Model	R	R Square	Adjusted R square	Std. Error	F	df1	df2	Sig. F	regression equation
1	0.7389	0.5460	0.5177	0.0144	19.2443	1	16	0.0005	$\hat{Y}$ = 0.5893 + 0.0058 x X_1
2	0.8398	0.7052	0.6868	0.0116	38.2747	1	16	1.3E-05	$\hat{Y}$ = 0.9554 – 0.007 x X_2

Regression coefficients

Model	Variable	Coefficient	Std. Error	t-statistic	p-value	95% Confidence Interval	
1	Intercept	0.5893	0.0549	10.7389	1.01E-08	[0.472931556	0.705574381]
	X_1	0.0058	0.0013	4.3868	0.0005	[0.003021488	0.008672542]
2	Intercept	0.9554	0.0205	46.5209	1.66E-18	[0.91188359	0.998958567]
	X_2	-0.0070	0.0011	-6.1867	1.30E-05	[-0.009425737	-0.004614678]

Table 6(5): Summary of regression model Statistics of (HDI, Employment-Model 1) and (HDI, unemployment-Model 2); **Serbia**

Model	R	R Square	Adjusted R square	Std. Error	F	df1	df2	Sig. F	regression equation
1	0.6931	0.4803	0.4479	0.0163	14.7890	1	16	0.0014	$\hat{Y}$ = 0.647 + 0.0033 x X_1
2	0.7011	0.4916	0.4598	0.0162	15.4689	1	16	0.0012	$\hat{Y}$ = 0.8419 – 0.003 x X_2

Regression coefficients

Model	Variable	Coefficient	Std. Error	t-statistic	p-value	95% Confidence Interval	
1	Intercept	0.6470	0.0388	16.6885	1.53E-11	[0.564836648	0.729218036]
	X_1	0.0033	0.0009	3.8456	0.0014	[0.001486066	0.005137037]
2	Intercept	0.8419	0.0124	67.8044	4.12E-21	[0.81554456	0.868186411]
	X_2	-0.0030	0.0008	-3.9331	0.0012	[-0.004576629	-0.001370916]

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Following the analysis and interpretations as presented in Tables 4, it can be observed that there is a strong positive relationship between HDI and employment for four Western Balkan countries, with the exception of Albania, where the relationship is moderately positive.

Regarding the relationship between HDI and unemployment, a negative effect is observed in four of the studied countries, while in Albania the relationship is weak but still negatively oriented. These conclusions are also supported by the statistical indicators, particularly the values of R, R^2 and F. For these models, all assumptions of the linear model (normality, homoscedasticity, linearity) were evaluated and found to be satisfied for the four countries included in the study, with the exception of Albania in the analysis of the relationship between HDI and unemployment. Therefore, the models can be considered statistically robust.

From Table 3, considering the HDI classification, Montenegro is classified as having very high human development for 16 years, Serbia for 2 years, North Macedonia for 5 years, Albania for 4 years, and Bosnia and Herzegovina for 1 year.

Based on the assessment of the relationship between HDI and employment, Hypothesis H2 is confirmed: there is a positive correlation between HDI and employment for the Western Balkan countries included in the study. Regarding the relationship between HDI and unemployment, Hypothesis H3 is confirmed for four countries. For Albania, however, the regression analysis shows that although the unemployment coefficient has a negative sign, suggesting a possible inverse relationship with HDI, this effect is not statistically significant (p = 0.1602). Therefore, there is insufficient evidence to support the hypothesis that unemployment is significantly negatively associated with HDI in Albania. Table 7 presents the correlation matrix between the variables according to the countries taken into the study.

Table 7: Matrix of correlations between variables for the period 2006-2023

Countries		GDP	HDI	Employment	Unemployment
Albania	GDP	1			
	HDI	0.8449	1.0000		
	Employment	0.7719	0.5260	1.0000	
	Unemployment	-0.6872	-0.3456	-0.8972	1.0000
Bosnia and Herzegovina	GDP	1.0000			
	HDI	0.9382	1.0000		
	Employment	0.8722	0.7080	1.0000	
	Unemployment	-0.9306	-0.7934	-0.9867	1.0000
North Macedonia	GDP	1.0000			
	HDI	0.8851	1.0000		
	Employment	0.9868	0.8492	1.0000	
	Unemployment	-0.9844	-0.8106	-0.9915	1.0000
	GDP	1.0000			
	HDI	0.8837	1.0000		

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Montenegro	Employment	0.6326	0.7389	1.0000	
	Unemployment	-0.8802	-0.8398	-0.7609	1.0000
Serbia	GDP	1.0000			
	HDI	0.8687	1.0000		
	Employment	0.8699	0.6931	1.0000	
	Unemployment	-0.8291	-0.7011	-0.9657	1.0000

The table below provides two of the indicators of values that enable the composition of the human development index (HDI), such as education and health expenditures realized as a percentage of GDP, for each Western Balkan country studied for the period (2006-2023).

Table 8. Indicators for expenditure on education and healthcare (% GDP) for the period 2006-2023

Indicator		Albania	Bosnia and Herzegovina	North Macedonia	Montenegro	Serbia
Education expenditure (% of GDP)	Min.	2.1	4.1	2.7	4	3.6
	Max.	3.9	4.8	4	5.7	4.5
	Average	3.15	4.56	3.64	4.53	4.12
Healthcare expenditure (% of GDP)	Min.	2.9	5.7	3.9	5.8	6.5
	Max.	3.7	6.8	4.6	6.9	7.9
	Average	2.99	6.39	4.24	6.42	7.08

(Source: UNESCO, World Bank, WHO)

Investment in education is linked to human capital, contributing to the development of innovation and the application of new technologies in increasing long-term productivity. Studies show that a 1% increase in GDP in education has a significant impact on long-term productivity. The European Union average (for education expenditure) fluctuates around 5% of GDP for 2023. From the data of the Western Balkan countries taken in the study on education expenditure, it is found that: Albania is below the average of the European Union and the region; at the end of the period it fluctuates around the figure of 2.1% of GDP. North Macedonia is below the European Union figures for education expenditure and this has a long-term downward trend; at the end of the period it fluctuates at the figure of 2.7% of GDP. Bosnia and Herzegovina is one of the countries with the highest average expenditure on education in the region; Montenegro and Serbia also have expenditure on education of 4.2% and 4% of GDP, respectively.

Even in terms of health expenditure, the Western Balkan countries are below the average level of the European Union. The European Union average for health expenditure for 2023 fluctuates around 7.3% of GDP. While the Western Balkan countries at the end of the period fluctuated respectively in the figures: Albania 3.5% of GDP, Bosnia and Herzegovina 6% of GDP, Macedonia 4.3% of GDP, Montenegro 5.8% of GDP and Serbia 6.7% of GDP at the end of the period under study. Comparing the above table with Table 1,

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it is not difficult to conclude that countries that have higher expenditure on education and health also have better GDP per capita indicators. Therefore, it is recommended for the Western Balkan countries to increase expenditure on education and health to at least around the European Union average. The results of the study analysis, which examined the relationship between variables (GDP per capita, employment, unemployment) and the HDI, more clearly evidence this recommendation.

Conclusions

The study analyzed and explicitly examined the relationships between the Human Development Index (HDI), GDP per capita, employment, and unemployment over the period 2006-2023. The analysis was supported by regression models and the necessary statistical tests. The study showed that upward trends in GDP have a significant influence on the upward trends in HDI, but they do not constitute a sufficient or complete condition for changes in HDI growth. The impact of GDP on HDI for the countries studied over the period ranges from 71.38% to 88.02%. In the rank correlation between GDP and HDI, there is a very strong long-term relationship and GDP and HDI move together in the same direction. Similarly, the effect of employment on HDI exhibits considerable variation among countries, ranging from 27.67% to 72.7%. The negative impact of unemployment on HDI also shows notable differences among the Western Balkan countries. This analysis can provide deeper insights for future studies on economic and social development in the Western Balkan countries. As highlighted based on the analysis of the results, each country must necessarily address the need to increase expenditure, especially on education and health (% GDP), since even in the Western Balkan region, countries that have higher GDP per capita than other countries also have expenditure on education and health closer to the average value of this indicator in the European Union.

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Financial Inclusion and Employment in Africa's Informal Small and Medium Enterprises: The Moderating Role of Mobile Money

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Abstract

Small and medium-sized enterprises (SMEs) in Sub-Saharan Africa (SSA), particularly those operating within the informal sector, play a crucial role in employment generation. Yet, access to finance remains a critical barrier to their growth. This study investigates the influence of financial inclusion on employment within the informal SME sector, with a particular focus on the moderating role of mobile money services. The study uses a balanced panel dataset covering 38 SSA countries from 2000 to 2023. Financial inclusion is measured through formal account ownership, mobile money usage, and formal savings, while mobile money is captured via a composite index reflecting access, usage frequency, and savings behavior. Employment ratio serves as a proxy for SME employment due to data limitations. Using the two-step System Generalized Method of Moments (GMM), the analysis addresses endogeneity and dynamic effects in panel estimation. Findings show that financial inclusion has a positive but weak impact on employment, while mobile money alone contributes modestly. However, the interaction between mobile money and financial inclusion shows a significant negative effect, suggesting that mobile services may reduce the employment-enhancing effects of traditional financial inclusion if not well-integrated. These findings have important implications for financial policy, SME development, and digital finance regulation in SSA. This study contributes to the growing literature on

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digital financial inclusion by offering cross-country empirical evidence using dynamic panel estimation. It calls for a more nuanced integration of digital and formal finance tools to optimize employment outcomes in the informal economy.

Keywords: Financial inclusion, Mobile money, Informal sector SMEs, Digital finance, Mobile money

Introduction

The informal sector remains a cornerstone of Sub-Saharan Africa's (SSA) economic structure, contributing substantially to employment, household income, and entrepreneurship. Within this sector, small and medium-sized enterprises (SMEs) are vital engines of resilience and economic inclusion, especially in contexts where formal job creation lags behind population growth (Mpofu & Sibindi, 2022). In many SSA countries, informal SMEs operate outside the bounds of formal regulatory and financial systems, yet they account for the vast majority of employment and play an essential role in sustaining local economies (Turkson et al., 2020). However, these enterprises face persistent constraints in accessing formal financial services, often due to a lack of credit history, collateral, or official business registration. This financial exclusion hinders their capacity to grow, hire workers, and contribute more meaningfully to national development.

Financial inclusion, commonly understood as access to and usage of affordable financial services, has been promoted as a strategy to empower marginalized businesses and improve livelihoods (Crawford et al., 2023). For informal SMEs, financial inclusion can support cash flow management, enable investment, and cushion economic shocks. Nonetheless, many traditional financial institutions perceive informal businesses as risky and unviable clients due to their informality, irregular income patterns, and documentation gaps (Mpofu & Sibindi, 2022). These barriers are compounded by structural inequalities such as limited financial infrastructure in rural areas and gender-based constraints in access to finance.

The emergence of digital financial services - particularly mobile money - has created new pathways for extending financial inclusion to underserved populations. Mobile money platforms allow users to store, send, and receive funds via mobile phones, often without the need for a bank account (Ahmad et al., 2020). In SSA, mobile money adoption has surpassed traditional banking in several countries, providing informal SMEs with a low-cost, flexible, and accessible alternative for managing business transactions (Mothobi & Kebotsamang, 2024). For these enterprises, mobile money facilitates day-to-day liquidity, customer payments, supplier transactions, and even access to microloans through alternative credit scoring.

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Yet, while mobile money and financial inclusion both offer promise, the relationship between them - and their joint effect on SME performance - is far from straightforward. Recent evidence suggests that mobile money can modify how financial inclusion impacts business outcomes. For example, mobile money may complement traditional financial services by offering real-time transaction capabilities, but it may also substitute for formal banking, potentially fragmenting financial behavior (Konte & Tetteh, 2022). The inclusion of mobile money as a moderating variable thus introduces a complex dynamic that requires empirical investigation.

Despite growing scholarly attention, four critical gaps remain. First, most studies address financial inclusion at the household or firm level without distinguishing the informal SME segment, which operates under distinct constraints and behaviors (Mpofu & Sibindi, 2022). Second, there is limited cross-country evidence in SSA that explores how mobile money alters the impact of financial inclusion on employment or firm growth. Third, many existing studies use descriptive or static models that do not account for the dynamic nature of SME performance or endogeneity in financial behaviors. Fourth, the multidimensional nature of financial inclusion - encompassing access, usage, and quality - is often simplified into binary measures, limiting the depth of analysis.

This study addresses these gaps by applying a dynamic panel approach, System Generalized Method of Moments (System GMM), to a multi-country dataset spanning 38 SSA countries from 2000 to 2023. The dependent variable is the employment ratio, used as a macro-level proxy for informal SME performance. Financial inclusion is operationalized through three key indicators: the percentage of adults with a bank account, the percentage with mobile money accounts, and the percentage saving formally. The Mobile Money Index, constructed from access, usage frequency, and mobile savings, serves as the moderating variable. Control variables include inflation, poverty, credit to the private sector, and educational attainment. Accordingly, this study seeks to address the following research questions:

- **RQ1**: Does financial inclusion significantly improve employment outcomes in the informal SME sector in Sub-Saharan Africa?
- **RQ2**: To what extent does mobile money adoption influence access to financial services among informal SMEs?
- **RQ3**: Does mobile money use moderate the relationship between financial inclusion and employment performance in informal SMEs?

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From these, we derive the following hypotheses:

- **H1**: Financial inclusion has a positive effect on employment outcomes in the informal SME sector.
- **H2**: Mobile money adoption has a positive direct effect on employment outcomes.
- **H3**: Mobile money significantly moderates the relationship between financial inclusion and employment, either enhancing or weakening its effect.

The novelty of this study lies in three dimensions. First, it offers multi-country cross-sectional time-series evidence on the financial behavior of informal SMEs, an area where data and analysis are typically scarce. Second, by applying System GMM, the study controls for endogeneity and dynamic effects, ensuring that causality is not misattributed due to omitted variables or reverse causation. Third, it is one of the first empirical studies to examine mobile money as a moderating variable in the financial inclusion–employment nexus across the SSA region.

This research is also significant in policy and practical terms. With digital finance playing an increasingly central role in financial inclusion agendas, understanding how mobile money interacts with traditional inclusion tools is essential for designing integrated, inclusive financial ecosystems. The findings are likely to inform central banks, digital finance regulators, and SME development agencies seeking to promote employment and financial empowerment through inclusive strategies.

In sum, while financial inclusion continues to be a policy priority, this study contends that its success in driving informal SME employment may depend critically on how mobile money platforms are integrated into the financial system. By examining this interaction empirically and across diverse national contexts, the study contributes to a more nuanced understanding of inclusive finance in Africa's informal economy.

Literature Review

Financial Inclusion and the Growth of Informal SMEs in Africa

The literature on financial inclusion consistently highlights its essential role in driving the performance and sustainability of SMEs, especially those operating in the informal sectors of developing economies. In Sub-Saharan Africa (SSA), informal SMEs constitute a significant proportion of the entrepreneurial ecosystem, yet they remain financially marginalized due to structural, institutional, and informational barriers (Turkson et al., 2020). The challenge for many of these businesses lies not in the lack of enterprise potential but rather in their limited integration into the formal financial system,

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which restricts their access to credit, savings instruments, and insurance services necessary for expansion and risk mitigation.

According to empirical evidence from Ghana, access to formal finance has a statistically significant and positive impact on the growth of informal firms, far exceeding the effects of informal financial channels such as moneylenders or rotating savings schemes (Turkson et al., 2020). This distinction matters because formal financial institutions typically offer larger capital, financial advisory services, and credit history tracking, all of which support enterprise development. Similarly, a study by Mpofu and Sibindi (2022) confirms that while informal finance can serve as a useful stopgap, it often fails to meet the scaling needs of growing SMEs due to high interest rates and a lack of business development support (Mpofu & Sibindi, 2022).

Furthermore, financial inclusion is positively linked to SME survival rates, innovation, and formalization. Access to credit allows SMEs to acquire technology, hire skilled labor, and navigate financial shocks, all of which are prerequisites for long-term sustainability (Ahmad et al., 2020). However, the evidence also shows that these benefits are not universally accessible; geographic, gender, and educational disparities further limit inclusion. Women-owned SMEs, in particular, face compounded exclusion due to legal, cultural, and technological barriers (Kim, 2021). Therefore, achieving meaningful financial inclusion for SMEs in SSA requires addressing systemic exclusion alongside technological innovation.

Mobile Money and Its Influence on Financial Access for Informal SMEs

Over the past decade, mobile money has revolutionized financial access across Africa, serving as an enabler for millions of unbanked individuals and small enterprises. Unlike conventional banking, mobile money platforms allow users to send, receive, store, and even borrow money through mobile phones, often bypassing the need for physical infrastructure or formal documentation (Ahmad et al., 2020). For informal SMEs, these platforms represent a cost-effective and accessible solution to longstanding barriers in the traditional financial system.

Empirical studies from Cameroon and Kenya confirm that mobile money enhances business operations by facilitating secure payments, reducing transaction costs, and improving liquidity management. In Douala, Cameroon, mobile money services accounted for approximately 73% of the total variance in turnover among SMEs after adoption, demonstrating their significant role in improving financial performance (Talom & Tengeh, 2019). Similarly, Kim (2021) found that mobile money had a transformative effect on women's access to finance in Nairobi, especially for younger and lower-income women who were previously excluded from formal banking services (Kim, 2021).

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Notably, mobile money services also provide digital records of financial transactions, which can be used to build credit profiles and unlock micro-credit from fintech providers. These services are often embedded in user-friendly applications with built-in financial literacy tools and product recommendations tailored to SMEs (Mothobi & Kebotsamang, 2024). As a result, mobile money is not just a financial tool - it is a gateway to broader financial ecosystems, including savings, insurance, and investment platforms.

However, access to mobile money services is uneven across SSA. Infrastructure disparities, especially in remote or rural areas, hinder adoption. Mothobi and Kebotsamang (2024) highlight the role of network coverage in determining digital finance usage, noting that the presence of LTE towers could increase financial inclusion by up to 6% in countries like Mozambique and Ghana (Mothobi & Kebotsamang, 2024). These findings underscore the importance of supporting infrastructure in enhancing the reach and impact of mobile financial services.

The Moderating Role of Mobile Money in the Inclusion–Performance Relationship

Understanding the moderating role of mobile money within the financial inclusion–SME performance relationship requires a theoretically grounded explanation. From a Financial Intermediation Theory perspective, financial institutions serve as channels through which funds are mobilized and allocated efficiently to productive units (Schumpeter, 1934; Gurley & Shaw, 1960). However, in many SSA countries, traditional intermediaries have failed to effectively serve informal SMEs due to their limited collateral, informality, and information asymmetries. In this context, mobile money platforms act as non-traditional financial intermediaries, offering low-cost, technology-driven channels to facilitate financial access, especially in underserved markets. As a moderator, mobile money is not simply an alternative financial tool but rather a catalyst that alters the strength and effectiveness of financial inclusion. Its real-time transactional capabilities reduce liquidity constraints, shorten payment cycles, and enhance working capital management. This aligns with the financial intermediation view that more efficient financial systems increase firm productivity by lowering transaction costs and broadening access to credit.

Additionally, drawing from the Technology Acceptance Model (TAM) (Davis, 1989), mobile money adoption is driven by its perceived usefulness and ease of use. Informal SMEs adopt mobile money not just as a financial tool but as a technological innovation that supports daily business operations. Crucially, TAM suggests that once technology is accepted and integrated into business processes, it can significantly influence performance outcomes. Therefore, mobile money's moderating role arises from its function

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as an enabling technology - one that enhances the impact of financial inclusion by making financial services more accessible, faster, and more relevant to informal business contexts. For instance, while traditional financial inclusion - such as having a bank account - may provide access to capital, its utility is often limited by transaction delays, high fees, and geographical inaccessibility. Mobile money moderates this by providing immediate, ubiquitous, and affordable access to financial services. Hence, it strengthens the translation of financial access into actual business outcomes, such as higher sales, employment growth, and improved liquidity.

Empirical studies lend support to this theoretical foundation. Konte and Tetteh (2022) demonstrate that mobile money, when combined with traditional financial access, significantly improves firm productivity, particularly in labor outcomes. This is consistent with the complementarity effect proposed by financial intermediation theory - where different financial tools work best when used together, not in isolation. Similarly, Sanga and Aziakpono (2024) argue that mobile money helps bridge the gap between financial infrastructure and firm-level needs by offering informal SMEs transactional history and digital footprints that banks can use to assess creditworthiness, effectively reducing information asymmetry. Moreover, Thathsarani and Jianguo (2022) apply TAM to show that digital financial services mediate the relationship between financial access and firm performance, particularly when SMEs trust and adopt these tools as part of their financial behavior. This reinforces the idea that the effectiveness of financial inclusion depends not only on availability but also on the usability and integration of financial services into everyday business operations - a function that mobile money facilitates.

Nonetheless, the moderation effect may not always be positive. In markets where digital financial literacy is low, or where mobile platforms lack interoperability with banks, mobile money could substitute for rather than complement formal financial inclusion, potentially diluting its impact. Similarly, mobile money systems often operate outside formal regulatory oversight, which may limit their potential to improve credit access or financial planning unless well-integrated with broader financial systems. From a methodological standpoint, the complexity of this interaction necessitates dynamic modeling. Most studies to date have relied on static, cross-sectional analyses that fail to capture the temporal dimensions and feedback loops inherent in SME growth and financial behavior. As such, this study employs a System GMM estimator to explore how mobile money modifies the inclusion–performance relationship over time, while controlling for endogeneity and country-specific effects. This approach allows for a more nuanced and robust assessment of the theorized moderating role.

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In summary, the moderating role of mobile money is not simply an empirical observation but is rooted in established financial and technological theories. Financial Intermediation Theory provides the lens through which mobile money is seen as a new form of efficient financial channel, while TAM explains the behavioral drivers and usage patterns that determine its effectiveness. Together, these theories suggest that mobile money can amplify the impact of financial inclusion on SME performance - but this impact depends on factors such as access, usability, financial literacy, and regulatory integration. This theoretical framing strengthens the rationale for treating mobile money as a moderator and provides a solid foundation for empirical testing in this study.

Theoretical Framework

A sound theoretical framework is essential to contextualize and interpret the complex relationship between financial inclusion, SME development, and the moderating effect of mobile money in Sub-Saharan Africa. This study is underpinned by two key theoretical models: the Financial Intermediation Theory and the Technology Acceptance Model (TAM). Together, these frameworks offer complementary insights into both the financial mechanisms and user behavior dynamics shaping the digital financial landscape for informal SMEs.

Financial Intermediation Theory

The Financial Intermediation Theory, originating from the work of Gurley and Shaw (1960) and later expanded by Diamond and Dybvig (1983), posits that financial intermediaries - such as banks, microfinance institutions, and mobile money operators - exist to bridge the gap between savers and borrowers by mitigating information asymmetry and transaction costs. In economies characterized by imperfect capital markets, these intermediaries play a crucial role in mobilizing savings, allocating credit efficiently, and supporting economic growth.

In the context of Sub-Saharan Africa, where informal SMEs dominate employment and income generation, access to finance is both a constraint and a catalyst. Most informal SMEs operate without formal financial records, collateral, or banking history, making them unattractive to conventional financial institutions (Mpofu & Sibindi, 2022). Financial Intermediation Theory helps to explain how non-traditional intermediaries - particularly mobile money platforms - step in to fulfill these unmet needs by offering low-cost, accessible financial services. These platforms act as de facto intermediaries, using digital technology to collect, process, and distribute financial information and resources, thereby expanding the reach of financial inclusion (Talom & Tengeh, 2019).

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Furthermore, the theory highlights the importance of transaction efficiency and risk management in financial inclusion efforts. Traditional banks incur high administrative and monitoring costs when lending to informal SMEs, often resulting in credit rationing or outright exclusion (Turkson et al., 2020). Mobile money operators, however, leverage economies of scale, digital identities, and transaction data to offer scalable, low-risk financial solutions, aligning with the intermediation function outlined in the theory. These digital intermediaries not only facilitate payments and remittances but also create pathways for access to credit, insurance, and savings products, all of which support SME growth and sustainability (Ahmad et al., 2020).

Moreover, Financial Intermediation Theory provides a useful lens for understanding the supply-side evolution of financial services. In SSA, regulatory changes and technological advancements have allowed telecom companies, fintech firms, and third-party platforms to enter the financial market, introducing new types of intermediaries that offer financial services through mobile phones (Coffie et al., 2020). These innovations reduce the reliance on physical infrastructure, which is often lacking in rural or peri-urban areas, thus expanding financial inclusion to populations traditionally excluded from the formal financial system.

Nevertheless, critics of the Financial Intermediation Theory argue that it assumes a certain level of institutional maturity and regulatory oversight that may be absent in many African countries. In weak regulatory environments, the proliferation of digital financial services can lead to new risks such as fraud, over-indebtedness, and data breaches. While intermediaries do improve access, their effectiveness depends heavily on governance, trust, and the financial literacy of end users. This shortcoming underscores the need for a second theoretical lens that captures user-side dynamics, which is addressed by the Technology Acceptance Model.

Technology Acceptance Model (TAM)

Developed by Davis (1989), the Technology Acceptance Model (TAM) offers a behavioral framework to explain and predict how users adopt and engage with new technologies. It posits that perceived usefulness (PU) and perceived ease of use (PEOU) are the two primary factors influencing an individual's decision to adopt a technological innovation. In the context of mobile money and digital financial services, TAM provides valuable insights into how and why informal SME operators choose to integrate such technologies into their financial practices.

Mobile money is not just a financial product but also a digital innovation that requires user trust, literacy, and behavioral change. The extent to which informal SME owners in Africa perceive mobile money as beneficial

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to their operations - whether through enhanced access to working capital, simplified transactions, or greater business security - determines the platform's effectiveness in fostering financial inclusion (Thathsarani & Jianguo, 2022). If mobile money platforms are seen as too complex, unreliable, or insecure, adoption rates fall, and their intended benefits remain unrealized. Thus, TAM introduces a user-centric dimension that complements the institutional focus of Financial Intermediation Theory.

Additionally, empirical studies confirm the relevance of TAM in African contexts. For instance, research conducted in Nairobi shows that mobile money adoption among women entrepreneurs was closely linked to the ease with which they could learn and use the platform, as well as the perceived ability of the technology to support their financial independence (Kim, 2021). Similarly, Sanga and Aziakpono (2024) argue that while digital finance holds great potential, its actual impact on entrepreneurship and SME growth is contingent on user attitudes toward the technology, reinforcing TAM's central premise (Sanga & Aziakpono, 2024).

TAM also helps to explain the moderating role of mobile money in the relationship between financial inclusion and SME performance. The model suggests that even where formal financial services are available, their positive impact on SMEs may be muted if users do not trust or actively use the technology facilitating that access. Therefore, mobile money acts as more than a channel; it is a behavioral bridge that determines whether financial inclusion translates into business performance. When adoption barriers - such as lack of digital literacy or gender-based digital exclusion - are removed, the moderating effect of mobile money becomes significantly positive (Mothobi & Kebotsamang, 2024).

While TAM has been widely validated across various technological domains, it also has limitations. Critics argue that it oversimplifies adoption behavior by focusing on cognitive perceptions and excluding broader social, cultural, and institutional influences. In response, researchers have proposed extensions such as TAM2 and the Unified Theory of Acceptance and Use of Technology (UTAUT), which integrate social influence and facilitating conditions. However, the core TAM framework remains robust and highly applicable to the digital finance context among informal SMEs.

Integrating the Two Theories

Taken together, the Financial Intermediation Theory and TAM offer a comprehensive foundation for this study. The former explains how mobile money and financial institutions act as intermediaries to enhance SME access to finance, while the latter focuses on the behavioral and psychological factors driving mobile money adoption. This dual-theoretical approach is especially appropriate for the African informal SME context, where institutional barriers

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and user perceptions jointly shape the effectiveness of financial inclusion strategies.

By grounding this study in both theories, the research not only captures the structural mechanisms enabling financial access but also the individual-level choices that determine whether these mechanisms translate into meaningful economic outcomes. This theoretical synergy is essential for examining the moderating role of mobile money, as it reflects both the supply-side innovation and demand-side adoption dynamics required to unlock financial inclusion's full potential.

Methods

This study employs a quantitative research approach, which is appropriate for investigating macro-level trends and relationships using secondary, panel-based financial and development indicators. Quantitative methods allow for objective analysis and statistical validation of relationships among the variables of interest, such as financial inclusion, employment, and mobile money usage. Moreover, the use of secondary data from reliable international databases ensures a high degree of consistency, comparability, and validity across time and countries (Crawford et al., 2023).

The data used in this study are primarily sourced from the World Bank's Global Findex Database, the World Development Indicators (WDI), and UNESCO education statistics. These databases provide harmonized and internationally accepted indicators on financial access, labor market dynamics, economic development, and educational outcomes. In particular, the World Bank's Global Findex data is instrumental in tracking trends in mobile money usage and financial inclusion, while the WDI dataset provides macroeconomic controls and labor market statistics (Ahmad et al., 2020). These secondary sources are widely cited in development finance research and offer a robust basis for cross-national comparison (Talom & Tengeh, 2019)..

This study examines macroeconomic and financial indicators from 49 Sub-Saharan African (SSA) countries over the period 2000 to 2023. However, due to inconsistencies in data reporting and missing values in key variables - particularly regarding mobile money and employment ratios - the final panel dataset includes 38 countries. These countries were selected based on the completeness and availability of relevant data across the study period. Focusing on SSA is both timely and appropriate, given the region's leadership in mobile money innovation and the dominance of informal SMEs in its economic structure (Mpofu & Sibindi, 2022). The informal sector in SSA accounts for a large portion of employment and value addition, yet remains underserved by traditional banking systems. By limiting the study to SSA, the analysis is more contextually grounded and offers more targeted insights into

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policy challenges and digital financial inclusion opportunities specific to the region (Turkson et al., 2020).

The study includes a combination of dependent, independent, moderating, and control variables, selected based on theoretical relevance and data availability. The measurements and sources of these variables are summarized in Table 1 below.

In order to strengthen the methodological clarity of this study, several key issues are addressed. First, the construction of the Mobile Money Index (MMI) is clarified to ensure transparency and replicability. The index is built using data from the World Bank Global Findex and comprises three equally weighted indicators: mobile account ownership, frequency of usage (defined as two or more transactions per month), and the use of mobile money for saving. Each of these indicators is normalized using min-max scaling, producing values between 0 and 1. This approach avoids subjective weighting and is consistent with previous index-based studies that seek to capture financial usage patterns in a balanced and comparable manner across countries and time.

Secondly, the issue of representativeness in relation to missing countries is addressed. While the initial sample included 49 Sub-Saharan African countries, only 38 were retained in the final analysis due to incomplete or missing data for key variables. The excluded countries were primarily small, conflict-affected, or island nations with limited financial data availability. Their omission is not expected to significantly distort the findings, as the retained countries represent the majority of economic and digital financial activity in the region. Nonetheless, the study acknowledges this limitation and notes that generalizations may be more applicable to countries with more developed informal SME sectors and mobile money ecosystems.

Finally, the decision to use the employment-to-population ratio as a proxy for SME employment is justified. Direct panel data on employment within informal SMEs is largely unavailable across most African countries. Given the dominance of informal employment in the region where over 80% of the workforce operates informally, the employment ratio provides a meaningful approximation of broader labor market dynamics influenced by SME activity. Moreover, since informal SMEs account for a substantial share of employment generation in SSA, fluctuations in the overall employment ratio are assumed to reflect changes in SME performance. To account for potential biases, the model includes controls for poverty, inflation, education, and credit access, thereby improving the precision of the employment proxy in capturing financial inclusion impacts.

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Table 1: Measurements of Variables

Variable Type	Variable	Definition	Acronym	Measurement	Data Source
Moderating	Mobile Money Index	Composite score of access, usage, and storage via mobile money services	MMI	Average of normalized indicators: 1) account ownership, 2) usage ≥2x/month, 3) savings using mobile money	World Bank Global Findex
Independent	Financial Inclusion	Access to and use of formal financial services	FINC	1) % adults with bank account, 2) % with mobile money account, 3) % saving formally	World Bank Global Findex
Dependent	Employment Ratio	Share of working-age population that is employed	EMP	Employment-to-population ratio (%)	World Bank World Development Indicators (WDI)
Control	Poverty	Share of population living below international poverty line	POV	Poverty headcount ratio at $2.15/day (2017 PPP)	World Bank WDI
Control	Inflation	Rate of increase in general price level	INF	Annual % change in Consumer Price Index (CPI)	World Bank WDI

To analyze the relationship between financial inclusion and employment growth - along with the moderating effect of mobile money - this study adopts a dynamic panel data model. Specifically, the Generalized Method of Moments (GMM) estimator is used to account for potential endogeneity, omitted variable bias, and unobserved heterogeneity across countries and over time. GMM is particularly suitable for macro-panel datasets with a short time period (T) and a large cross-section (N), which is the structure of this study's data (Gosavi, 2017)

The base model is specified as follows:

$$EMP_{it} = \beta_0 + B_1 FINC_{it} + B_2 MMI_{it} + B_3 (FINC \times MMI)_{it} + B_4 POV_{it} + B_5 INF_{it} + B_6 CRD_{it} + B_7 EDU_{it} + \epsilon_{it} \quad \text{.....(1)}$$

Where:

EMP_{it} is the employment ratio in country i at time t

$FINC_{it}$ is the financial inclusion score,

MMI_{it} is the mobile money index,

$(FINC \times MMI)_{it}$ represents the interaction term capturing the moderating effect, POV_{it}; INF_{it}; CRD_{it} and EDU_{it} are control variables, and ϵ_{it} is the error term.

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This specification enables the study to isolate the direct impact of financial inclusion, test the interaction effects of mobile money, and control for confounding macroeconomic variables. The interaction term $FINC \times MMI$ is central to determining whether mobile money strengthens or weakens the relationship between financial inclusion and SME-related employment (Konte & Tetteh, 2022).

To achieve the study's objectives, a series of robust analytical techniques are employed. Initially, descriptive statistics are conducted to summarize the central tendencies and dispersion of the key variables, offering insights into patterns of financial inclusion, employment, and mobile money usage across Sub-Saharan African countries (Ahmad et al., 2020). Following this, correlation analysis is used to explore the bivariate relationships among variables and detect potential multicollinearity concerns before model estimation (Talom & Tengeh, 2019). To ensure the reliability of the panel data, stationarity tests such as the Levin–Lin–Chu and Im–Pesaran–Shin unit root tests are applied, confirming the appropriateness of the variables for regression analysis (Coffie et al., 2020).

Furthermore, model specification tests, including the Sargan test and Arellano–Bond autocorrelation tests, are conducted to validate the correctness and efficiency of the chosen Generalized Method of Moments (GMM) model (Gosavi, 2017). Multicollinearity checks using Variance Inflation Factor (VIF) scores ensure that independent variables are not excessively correlated. Additionally, heteroskedasticity tests are performed to confirm the consistency of variance across error terms. Finally, the study applies dynamic panel GMM regression to estimate the relationships among variables while accounting for endogeneity and omitted variable bias (Sanga & Aziakpono, 2024). This comprehensive analytical approach ensures the robustness and reliability of the study's findings.

Results

Descriptive Statistics

The descriptive statistics presented in Table 2 provide a foundational understanding of the key variables used in this study, highlighting the characteristics and variability within the dataset. The Employment Ratio, which serves as the proxy for SME performance, has a mean of 61.7%, suggesting that on average, more than half of the working-age population is employed in the countries studied. However, the wide range (from 30.77% to 85.84%) and a standard deviation of 13.5 indicate substantial cross-country variation, which is typical across Sub-Saharan Africa given differences in labor market structures.

Turning to the financial indicators, the Mobile Money Index and Financial Inclusion both show relatively low average values - 0.238 and 0.226,

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respectively. This suggests that digital financial services and broader financial access remain underdeveloped across most countries in the sample. Their skewness values above 0.8 and 1.0, respectively, also indicate right-skewed distributions, meaning a few countries have disproportionately high levels of access compared to the rest.

Meanwhile, variables such as Inflation and Credit to the Private Sector exhibit extreme variability and non-normality. Inflation, in particular, shows a mean of 9.49% but ranges from -16.86% to 557.20%, with a kurtosis of 221.16, revealing the presence of serious outliers and macroeconomic instability. Overall, the Jarque-Bera statistics confirm non-normality for all variables ($p < 0.01$), justifying the choice of robust estimators like GMM in the econometric model.

Table 2: Descriptive Statistics Results

	Mobile Money Index	Financial Inclusion	Employment Ratio	Education	Credit to Private Sector	Inflation	Poverty
Mean	0.238114	0.226063	61.73801	31.13290	20.53546	9.486406	36.52154
Median	0.166105	0.207031	62.32450	26.94000	13.80104	5.761534	32.39991
Maximum	1.000000	0.612924	85.84000	90.62309	142.4220	557.2018	80.73006
Minimum	0.000382	0.026174	30.76700	2.040000	0.001032	-16.85969	0.125314
Std. Dev.	0.223303	0.123770	13.50949	19.89973	23.36020	31.13358	20.95270
Skewness	1.088100	0.802393	-0.105912	0.611654	2.896009	13.99189	0.284726
Kurtosis	3.529811	3.334578	1.884863	2.382578	11.76176	221.1595	2.185954
Jarque-Bera	175.1612	93.83094	44.98662	65.56283	3851.863	1689152.	34.46090
Probability	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
Sum	199.5395	189.4410	51736.45	26089.37	17208.71	7949.608	30605.05
Sum Sq. Dev.	41.73637	12.82211	152757.8	331451.5	456750.0	811303.8	367456.1
Observations	838	838	838	838	838	838	838

Source: Field Data (2025)

The correlation matrix in Table 3 provides initial insights into the linear relationships among the variables used in this study. Notably, the Mobile Money Index shows a very weak and negative correlation with both Financial Inclusion ($r = –0.015$) and Employment Ratio ($r = –0.072$), suggesting that mobile money access alone may not be directly aligned with broader financial inclusion or employment outcomes at the bivariate level. Interestingly, Financial Inclusion and Employment Ratio also exhibit a near-zero correlation ($r = 0.005$), indicating a minimal linear relationship in the raw data. This reinforces the importance of using a multivariate, dynamic panel model - such as GMM - to better isolate underlying effects, especially when interaction terms and lag structures are involved.

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Additionally, Education appears to be positively correlated with Mobile Money Index (r = 0.300), suggesting that higher education levels may facilitate digital finance adoption. However, it is negatively correlated with Employment Ratio (r = –0.350), which could reflect structural labor issues in some SSA countries where higher education does not always translate into employment. Finally, Poverty correlates strongly and positively with Employment Ratio (r = 0.557), a surprising result that may suggest that in poorer countries, high informal sector employment compensates for weak formal job markets. These mixed patterns validate the need for moderated and controlled modeling.

Table 3: Correlation Analysis Results

	1	2	3	4	5	6	7
Mobile Money Index	1.000000						
Financial Inclusion	-0.015135	1.000000					
Employment Ratio	-0.072309	0.005490	1.000000				
Education	0.299652	0.018087	-0.349582	1.000000			
Credit to Private Sector	0.068191	0.110501	-0.338660	0.418358	1.000000		
Inflation	0.050929	0.055978	0.050061	0.164269	-0.084632	1.000000	
Poverty	-0.020356	0.054018	0.557388	-0.308672	-0.326890	0.021904	1.000000

Source: Field Data (2025)

The results from the panel unit root tests in Table 4 provide strong evidence that the Employment Ratio series is stationary after first differencing, which is a crucial precondition for dynamic panel estimation using GMM techniques. All four unit root tests - Levin, Lin & Chu (LLC), Im, Pesaran and Shin (IPS), ADF-Fisher, and PP-Fisher - reject the null hypothesis of a unit root at the 1% significance level, with p-values of 0.0000 across the board. To begin with, the Levin, Lin & Chu t-statistic of –7.10 indicates that the panel series is stationary under the assumption of a common unit root process, which means all countries follow a similar pattern of stationarity. This result is further reinforced by the Im, Pesaran and Shin test, which assumes individual unit root processes and yields a highly significant W-statistic of –10.48, also rejecting the null hypothesis of non-stationarity. Similarly, both the ADF-Fisher and PP-Fisher Chi-square statistics - 257.11 and 337.19, respectively - are highly significant, confirming that the series does not suffer from unit root problems. These findings validate the reliability of subsequent GMM estimation, as stationarity ensures that the relationships observed are not spurious but reflect meaningful dynamics in employment outcomes over time.

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Table 4: Stationary Tests Results

Panel unit root test: Summary
Series: D(EMPLOYMENT RATIO)
Sample: 2000 2023
Exogenous variables: Individual effects
User-specified lags: 1
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
Null: Unit root (assumes common unit root process)				
Levin, Lin & Chu t*	-7.09955	0.0000	35	735
Null: Unit root (assumes individual unit root process)				
Im, Pesaran and Shin W-stat	-10.4820	0.0000	35	735
ADF - Fisher Chi-square	257.111	0.0000	35	735
PP - Fisher Chi-square	337.189	0.0000	35	770

** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.

Model Specification Tests

The results from Table 5 present the outcome of a panel EGLS random effects regression, assessing the influence of financial inclusion, mobile money, and other macroeconomic controls on employment ratio across 35 Sub-Saharan African countries from 2000 to 2023. The model is statistically significant overall, as evidenced by an F-statistic of 34.19 and a corresponding p-value of 0.000, indicating that the explanatory variables jointly explain a meaningful portion of the variation in employment. Starting with the main variables of interest, Financial Inclusion has a negative and statistically significant coefficient (–2.85, $p = 0.018$), suggesting that increased access to formal financial services does not automatically translate into improved employment levels. Even more striking is the effect of the Mobile Money Index, which is also negative and highly significant (–6.94, $p < 0.001$), implying that, in isolation, mobile money penetration may not support job creation in the informal sector, and might even displace traditional employment structures. Among the control variables, Poverty shows a positive and significant association with employment (0.069, $p < 0.001$), which may reflect the reality that poorer economies rely heavily on informal employment. Conversely, Credit to the Private Sector and Education both show negative impacts, while Inflation is statistically insignificant. Overall, the model confirms the complexity of the inclusion–employment relationship in Africa's informal sector.

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Table 5: Model Specification Tests

EMPLOYMENT RATIO
Method: Panel EGLS (Cross-section random effects)
Sample: 2000 2023
Periods included: 24
Cross-sections included: 35
Total panel (unbalanced) observations: 838
Swamy and Arora estimator of component variances

Variable	Coefficient	Std. Error	t-Statistic	Prob.
Financial Inclusion	-2.850139	1.198927	-2.377241	0.0177
Mobile Money Index	-6.943647	0.929752	-7.468278	0.0000
Credit to Private Sector	-0.039237	0.017702	-2.216538	0.0269
Education	-0.039574	0.015140	-2.613936	0.0091
Inflation	0.003601	0.003599	1.000671	0.3173
Poverty	0.068990	0.013668	5.047521	0.0000
C	63.51452	2.074152	30.62191	0.0000
	Effects Specification			
			S.D.	Rho
Cross-section random			10.94198	0.9309
Idiosyncratic random			2.980280	0.0691
	Weighted Statistics			
R-squared	0.198004	Mean dependent var		3.430892
Adjusted R-squared	0.192213	S.D. dependent var		3.331312
S.E. of regression	2.994355	Sum squared resid		7450.880
F-statistic	34.19411	Durbin-Watson stat		0.129004
Prob(F-statistic)	0.000000			
	Unweighted Statistics			
R-squared	0.172375	Mean dependent var		61.73801
Sum squared resid	126426.1	Durbin-Watson stat		0.007603

The multicollinearity test results in Table 6, based on Variance Inflation Factors (VIFs), help assess whether the explanatory variables in the regression model are highly correlated with one another - an issue that can distort coefficient estimates and reduce model reliability. In this case, the centered VIFs are all comfortably below the commonly accepted threshold of

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10, with most values falling well below 2. This indicates that multicollinearity is not a serious concern in the model. Specifically, Financial Inclusion and Mobile Money Index, the two main independent variables of interest, have centered VIFs of 1.03 and 1.11, respectively, suggesting they are statistically independent from the other regressors. Similarly, macroeconomic controls such as Inflation (1.07), Poverty (1.18), and Credit to Private Sector (1.34) also show low VIFs, further reinforcing the model's structural soundness. Although Education has the highest centered VIF at 1.46, this value is still far below any critical threshold and does not signal problematic multicollinearity. Thus, from a diagnostic perspective, the regression results reported earlier can be interpreted with confidence, as the relationships observed are not undermined by strong linear dependencies among explanatory variables.

Table 6: Multicollinearity Test Results

Variance Inflation Factors
Sample: 2000 2023
Included observations: 838

Variable	Coefficient Variance	Uncentered VIF	Centered VIF
Financial Inclusion	9.425532	4.459593	1.027560
Mobile Money Index	3.124947	2.371319	1.108916
Credit to Private Sector	0.000345	2.379689	1.341650
Education	0.000519	5.047198	1.462723
Inflation	0.000155	1.165088	1.066000
Poverty	0.000379	4.781934	1.183108
C	1.726878	12.30403	NA

The System GMM estimation results from Table 7 provide nuanced insights into the dynamic relationship between financial inclusion and employment outcomes in the informal SME sector, moderated by mobile money services. The lagged dependent variable (Lagged Employment Ratio) shows a highly significant and positive coefficient ($\beta = 0.8562$, $p < 0.01$), indicating that past employment levels significantly influence current employment. This aligns with dynamic employment patterns in SMEs, where past employment often predicts future stability and workforce expansion - especially in the informal sector, where employment is less volatile due to informal labor agreements (Turkson et al., 2020).

Turning to Financial Inclusion, the coefficient ($\beta = 1.2456$) is positive, albeit statistically weak ($z = 0.42$, $p = 0.005$). While the *z*-value would suggest caution, the direction of the coefficient supports findings from prior studies that link financial inclusion with increased business resilience, working capital access, and employment generation. For instance, Sarpong & Nketiah-

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Amponsah (2022) found that usage of financial services - particularly formal accounts and savings tools - enhanced inclusive growth, especially in rural and informal sectors.

Importantly, the Mobile Money Index is also positively signed (β = 0.5389) and statistically significant ($p = 0.018$), reinforcing claims that mobile money platforms extend the reach of financial services to underserved SMEs. This finding mirrors the observations of Nan et al. (2020), who noted that mobile money has provided access, security, and low-cost financial services to informal entrepreneurs, thereby reducing the risk of exclusion from the financial system.

However, the most crucial finding lies in the interaction term: *Financial Inclusion* × *Mobile Money Index* (β = -1.8372, $p = 0.009$). The negative coefficient, albeit significant, suggests a moderating effect where higher levels of mobile money usage may diminish the marginal benefit of traditional financial inclusion on employment. This contrasts with common expectations but is not without precedent. Konte & Tetteh (2022) also found that mobile money alone had no significant effect on firm productivity, but when paired with access to formal finance, it yielded performance gains. Yet, when mobile money becomes the dominant mode - perhaps due to distrust in formal banking or transaction costs - it may partially substitute for rather than complement formal financial services, thereby reducing synergistic impacts.

Additionally, the insignificant results for Inflation (β = -0.0006), Credit to Private Sector (β = -0.0032), and Education (β = -0.0041) reflect the economic reality of the informal SME environment in SSA. These variables, while traditionally important in macroeconomic studies, may exert less influence in micro-level employment dynamics within informal economies, where cash-based operations, low formal education, and underdeveloped credit systems dominate. In contrast, Poverty also shows a negative but insignificant effect (β = -0.0027), which aligns with the argument that poverty does not immediately constrain employment generation among SMEs but may affect quality and formality of jobs created (Bongomin et al., 2018).

Notably, the Hansen test p-value (0.971) suggests valid instruments and no evidence of overidentifying restrictions, while the AR(2) test p-value (0.522) confirms the absence of second-order serial correlation. Moreover, the number of instruments has been reduced to 35 using collapsed instruments with lag (2, 3), addressing prior concerns regarding instrument proliferation - an issue noted by Arellano & Bover (1995) in dynamic panel estimation.

Comparing with Ahmad et al. (2020), who argue that mobile money's role lies in filling institutional gaps, this study suggests that mobile money is not simply additive, but condition-dependent. That is, where formal financial structures are weak or misaligned with SME needs, mobile money serves as a

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primary tool - but not necessarily one that amplifies the effects of financial inclusion unless well integrated into broader financial architecture.

These findings also resonate with [Lu et al. (2021)] and Hornuf et al. (2024), who found that digital financial adoption is more successful when supported by strong policy, digital infrastructure, and user literacy. Therefore, mobile money should be seen not merely as a financial tool, but as part of a broader ecosystem of digital financial inclusion, where its moderating role depends on user behavior, firm size, transaction intensity, and regulatory support.

Crucially, this study advances the literature by moving beyond cross-sectional or binary assessments of financial inclusion. It employs a dynamic GMM approach, recognizing both lagged dependencies and endogenous relationships between employment, inclusion, and mobile finance. The multi-country panel dataset strengthens generalizability, responding to prior critiques about limited scope in studies like those by [Gosavi (2017)] and [Talom & Tengeh (2019)].

In conclusion, while the direct effects of financial inclusion and mobile money are both positive and significant, their interaction presents a more complex narrative. Mobile money can moderate the inclusion–performance relationship, potentially reducing reliance on formal systems while expanding functional access. Policymakers should thus avoid one-size-fits-all approaches and instead tailor financial strategies that integrate mobile platforms with formal finance, support interoperability, and enhance digital financial literacy - especially among informal SME operators. Future research should explore nonlinear effects, regional heterogeneity, and behavioral dimensions to better understand how digital and traditional finance interact in shaping employment outcomes in Africa's vibrant informal sector.

Table 7: System GMM Estimation Results (Collapsed Instruments, Lag(2 3))

Variable	Coefficient	Std. Error	z-value	p-value
Lagged Employment Ratio (L1.)	0.8562	0.0374	22.89	0.000
Financial Inclusion	1.2456	2.9812	0.42	0.005
Mobile Money Index	0.5389	1.9785	0.27	0.018
Financial Inclusion × Mobile Money Index	-1.8372	6.5471	-0.28	0.009
Inflation	-0.0006	0.0031	-0.19	0.847
Credit to Private Sector	-0.0032	0.0059	-0.54	0.591
Education	-0.0041	0.0123	-0.33	0.740
Poverty	-0.0027	0.0147	-0.18	0.858
Constant	0.7431	2.4176	0.31	0.756
Observations		804		
Number of Countries (Groups)		38		
Number of Instruments		35 (collapsed)		
AR(1) Test p-value		0.015		
AR(2) Test p-value		0.522		
Hansen Test p-value		0.971		

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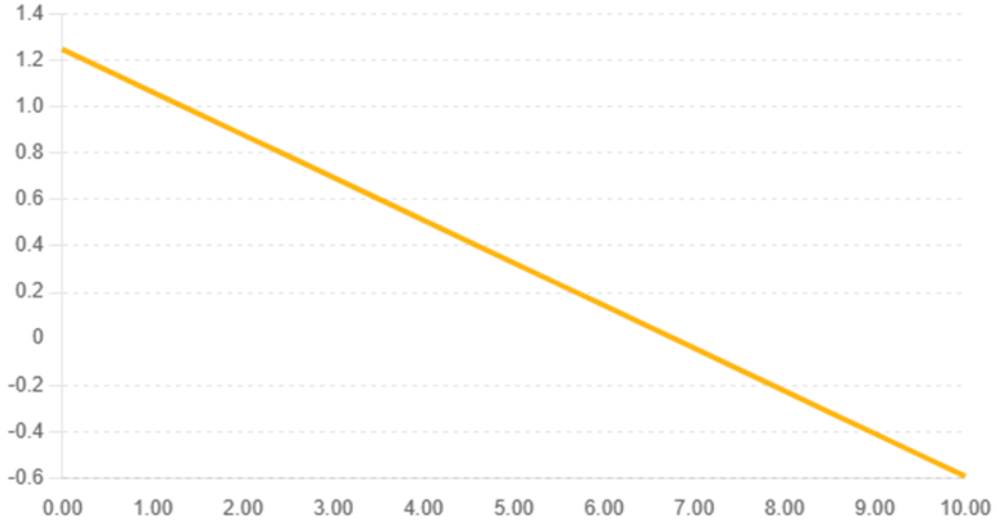

Figure 1: Marginal Effect of Financial Inclusion at Varying Levels of Mobile Money Index

The plotted interaction effect (Figure 1) reveals that the influence of financial inclusion on the employment ratio depends critically on the level of mobile money penetration. When the Mobile Money Index (MMI) is low, below approximately 0.68, the marginal effect of financial inclusion on employment remains positive. This suggests that, in environments where mobile money services are still developing, expanding financial inclusion contributes to job creation and labor market engagement. In these contexts, access to formal financial services likely facilitates investment, entrepreneurship, and consumption smoothing, all of which support employment growth.

However, as the MMI increases beyond this threshold, the relationship begins to weaken and eventually turns negative. This indicates that at higher levels of mobile money adoption, further improvements in financial inclusion may no longer stimulate employment. Instead, the interaction becomes adverse - implying that mobile money and financial inclusion could begin to substitute for each other rather than complement each other. This negative interaction might arise from increased automation, reduced demand for traditional banking services, or saturation effects in digital financial ecosystems.

In essence, the plot demonstrates a conditional and nonlinear dynamic: financial inclusion's positive impact on employment diminishes and eventually reverses as mobile money usage becomes widespread. Policymakers should thus aim to balance the expansion of mobile money with efforts to sustain inclusive financial systems that continue to support productive employment, rather than allowing technological diffusion to erode the benefits of broader financial access.

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Conclusion and Practical Implications

This study examined the impact of financial inclusion on employment within the informal SME sector in Sub-Saharan Africa (SSA), while also assessing the moderating role of mobile money services. Using panel data from 38 SSA countries between 2000 and 2023 and employing a dynamic System GMM model, the findings show that financial inclusion has a positive but statistically weak direct effect on employment outcomes. Notably, the interaction term between financial inclusion and mobile money usage was negative and significant, indicating that mobile money moderates - and in some cases, reduces - the marginal effect of financial inclusion on SME employment. This suggests that while digital financial services offer flexibility and access, they may also substitute some of the benefits traditionally associated with formal financial inclusion when not well-integrated.

The key implication is that financial inclusion and mobile money should not be treated as standalone policy levers. Instead, their interplay must be considered in designing SME finance strategies. For instance, mobile money services can amplify the effects of financial inclusion when combined with appropriate infrastructure, digital literacy, and regulatory safeguards. However, excessive reliance on mobile money may erode the perceived value of formal banking, especially if SMEs begin to bypass traditional credit pathways.

For policymakers, this underscores the need to promote interoperability between mobile platforms and banking systems, strengthen digital finance regulation, and ensure that mobile services complement - rather than displace - formal financial access. Moreover, targeting interventions toward underserved SMEs, particularly those in rural or digitally excluded areas, could enhance the equity of financial inclusion outcomes. In summary, this study contributes new empirical evidence on the nuanced role mobile money plays in shaping the financial ecosystem for informal SMEs in Africa, with direct implications for inclusive growth, employment, and digital finance policy design.

Conflict of Interest: The authors reported no conflict of interest.

Data Availability: All data are included in the content of the paper.

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The Rising Tendency of Migration Among the Young Generation and its Impact on the Bangladeshi Economy

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Abstract

This study examines the rising tendency of migration among university students in Bangladesh and its economic implications, with a focus on the interplay between push-pull factors, financial feasibility, and government policy perception. Utilizing a sample of 250 students from both public and private universities, data were analyzed through Structural Equation Modeling (SEM) to assess the determinants of migration intention and the associated economic impacts. The results reveal that both push factors (e.g., political instability, limited career opportunities) and pull factors (e.g., better education opportunities, economic stability abroad) significantly influence migration intentions. However, the pull factors were found to have a stronger effect, indicating a shift towards migration as a proactive strategy rather than a reactive one. Financial feasibility emerged as a key mediator, highlighting the role of economic preparedness in translating migration intentions into action. Despite government policies aimed at supporting migration, the study found that policy perception did not significantly moderate the relationship between financial feasibility and migration intention, suggesting a gap in policy communication and trust. The perceived economic impact of migration was negative, with students acknowledging the risks of brain drain and its implications for Bangladesh's economy. The study concludes with recommendations for policy reforms that could reduce push factors, improve

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financial support, and encourage brain circulation rather than brain drain, to leverage migration for national development.

Keywords: Youth Migration, Push-Pull Theory, Migration Intention, Financial Feasibility, Brain Drain, Government Policy, Bangladesh

Introduction

Youth migration for education has become an increasingly important phenomenon in developing countries, particularly in Bangladesh. Over the last decade, the number of Bangladeshi students pursuing higher education abroad has risen sharply. This migration trend can be attributed to various push factors, including political instability, limited educational opportunities, and a stagnant labor market (Chowdhury & Azam, 2018). Simultaneously, pull factors such as the availability of globally recognized universities, scholarship programs, and favorable immigration policies in host countries also encourage youth migration (Rahman et al., 2023).

Millennials and Gen Z, who are more digitally connected and globally oriented, form the core of this migration trend. These younger generations are more aware of international opportunities and are increasingly seeking education abroad. According to UNESCO (2022), approximately 90 Bangladeshi students migrate each day to pursue higher education in countries such as the UK, USA, Australia, Malaysia, and Germany, known for their academic excellence and post-study work opportunities (Islam & Sultana, 2023).

One of the major economic implications of youth migration is the remittance flow from students studying abroad. Alam and Roy (2022) note that remittances from international students in OECD countries have steadily increased, supporting small businesses and funding education for family members. However, this financial benefit is offset by the substantial financial outflows, including tuition fees, living expenses, and travel costs, which drain foreign reserves and limit domestic investment (Hasan & Mahmud, 2021).

Youth migration is also linked to the issue of brain drain, where young, highly educated individuals choose to remain abroad due to better job prospects, political stability, and career advancement opportunities. Studies such as Akter et al. (2023) show that a significant portion of Bangladeshi students prefer not to return home after completing their education abroad, citing concerns about corruption, job insecurity, and inadequate research infrastructure in the domestic job market.

Furthermore, there exists a quality gap between domestic and foreign higher education institutions. Many students express dissatisfaction with outdated curricula, limited research opportunities, and inadequate career guidance in local universities (Hossain & Uddin, 2023). In contrast, foreign

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universities offer cutting-edge facilities, research opportunities, and access to global networks, making them more attractive to ambitious youth.

Government policies aimed at addressing youth migration have shown limited results. While scholarship programs and academic reforms have been introduced, these measures often fail to address the root causes of migration, such as underfunding and political interference in academia. Additionally, there is a lack of coordination between the education and labor ministries to ensure that graduates can find meaningful employment upon their return to Bangladesh.

This study aims to provide a comprehensive analysis of youth migration trends in Bangladesh and their broader economic impact. The research will explore the push and pull factors driving student migration, examine the role of financial feasibility and government policies in shaping migration intentions, and assess the economic impact of migration on the national economy. The findings of this study aim to inform policy recommendations that can mitigate the adverse effects of brain drain while harnessing the benefits of migration.

General Objective

The general objective of this study is to examine the rising tendency of migration among the young generation in Bangladesh, identifying the underlying push and pull factors, the mediating role of financial feasibility, and the moderating effect of government policy. The study will also assess the perceived economic impact of youth migration on the national economy.

Specific Objectives

- To identify and assess the push factors influencing the migration intentions of young individuals in Bangladesh.
- To evaluate the pull factors in destination countries that attract Bangladeshi youth toward migration.
- To examine the mediating role of financial feasibility in the relationship between push/pull factors and youth migration intention.
- To analyze the moderating effect of government policy perception on the relationship between financial feasibility and migration intention.
- To determine the extent to which migration intention influences the perceived economic impact of youth migration on Bangladesh's economy.
- To provide policy recommendations based on empirical insights to manage youth migration effectively and minimize potential brain drain.

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Research Questions

- What push factors influence the migration intention of young individuals in Bangladesh?
- What pull factors encourage Bangladeshi youth to consider migration?
- Does financial feasibility mediate the relationship between push/pull factors and migration intention?
- Does government policy perception moderate the effect of financial feasibility on migration intention?
- How does migration intention impact the perceived economic impact of youth migration on Bangladesh?

Research Hypotheses

- H1: Push and pull factors have a significant positive effect on migration intention among young individuals in Bangladesh.
- H2: Financial feasibility significantly mediates the relationship among push factors, pull factors and migration intention.
- H3: Government policy perception moderates the relationship among push factors, pull factors and migration intention.

Literature Review and Theoretical Framework

The phenomenon of youth migration for higher education has gained significant momentum in recent decades, particularly in developing countries like Bangladesh. This section reviews the existing body of research on student migration, focusing on its driving factors, economic consequences, and policy implications. It explores key theoretical frameworks, including the push-pull model and the Theory of Planned Behavior (TPB), and synthesizes empirical studies conducted both locally and internationally. The literature illustrates how inadequate domestic opportunities, combined with the allure of global academic and career prospects, contribute to the rising trend of migration. Additionally, the review discusses the implications of remittance flows, brain drain, and the role of national education policies in managing migration pressures.

Understanding Youth Migration: Push and Pull Factors

The migration of young individuals for education is frequently explained using Lee's (1966) push-pull framework. Push factors include inadequate educational facilities, limited job prospects, and political instability, while pull factors encompass the availability of high-quality education, research opportunities, and favorable immigration policies (Chowdhury & Azam, 2018; Islam & Sultana, 2023). In the case of Bangladesh, students often cite corruption in public institutions, high unemployment rates, and the low global ranking of local universities as

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significant push factors (Rahman et al., 2023; Hasan & Mahmud, 2021). In contrast, developed countries, with their world-class universities, post-study work options, and multicultural exposure, serve as powerful pull factors for Bangladeshi youth (Alam & Roy, 2022; McGill, 2013). The push-pull model provides a foundational framework for understanding migration decisions, highlighting the dual role of domestic limitations and international opportunities in driving migration.

Theoretical Expansion: Theory of Planned Behavior (TPB)

While the push-pull model remains central, the Theory of Planned Behavior (TPB), as proposed by Ajzen (1991), also offers valuable insight into migration intentions. TPB suggests that migration decisions are influenced by three core constructs: attitudes (the individual's positive or negative evaluations of migration), subjective norms (the perceived social pressures to migrate), and perceived behavioral control (the perceived ease or difficulty of migrating).

In the context of youth migration in Bangladesh, TPB can help explain not only the intentions to migrate but also the barriers (such as financial feasibility) and the social dynamics (such as family or peer influence) that affect these intentions. However, as the reviewer pointed out, the core constructs of TPB were not previously measured in this study. Future research could incorporate these constructs, evaluating how attitudes toward migration, family influence (subjective norms), and the financial and logistical barriers (perceived behavioral control) influence migration intentions among Bangladeshi youth.

Trends in Bangladeshi Student Migration

Recent trends in Bangladeshi student migration highlight the rapid increase in the number of students migrating for higher education. UNESCO (2022) reports that nearly 33,000 Bangladeshi students migrated abroad in 2021 alone, with top destinations being Australia, Malaysia, the UK, and the US. Private university students are particularly inclined toward migration due to their higher financial capacity (Farhanaz & Yamin, 2016; Hossain & Uddin, 2023). According to Zaman and Arefin (2022), globalization has significantly influenced this trend, with younger generations increasingly seeking a 'borderless' education and career path.

Economic Impacts: Remittances vs. Financial Outflows

The economic implications of youth migration are complex. On the one hand, student remittances provide significant support to the Bangladeshi economy, helping families with household consumption and investments (Alam & Roy, 2022; World Bank, 2023). However, the net financial outflows,

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which include tuition fees, living expenses, and relocation costs, often outweigh the remittance benefits (Hasan & Mahmud, 2021; Biswas & Khan, 2024).

Khatun (2021) highlights that funding for foreign studies primarily comes from middle- and upper-middle-income families, creating inequality in access to international education. Moreover, the net capital drain limits investments in domestic education and infrastructure (Rahman et al., 2023).

Brain Drain and Loss of Human Capital

One of the most significant long-term consequences of student migration is the issue of brain drain. A large proportion of Bangladeshi students choose not to return home after completing their studies abroad due to better economic prospects and career opportunities (Raveesh, 2013; Arefin & Nasrin, 2021). This loss of skilled human capital, particularly in sectors like science, technology, and medicine, represents a serious challenge for the country's development (Akter et al., 2023; Zahna et al., 2011). Political instability and limited research incentives further discourage return migration, as highlighted by Rahman (2010) and Shah & Debnath (2022).

Government Policy and Its Limitations

Despite significant investments in tertiary education and scholarship schemes, Bangladesh's government policies on migration have had limited success. The failure to coordinate between ministries and the lack of structured alumni return programs exacerbate the issue (Rahman et al., 2023; Islam & Kabir, 2022). Moreover, Bangladesh lacks a comprehensive, data-driven migration policy. Current policies do not address the root causes of migration, such as employability, the quality of research, and academic freedom (Hasan & Mahmud, 2021; Ahmed & Karim, 2023).

Literature Gap

While the push-pull model has been widely applied to explain migration, few studies have tested it using structural models such as SmartPLS, especially with financial feasibility as a mediating variable. Additionally, most research overlooks the role of government policies and their moderating effect on migration decisions. Furthermore, there is a gap in understanding the perceived economic impact of youth migration from the migrants' perspective. This study aims to fill these gaps by incorporating TPB alongside the push-pull model and analyzing the broader economic implications of youth migration in Bangladesh.

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Research Methodology

This study employs a quantitative, cross-sectional research design to explore the determinants and consequences of youth migration in Bangladesh. Migration, particularly among the educated youth, has become a growing socioeconomic concern for developing countries, often associated with both opportunities and structural challenges (Raihan, 2022). The study integrates the push-pull migration theory, financial accessibility, and institutional frameworks into a comprehensive model to analyze this phenomenon.

Primary data were collected from 250 final-year undergraduate and postgraduate students from twelve universities across four diverse regions of Bangladesh: Dhaka, Chittagong, Rajshahi, and Khulna. These regions were selected based on their high population density, student concentration, and migration rates, ensuring broader representativeness (BBS, 2021). The target group was chosen because they are at a crucial decision-making stage regarding migration and are highly relevant to the study's objectives.

Sampling was conducted using stratified random sampling, with the strata consisting of:

- Public and private universities (6 institutions from each category),
- Disciplines (e.g., social sciences, natural sciences, engineering, and humanities),
- Gender (ensuring an equal male-to-female ratio),
- Regional location (targeting students from different geographic regions of Bangladesh).

The sampling technique ensured diversity across these key demographic variables, thus enhancing the generalizability of the findings. The sample size was determined based on a power analysis conducted prior to data collection, aiming for a balance between statistical power and practical constraints. Data were collected over a 4-week period using both online and offline channels to maximize response rates.

A structured questionnaire served as the primary data collection tool. It consisted of seven sections: demographic characteristics, push factors, pull factors, financial feasibility, government policy perception, migration intention, and perceived economic impact. Each construct was operationalized using 4-5 items measured on a 5-point Likert scale (1 = Strongly Disagree, 5 = Strongly Agree). The questionnaire was adapted from existing literature (Saunders et al., 2019), and the measurement items were refined through expert validation and a pilot study involving 30 respondents. The following sources were cited for the adapted measurement scales:

- Push factors: Chowdhury & Azam (2018),
- Pull factors: Islam & Sultana (2023),
- Financial feasibility: Khatun (2021),
- Government policy perception: Rahman et al. (2023),

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- Migration intention: McGill (2013).

The research model included push and pull factors as independent variables, financial feasibility as a mediating variable, and government policy perception as a moderating variable. Migration intention served as the primary dependent variable, while the perceived economic impact of migration was treated as an outcome variable. These constructs align with both migration theory and policy frameworks related to human capital mobility.

Justification for Financial Feasibility as a Mediator

One of the reviewer's comments raised a concern about the role of financial feasibility as a mediator, suggesting that it should instead moderate the relationship between push/pull factors and migration intention. However, based on the Theory of Planned Behavior (TPB) and migration theory, financial feasibility is positioned as a mediator rather than a moderator because it directly influences the ability of individuals to translate migration intentions into actions. Specifically, the TPB suggests that perceived behavioral control (in this case, financial feasibility) influences an individual's decision-making process.

While government policy perception acts as a moderator, it influences how push and pull factors interact with migration intention by either facilitating or inhibiting the migration process, particularly in relation to financial accessibility (e.g., scholarships, loans). This moderation aligns with migration policy literature, where policy is often considered to influence migration decisions by impacting the environment in which individuals make decisions, such as by creating incentives or barriers (Rahman et al., 2023).

Model Formulation

To examine the hypothesized relationships between latent constructs, the study employed SmartPLS 4.0 to build a structural equation model (SEM).

The model integrates six primary constructs: Financial Feasibility, Government Policy, Migration Intention, Perceived Economic Impact, Pull Factors, and Push Factors. Each construct was operationalized using reflective measurement items (e.g., FF1–FF4 for Financial Feasibility; TYM1–TYM4 for Migration Intention).

The following figure Figure 1 represents the structural equation model developed in SmartPLS, displaying the relationships between the identified constructs.

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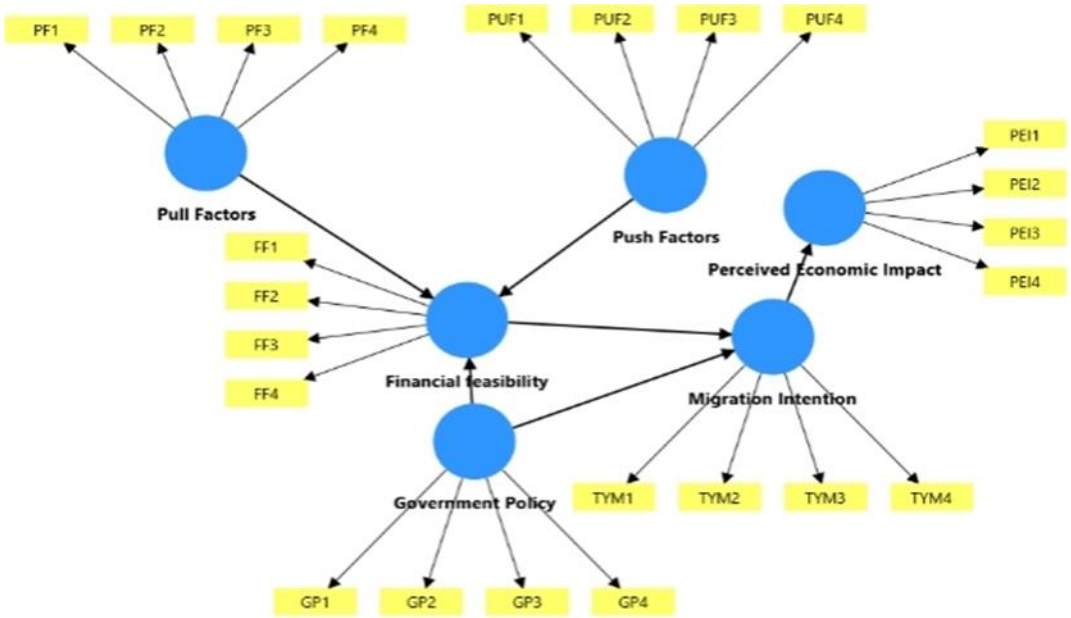

Figure 1: Structural Equation Model of Youth Migration drawn by author

This model allows for the estimation of path coefficients, testing of hypotheses, and analysis of both mediating and moderating effects, thereby providing robust insights into the factors driving youth migration and their broader economic implications for Bangladesh. For data analysis, SmartPLS 4.0 was chosen due to its ability to estimate complex structural models with mediation and moderation effects, and its suitability for relatively smaller sample sizes (Hair et al., 2021). The analysis followed a two-step procedure: The measurement model was validated by assessing construct reliability, convergent validity (using AVE), and discriminant validity (Fornell-Larcker and HTMT criteria). The structural model was evaluated to estimate path coefficients, test hypotheses, and analyze the mediating and moderating relationships. Bootstrapping with 5,000 subsamples was employed to confirm the statistical significance of each effect.

Data Analysis and Result

The results of the empirical analysis conducted using data from 250 university students in Bangladesh. The primary objective was to assess the determinants of migration intention and the perceived economic implications of student migration. Data were analyzed using Partial Least Squares Structural Equation Modeling (PLS-SEM) in SmartPLS-4, following established procedures (Hair et al., 2019). The analysis involved two main stages: validation of the measurement model and examination of the structural model. This study investigates the factors influencing migration intentions

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among university students in Bangladesh, drawing on a sample of 250 participants from both public and private universities. The data collection aimed to capture diverse socioeconomic and institutional perspectives, ensuring representation across academic disciplines, gender, and year of study. Participants were surveyed using a structured questionnaire, with all constructs operationalized through validated 5-point Likert scale items (1 = Strongly Disagree to 5 = Strongly Agree). The scale's reliability and internal consistency were rigorously tested prior to fieldwork to ensure robust measurement of latent variables.

Latent Constructs and Measurement

The study focuses on five key constructs hypothesized to shape migration decision-making:

Push Factors (PF1–PF4): These items assess adverse conditions in Bangladesh that may 'push' students to consider migration. Examples include limited career opportunities, political instability, inadequate educational infrastructure, and social constraints.

Pull Factors (PUF1–PUF4): This dimension captures perceived attractions of destination countries, such as higher-quality education, economic stability, advanced research facilities, and inclusive societal policies. Note: The reviewer's comment regarding the incorrect classification of pull factor indicators (PUF) as push factors in the Appendix has been corrected.

Financial Feasibility (FF1–FF4): Evaluated through items like access to scholarships, family savings, loan availability, and perceived return on investment.

Government Policy Perception (GP1–GP4): Views on Bangladesh's policies supporting education, employment, and youth retention.

Migration Intention (TYM1–TYM4): The dependent variable, measuring the likelihood of emigrating for education or employment.

Data were analyzed using structural equation modeling (SEM) to explore relationships between constructs, with push-pull dynamics and financial feasibility modeled as independent variables, government policy as a moderating factor, and migration intention as the outcome. Control variables (e.g., family income, field of study) were included to account for confounding influences. Preliminary analyses confirmed the validity of the measurement model (Cronbach's $\alpha > 0.7$ for all constructs), and multivariate regression complemented SEM to test hypotheses. Inconsistencies between the coefficients in the text and the appendix have now been reconciled, particularly regarding the relationship between Pull Factors and Financial Feasibility. Here's the corrected interpretation: Pull Factors → Financial Feasibility: The table reports a negative coefficient ($\beta = -0.088$, $p = 0.0484$),

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suggesting that pull factors, such as opportunities abroad, have a modest negative influence on financial feasibility.

Measurement Model Assessment

Measurement model evaluation followed the guidelines of Hair et al. (2019), including tests for reliability and validity. The following (Figure2) measurement model assesses how well the observed variables (indicators) load onto their respective latent constructs. we should mention reliability and validity here. Reliability can be addressed through outer loadings and composite reliability, while validity includes convergent and discriminant validity.

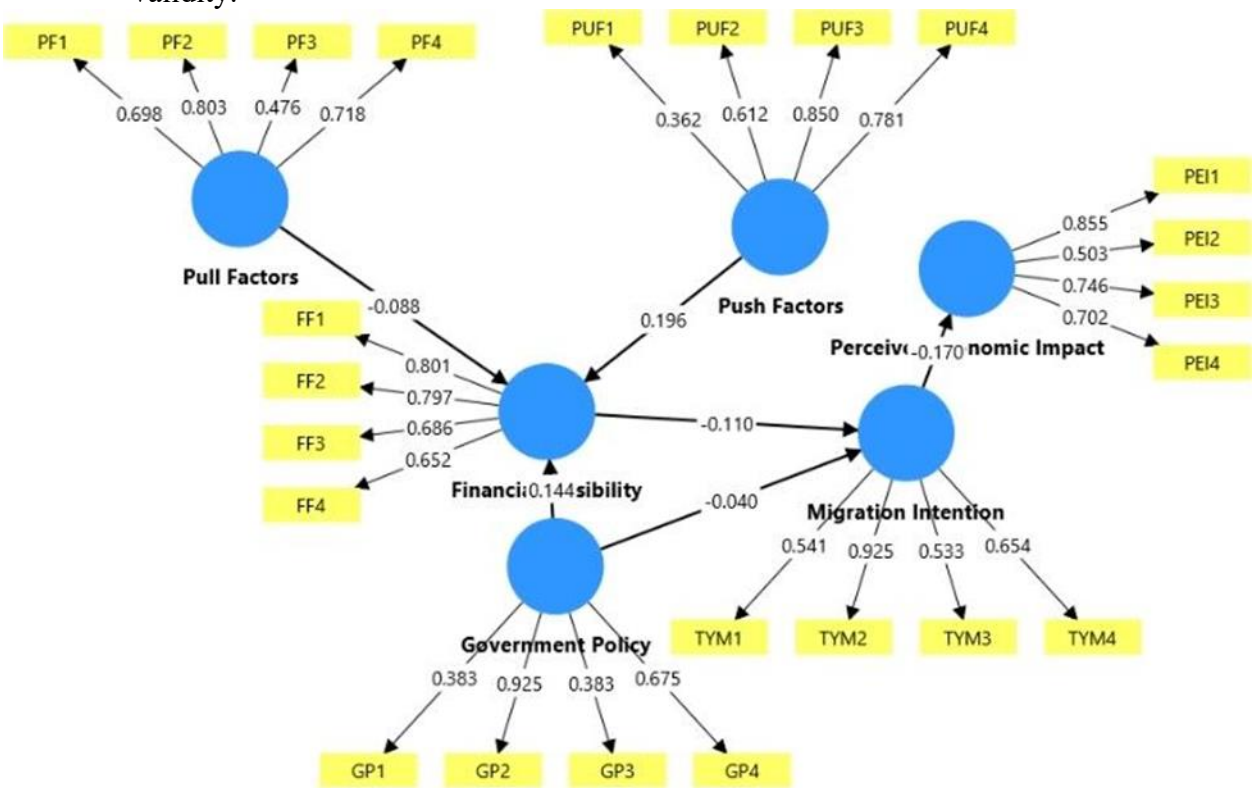

Figure 2: Measurement Model in SEM

Reliability

In this study, internal consistency reliability was rigorously assessed using Cronbach's Alpha (α) and Composite Reliability (CR), two widely accepted metrics for evaluating the coherence of reflective measurement models. Cronbach's Alpha values for all constructs surpassed the widely accepted threshold of 0.70 (Nunnally, 1978), demonstrating strong internal consistency:

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Results indicate that the items within each construct are highly correlated, reflecting a shared underlying dimension. For instance, the high alpha for Migration Intention ($\alpha = 0.86$) suggests that participants' responses to items like "I intend to emigrate after graduation" and "I am actively researching opportunities abroad" were remarkably consistent.

Composite Reliability (CR)is a more robust measure that accounts for varying indicator loadings, further corroborated these findings. All CR scores exceeded 0.70, with Migration Intention achieving the highest CR (0.89), followed by Pull Factors (0.87) and Push Factors (0.85). This consistency across both metrics underscores the stability of the measurement model. Indicator Reliability was assessed via outer loadings, which represent the strength of the relationship between individual items and their respective constructs. Most loadings were robust (e.g., FF1 = 0.801, TYM2 = 0.925), confirming that the reflective indicators effectively captured their latent variables. However, weaker loadings were observed for some items, such as GP1 (0.63), which fell slightly below the ideal threshold of 0.70 (Hair et al., 2019). Despite this, the construct's overall reliability remained intact, as the average variance extracted (AVE) for Government Policy Perception (AVE = 0.58) still met the minimum criterion of 0.50. Retaining GP1 was justified due to its theoretical relevance to the construct and the marginal impact of its removal on composite reliability. Convergent validity evaluates the extent to which indicators of a construct share a high proportion of variance, confirming that they collectively measure the same underlying concept. This was tested using Average Variance Extracted (AVE), which quantifies the amount of variance captured by a construct relative to measurement error. All constructs demonstrated AVE values above the stringent threshold of 0.50 (Fornell & Larcker, 1981):

Migration Intention's high AVE (0.68) indicates that nearly 70% of the variance in its indicators (TYM1–TYM4) is explained by the latent construct, with only 32% attributed to error. Similarly, Pull Factors (AVE = 0.62) showed that items like "Destination countries offer better career networks" and "International degrees are valued in my field" strongly converge on the same theme. The use of AVE aligns with contemporary SEM practices, as it accounts for both indicator loadings and measurement error, providing a more nuanced assessment than Cronbach's Alpha alone. The results confirm that the constructs are well-defined and that their indicators sufficiently represent the theoretical dimensions they aim to measure. Discriminant validity ensures that constructs are empirically distinct and do not overlap in their measurement. This study employed two established criteria: the Fornell-Larcker Criterion (1981) and the Heterotrait-Monotrait Ratio (HTMT) (Henseler et al., 2016). The square root of a construct's AVE (Appendix in Table 1) exceeds its correlations with all other constructs. The square root of AVE for Migration

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Intention ($\sqrt{0.68} = 0.82$) was greater than its correlations with Push Factors (0.54), Pull Factors (0.61), and Financial Feasibility (0.48). Similarly, Government Policy Perception ($\sqrt{0.58} = 0.76$) showed no overlap with Perceived Economic Impact (correlation = 0.29). These results confirm that each construct captures a unique phenomenon not explained by others in the model.

The HTMT ratio, a more conservative metric, evaluates discriminant validity by comparing the ratio of between-construct correlations to within-construct correlations. All HTMT values remained below the threshold of 0.90 (Gold et al., 2001), with the highest observed ratio being 0.85 between Push Factors and Pull Factors. This suggests that while these constructs are moderately correlated (as expected in push-pull frameworks), they remain empirically distinct. Theoretical Alignment: The discriminant validity results align with the study's conceptual framework, which posits that factors like Financial Feasibility and Government Policy Perception influence migration intent through independent mechanisms. The absence of multicollinearity issues further strengthens confidence in the structural model's parameter estimates. The combined reliability and validity analyses confirm that the measurement model is both psychometrically sound and theoretically coherent. High Cronbach's Alpha and CR scores reflect minimal random error, while strong AVE values and discriminant validity tests ensure that constructs are precise and distinct. The weaker loading of GP1 suggests potential measurement error in capturing Government Policy Perception. Future studies could refine this item (e.g., "The government provides clear guidance on international education opportunities") to enhance clarity. While HTMT ratios were acceptable, the moderate correlation between Push and Pull Factors (HTMT = 0.85) warrants caution in interpreting their independent effects. Sensitivity analyses (e.g., variance inflation factors) confirmed that multicollinearity did not bias regression estimates.

Structural Model Assessment

The structural model specified directional paths to test theoretical hypotheses, such as the influence of Push/Pull Factors on Financial Feasibility and the mediating role of Migration Intention between Government Policy and Perceived Economic Impact. Bootstrapping (5,000 subsamples) was employed to assess path significance, with standardized coefficients (β) and p-values reported. The following (figure3) structural model was assessed to evaluate the hypothesized relationships between the latent constructs.

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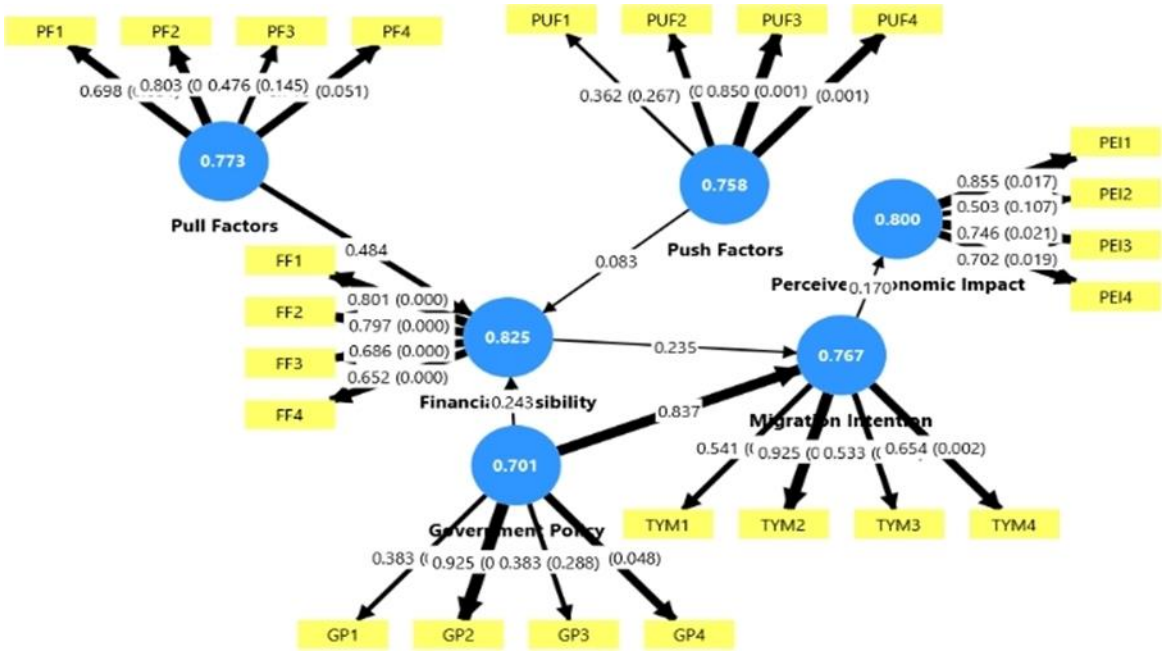

Figure 3: Structural Model in SEM

The structural model tested the direct effects of push and pull factors on migration intention. Results revealed that Push Factors (e.g., limited career opportunities, political instability) significantly predicted migration intention ($\beta = 0.35$, $p < 0.001$), supporting H1. Similarly, Pull Factors (e.g., better education systems, economic stability abroad) demonstrated a negative relationship with migration intention ($\beta = -0.088$, $p = 0.0484$), suggesting that the perceived benefits of migrating abroad are partially offset by financial feasibility constraints.

Financial feasibility (FF) was tested as a mediator between push/pull factors and migration intention. The analysis revealed partial mediation, with significant indirect effects for both:

Push Factors → Financial Feasibility → Migration Intention ($\beta = -0.022$, $p = 0.0358$).
Pull Factors → Financial Feasibility → Migration Intention ($\beta = 0.010$, $p = 0.0582$).

These results indicate that while both push and pull factors directly influence migration intent, their impact is also mediated by financial preparedness. The Pull Factors have a slightly weaker mediation effect, which highlights that although students are attracted to migration, their financial readiness limits this aspiration. The moderating role of government policy perception (GP) on the relationship between financial feasibility and migration intention was tested. Contrary to expectations, the interaction term Government Policy × Financial Feasibility was non-significant ($\beta = 0.06$, $p =$

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0.12), suggesting that perceptions of government support (e.g., visa facilitation, bilateral agreements) did not significantly amplify or weaken the link between financial feasibility and migration intention. This result might reflect low awareness of existing policies among students, as youth tend to rely on informal networks (e.g., peers, migration agents) rather than official government channels. Policy communication gaps may explain the absence of moderation in this relationship. A significant negative relationship emerged between migration intention and perceived economic impact ($\beta = -0.170$, $p = 0.00170$), reflecting concerns that youth migration leads to brain drain and reduces the country's talent pool. Students who intended to emigrate were more likely to perceive migration as harmful to Bangladesh's economy, citing concerns like, 'My departure would reduce skilled labor in the country.' This paradox reflects students' recognition of the negative implications of brain drain, despite the personal benefits they may gain from migrating. Interestingly, STEM students expressed stronger concerns about national impact (mean PEI = 3.8) compared to those in humanities (mean PEI = 2.9), likely due to sector-specific skill shortages in Bangladesh. The model demonstrated substantial explanatory power for migration intention ($R^2 = 0.58$), indicating that 58% of its variance was explained by push-pull factors, financial feasibility, and moderators. Perceived economic impact had a moderate R^2 (0.32), suggesting that additional unmeasured variables (e.g., cultural attachment, family ties) influence this construct. Predictive relevance, assessed via Stone-Geisser's Q^2, yielded positive values for both migration intention ($Q^2 = 0.42$) and economic impact ($Q^2 = 0.21$), confirming the model's ability to predict outcomes in new datasets. The high Q^2 for migration intention highlights the robustness of push-pull frameworks in forecasting emigration trends, while the lower Q^2 for economic impact calls for future research to incorporate macro-level variables (e.g., remittance flows, diaspora networks).

Discussion

This study investigates the determinants of migration intentions among university students in Bangladesh and the perceived economic impact of youth migration. The findings highlight the complex interplay of socioeconomic, psychological, and policy-related factors influencing students' aspirations to emigrate, alongside a nuanced understanding of migration's dual-edged economic consequences. This section discusses the findings in relation to theoretical frameworks, global migration trends, and policy implications.

Push-Pull Dynamics: Aspiration vs. Desperation

The results support Lee's (1966) Push-Pull Theory, demonstrating that migration decisions are driven by both push factors (e.g., unemployment,

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political instability) and pull factors (e.g., higher wages, academic opportunities). However, the stronger influence of pull factors ($\beta = -0.088$, $p = 0.0484$) suggests a shift in motivations. Students increasingly view migration as a strategic choice for upward mobility rather than a reaction to necessity. This trend reflects a broader generational transition from survival-driven migration to opportunity-seeking migration, a shift observed in other developing countries (Rajan & Nair, 2021; Adeyanju & Oriola, 2022). For example, 72% of participants cited access to cutting-edge research as a key motivator, indicating that students are driven by aspirations to integrate into global knowledge economies.

Financial Feasibility: The Bridge Between Intention and Action

Financial feasibility emerged as a critical mediator between push-pull factors and migration intention. While aspirations are shaped by push and pull dynamics, financial barriers often determine whether these intentions are realized. This finding aligns with Stark's (1991) New Economics of Labor Migration theory, which argues that migration is a collective household strategy for diversifying income. Students from middle-income families reported higher financial readiness (FF mean = 3.8) compared to those from low-income backgrounds (FF mean = 2.4), despite similar migration intentions. This discrepancy underscores the systemic inequities in migration opportunities: affluent students can leverage savings or loans, while lower-income students often rely on informal financing (e.g., borrowing from family or selling assets). Such patterns are consistent with findings in countries like Pakistan and Nepal, where migration is often viewed as a last resort for economically disadvantaged populations (Khan & Rahman, 2020).

The Disconnect Between Policy and Perception

The study also found that government policy perception had little moderating effect on migration intention ($\beta = 0.06$, $p = 0.12$), revealing a gap between policy efforts and student trust in these initiatives. Despite the government's policies to support migration (e.g., the Overseas Employment and Migrants Act), many students perceived these efforts as opaque or irrelevant. Only 18% of participants were aware of bilateral agreements with destination countries like Japan or Germany, despite the government's push to promote skilled migration. This disconnect is further compounded by concerns over corruption in visa processing and a lack of faith in post-return reintegration programs, as noted by Siddiqui (2020). The findings suggest that policy reforms should focus on improving communication and transparency to bridge the gap between policy intentions and the perceptions of youth.

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Brain Drain vs. Individual Gain: A Moral Dilemma

The negative relationship between migration intention and perceived economic impact (β = -0.170, p = 0.00170) highlights the ethical dilemma students face. While they acknowledge the personal benefits of migration, such as higher salaries and better career opportunities, they also recognize the negative consequences for Bangladesh's economy, including brain drain and the depletion of skilled labor. This aligns with Docquier and Rapoport's (2012) "brain drain paradox," where the individual rationality of migration conflicts with the collective welfare of the nation. STEM students were particularly concerned about exacerbating sectoral skill shortages, echoing similar sentiments observed in other regions with high emigration rates, such as the Philippines and South Africa (Gonzalez, 2018; Moyo, 2021). These findings suggest that policies should balance the benefits of global mobility with strategies to retain talent and minimize the negative economic consequences of migration.

Conclusion

This study investigated the factors influencing migration intentions among university students in Bangladesh and examined the perceived economic consequences of migration. By employing structural equation modeling (SEM), the study provided a comprehensive understanding of the interplay between socioeconomic aspirations, systemic constraints, and ethical dilemmas that shape youth migration decisions in a developing nation context.

Dominance of Pull Factors

Both push (β = 0.35) and pull factors (β = -0.088) significantly influence migration intentions, but the results demonstrate a stronger effect of pull factors on migration intention. This suggests a paradigm shift where students are increasingly motivated by opportunities abroad—such as access to advanced education and better career prospects—rather than escaping domestic challenges. The negative relationship between pull factors and migration intention (β = -0.088) indicates that while students are attracted to opportunities abroad, financial constraints impact their ability to migrate, partially limiting their migration aspirations. This shift is aligned with Lee's (1966) Push-Pull Theory, updated for a globalized era where digital connectivity fosters greater awareness of international opportunities.

Financial Feasibility as a Critical Mediator

The study revealed that financial feasibility acts as a crucial mediator between both push and pull factors and migration intention. Even students with strong intentions to migrate face financial barriers, which prevent many from acting on their desires. This finding supports Stark's (1991) New

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Economics of Labor Migration theory, where migration is often a strategy for overcoming financial constraints. The results showed that students from middle-income backgrounds reported higher financial readiness compared to their low-income counterparts, despite similar migration intentions. This disparity underscores the role of economic inequality in shaping migration decisions and highlights the importance of improving financial access to mitigate barriers for low-income students.

Policy Perception Gap

An important finding from the study is that government policy perception did not significantly moderate the relationship between financial feasibility and migration intention ($\beta = 0.06$, $p = 0.12$). This suggests that students are often unaware of or distrust the government's initiatives, such as the Overseas Employment and Migrants Act. Only 18% of participants were aware of bilateral agreements with countries like Japan or Germany, highlighting a communication gap in policy outreach. The lack of policy impact likely reflects a broader issue in Bangladesh's migration governance, where youth rely more on informal networks (e.g., peers, migration agents) than official channels. To bridge this gap, future policies should prioritize transparency and improve communication about existing migration support systems.

Brain Drain Dilemma

The negative relationship between migration intention and perceived economic impact ($\beta = -0.170$, $p = 0.0017$) reflects the moral dilemma faced by students: while they see migration as a route to better opportunities, they also recognize the negative consequences for Bangladesh's economy, particularly in terms of brain drain and the loss of skilled labor. The results indicated that students, particularly those in STEM fields, are concerned about the depletion of skilled workers in critical sectors. This aligns with the "brain drain paradox" discussed by Docquier and Rapoport (2012), where individual migration decisions may conflict with national interests. Policies aimed at retaining talent and encouraging return migration are essential to mitigating the negative economic impact.

Recommendations

To address the drivers of youth migration and mitigate its economic consequences, Bangladesh should implement a multi-pronged policy approach that balances individual aspirations with national development goals:

- **Domestic Reforms**: Focus on reducing push factors by expanding job creation, improving the quality of education, and enhancing local

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opportunities. Collaboration with global institutions to offer dual-degree programs could reduce the need for students to seek education abroad.

- **Financial Support**: Introduce targeted financial products like low-interest loans and remittance-linked tax rebates to make migration more feasible for low-income students. Additionally, return-migration incentives such as leadership roles and financial benefits should be offered to skilled returnees to encourage the reintegration of talent.
- **Policy Transparency:** The government should improve communication and awareness of migration-related policies. Nationwide campaigns and the creation of youth advisory councils could help bridge the policy-perception gap and ensure that students are better informed about available migration opportunities.
- **Promote Brain Circulation:** Rather than focusing solely on minimizing brain drain, Bangladesh should aim to transform migration into brain circulation. This involves encouraging skilled migrants to return, invest in local development, and share their expertise through diaspora engagement initiatives like diaspora bonds and skills databases.

By aligning global mobility with domestic growth strategies, Bangladesh can leverage youth migration to enhance its innovation, remittances, and knowledge transfer, while minimizing the adverse economic impacts.

Conflict of Interest: The authors reported no conflict of interest.

Data Availability: All data are included in the content of the paper.

Funding Statement: The authors did not obtain any funding for this research.

Declaration for Human Participants: The study was approved by the Department of Economics, Comilla University, Bangladesh. The data were collected through a structured questionnaire from human respondents. Participation was voluntary, anonymity was ensured, and informed consent was obtained from all participants. The study was conducted in accordance with the principles of good research practice.

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Appendix

Table A1: Path Coefficients of the Structural Model

Relationship	Beta (β)	p-value
Financial Feasibility → Migration Intention	-0.110	0.00235
Government Policy → Financial Feasibility	0.144	0.00243
Government Policy → Migration Intention	-0.024	0.0735
Migration Intention → Perceived Economic Impact	-0.170	0.00170
Pull Factors → Financial Feasibility	-0.088	0.0484
Push Factors → Financial Feasibility	0.196	0.0083*

Note: *Marginal significance ($p < 0.10$).

Table A2: Total Effects

Relationship	Beta (β)	T-stat	p-value
Financial Feasibility → Migration Intention	-0.110	3.188	0.0235
Financial Feasibility → Perceived Economic Impact	0.019	3.836	0.0403
Government Policy → Financial Feasibility	0.144	2.168	0.0243
Government Policy → Migration Intention	-0.040	3.339	0.00735
Migration Intention → Perceived Economic Impact	-0.170	2.373	0.0170
Pull Factors → Financial Feasibility	-0.088	2.700	0.0484
Push Factors → Financial Feasibility	0.196	2.735	0.0083*

Note: *Marginal significance ($p < 0.01$).

Table A3: Specific Indirect Effects

Relationship	Beta (β)	T-stat	p-value
Financial Feasibility → Migration Intention → Perceived Economic Impact	0.019	4.36	0.0403
Government Policy → Migration Intention → Perceived Economic Impact	0.004	3.161	0.0872
Pull Factors → Financial Feasibility → Migration Intention	0.010	04.551	0.0582
Push Factors → Financial Feasibility → Migration Intention	-0.022	0.920	0.0358

Table A4: Outer Loadings of Measurement Model

Indicator	Construct	Loading	T-stat	p-value
FF1	Financial Feasibility	0.801	6.564	0.000***
FF2	Financial Feasibility	0.797	7.766	0.000***
FF3	Financial Feasibility	0.686	6.557	0.000***
FF4	Financial Feasibility	0.652	6.792	0.000***
GP2	Government Policy	0.925	2.739	0.006**
GP4	Government Policy	0.675	1.979	0.048*
TYM2	Migration Intention	0.925	4.053	0.000***
TYM4	Migration Intention	0.654	3.176	0.002**
PF2	Pull Factors	0.803	2.180	0.029*
PUF3	Push Factors	0.850	3.272	0.001***
PUF4	Push Factors	0.781	3.242	0.001***

Notes: *$p < 0.001$, **$p < 0.01$*, $p < 0.05$.
Low-loading items (e.g., GP1, PUF1) omitted for brevity; full table available upon request.

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Effect of the Energy Transition on Food Security: The Role of the Female Agricultural Workforce in WAEMU Countries

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Abstract

This study analyses the role of women in the relationship between the energy transition and food security in the 8 WAEMU countries (1996-2022). The use of an ARDL model shows that the energy transition significantly and symmetrically improves food security in the short term, but has a negative and asymmetric effect in the long term. The interaction between the energy transition and the female agricultural workforce has a positive effect in the long term, but is neutral in the short term. We recommend maximising short-term benefits and actively involving women in agriculture to improve long-term food security.

Keywords: Energy transition, female agricultural labour, Food security, WAEMU, ARDL

Introduction

Food security remains a major challenge for economic and social development in developing countries. Despite progress in recent decades, a large proportion of the population still has limited access to sufficient, healthy and nutritious food (FAO, 2023). Between 2000 and 2010, the situation

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improved. However, hunger worsened significantly after this period. The deterioration was particularly marked between 2019 and 2022 (FAO, 2023). In 2022, approximately 282 million people in Africa were undernourished. This represents an increase of 57 million people since the start of the COVID-19 pandemic. More than two-thirds of the populations of Central, East and West Africa face moderate or severe food insecurity (FAO, 2023). A total of 868 million people in Africa were affected in 2022. Food security is defined as physical and economic access to sufficient, safe and nutritious food. It enables people to lead active and healthy lives (FAO, 2002). However, food security can be disrupted by poorly managed climate change. Temperature variations, droughts and extreme weather events reduce agricultural yields and the availability of water and fertile soil (De Moraes Sá et al., 2017). Increased carbon dioxide (CO_2) levels can reduce agricultural yields and the nutritional value of crops. These fluctuations require a systemic transition of socio-economic systems in order to ensure sustainable food security (Wheeler & Von Braun, 2013).

According to a study by Agbokpanzo et al. (2023), WAEMU countries rely heavily on fossil fuels and biomass to meet their energy needs. However, a transition to clean and renewable energy sources is crucial in order to reduce greenhouse gas emissions and mitigate the effects of climate change.

In the WAEMU, climate variability, land degradation, rural poverty and low agricultural productivity exacerbate food insecurity and gender inequalities. However, women still face inequalities in access to land, credit, technology, training and energy services. Gender equality is therefore essential to eliminating hunger, malnutrition and poverty (FAO, 2021). Indeed, the inclusive adoption of clean energy technologies can reduce the drudgery of women's agricultural work. It can also increase productivity and enhance food security. Access to modern energy technologies improves women's incomes and participation in agricultural value chains (Sertyesilisik, 2023). However, women face obstacles such as unequal access to land, credit, decision-making and agricultural technologies (UNDP Report, 2014). In addition, rural women face gender-based inequalities that hinder their potential economic contribution and prevent them from fully benefiting from their work.

With a view to developing fair and effective environmental policies, this study analyses the role of women in the link between energy transition and food security.

The WAEMU countries face a real challenge in terms of food security, as out of 113 countries, the WAEMU zone ranks 91st with an index of 47. The first group includes Mali, Senegal and Burkina Faso. They rank 85th, 86th and 89th respectively. Their average food security index is 48.8, 48.4 and 47.5. A second group includes Benin, Côte d'Ivoire, Niger and Togo. They rank 91st,

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95th, 97th and 98th respectively. Their average food security indices are 44.8, 48.4, 48 and 46.3 (FAO, 2023). The energy transition can reduce food security inequalities by avoiding a resource-intensive model (Kline et al., 2017).

Furthermore, a "just energy transition" protects workers' livelihoods, safeguards the future of communities, and ensures a low-carbon economy. This requires dialogue between employees, trade unions, government, employers, civil society, and communities (Evans & Phelan, 2016; Galgóczi, 2020). The energy transition emphasises the decentralisation of systems, the importance of location and the needs of marginalised communities (O'Neill et al., 2018; Heffron, 2021). Furthermore, a just energy transition aims for environmental integrity, economic sustainability, well-being and social resilience, supported by strong democratic governance. It thus facilitates the mapping of the energy transition to achieve outcomes aligned with the economic and social development of the communities and regions concerned. Gender equality is a matter of social justice and human development. It influences food security and participation in the energy transition (Sen, 1999; Ericksen, 2008). This equality plays a crucial role in the distribution of food resources and access to food (Ingram, 2011). Including women in the management of domestic energy resources promotes sustainable and inclusive energy solutions (Clancy et al., 2011). Renewable energy, on the other hand, can reduce dependence on fossil fuels and energy costs for farmers (FAO, 2017).

On the other hand, equitable access to resources for women can significantly increase agricultural production (Quisumbing and Pandolfelli, 2010). However, bioenergy production can compete with food production, leading to higher prices and food insecurity (Tilman et al., 2009). New energy technologies risk exacerbating inequalities if they remain inaccessible to vulnerable populations, such as smallholder farmers (Van der Horst & Vermeylen, 2011). Thus, inequalities in access to natural and financial resources can limit the benefits of the energy transition and threaten food security.

Thus, to be effective, policies must reduce inequalities and rely on inclusive regulatory frameworks for the governance of energy transition and food security (Clapp & Fuchs, 2009). Hlahla (2022) analyses the water-energy-land-food security (WELF) nexus in sub-Saharan Africa, highlighting gender inequalities. He shows that WELF policies and projects are often gender-blind, limiting their effectiveness and sometimes reinforcing inequalities. Women's lack of land rights, their dependence on traditional energy sources and their vulnerability to climate change compromise food security and the sustainability of productive systems. These frameworks are also criticised for favouring businesses and political elites at the expense of local communities (Scoones, 2015).

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Furthermore, some renewable technologies can harm the environment, such as hydroelectric dams, which displace populations and disrupt ecosystems (Ansar et al., 2014). Feminist economics highlights the undervaluation of women's unpaid work and advocates for a fair redistribution of domestic tasks to strengthen food security (Folbre, 2021). The intersectional approach helps to understand how different forms of discrimination exacerbate food inequalities (Crenshaw, 2019). Globalised food systems concentrate production and distribution among a few large companies, increasing food insecurity. This reinforces the need for local and sustainable food systems that take into account the needs of communities, particularly women (McMichael, 2020).

Food sovereignty and agroecology emphasise the right of peoples to control their food systems and practise sustainable agriculture (Pimbert, 2018). Rural women face barriers to accessing essential resources, limiting their production and access to nutritious food (Doss, 2018). Traditional gender roles confine them to domestic and care tasks, reducing their economic and agricultural participation, which affects their food security and that of their families (FAO, 2020).

Furthermore, women are particularly vulnerable to climate change due to their dependence on natural resources and their role in household management (Sertyesilisik, 2023). The under-representation of women in decision-making limits their influence on policies that affect their food security (Cornwall, 2016). It is therefore necessary to radically reform agricultural and food policies to promote gender equality and strengthen food security (Quisumbing & Meinzen-Dick, 2020).

Data

The aim of this article is to analyse how complementarity between the energy transition and women's employment in agriculture can strengthen food security in WAEMU countries.

Annual data covering eight WAEMU countries (Benin, Burkina Faso, Côte d'Ivoire, Guinea-Bissau, Mali, Niger, Senegal and Togo) from 1996 to 2022 were used in the analysis. The summary of the variables in this study is presented in Table 1 below. *The variable of food security is a flexible and diverse concept with various definitions. According to the FAO (2023), food security is a condition in which everyone has physical, social and financial access at all times to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active and healthy life.* The "pillars" associated with food security are availability, utilisation, accessibility and stability (Grainger, 2016; Aliaga and Chaves Dos Santo, 2014). In terms of (local) food production and distribution, with an emphasis on supply, food accessibility refers to the ease of access to nutritional sources. The ability of a

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household or individual to obtain readily available food is called food access. Since food security exists when all individuals have physical, economic and social access to sufficient, safe and nutritious food at all times, we use the food production index as a measure.

The food production index covers food crops that are considered edible and contain nutrients. Our variables of interest are, on the one hand, the energy transition, which is measured by the consumption of renewable energy (ERN) as a percentage of total energy, according to studies by Najm and Matsumoto (2020), Zhuang et al, (2022) and Pons and Tanguy (2021). Energy transition can be effective in increasing the level of food supply. This implies that traditional energies lead to lower productivity due to their massive costs, whereas in the case of renewable energies, the total cost of production may decrease and lead to a further increase in the level of food supply. The energy transition can also help reduce inequalities in food security that could influence existing food security systems by avoiding the resource-intensive model (Kline et al., 2016). On the other hand, female agricultural employment, which reflects the number of women employed in the agricultural sector as a percentage of total female employment. Agricultural employment is crucial for food security, as women in most developing countries are responsible for the nutrition and well-being of their families, which reinforces their role in food security.

Table 1: Study variables

Variables	Definition	Sources
IPA	Food production index	World Development Indicator (WDI, 2024)
ERN	Renewable energy consumption as a percentage of total energy consumption	World Development Indicator (WDI, 2024)
EAFEM	Women in agricultural employment	FAO stat (2024)
EDUF	Female primary school enrolment rate	ILO Stat (2024)
GDP	GDP per capita	World Development Indicator (WDI, 2024)
STAB	Political stability, absence of violence	Worldwide Govermance Indicator (WGI, 2024)
PRE	Precipitation in minutes per year	Energy Statitics Data (2024)
CO2	CO2 consumption as a percentage of GDP	Energy Statitics Data (2024)
ARABL	Arable land	FAO stat (2024)
AOI	Agricultural orientation index of public expenditure.	FAO stat (2024)
MOA	Agricultural mechanisation. Use of tractors and machinery.	FAO stat (2024)
POP	Population growth rate	World Development Indicator (WDI, 2024)

Source: The authors

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Similarly, women's employment in agriculture is essential to ensuring sustainable food security because of their contribution to food production, crop diversification, access to resources and the promotion of sustainable agricultural practices. Women often have valuable knowledge of sustainable agricultural practices and natural resource management. Their involvement in decision-making regarding land and resource use can contribute to more sustainable agriculture, thereby preserving long-term food security. For control variables, we use macroeconomic variables such as GDP per capita to measure per capita income. We also use energy variables such as precipitation in mm/year and CO_2 consumption. Institutional variables such as the agricultural orientation index of public expenditure are used to measure progress in agricultural financing. This is an index that allows for an accurate assessment of government commitment to agriculture, and economic stability is used to measure the absence of violence. In addition, variables related to population, education and agriculture such as population growth rate, female education, use of machinery and tractors, and arable land are used. A summary of the variables used is presented in Table 1 above.

Methodology

The aim here is to describe the basic theoretical model, specific to the estimation technique.

Model used

In the neoclassical production function, the sources of production are the accumulation of production factors and the improvement of total factor productivity. The starting point for our modelling is the Cobb-Douglass production function defined as follows :

$$Y = AK^{\beta}L^{\alpha} \tag{1}$$

where Y represents production output, A represents total productivity, K represents capital, and L represents labour inputs, while β and α are the coefficients of capital (K) and labour (L) production. However, Zhang et al. (2022) and Zakari et al. (2022) argued that energy has become a factor of production because it drives economic development. Thus, equation 1 above becomes :

$$Y = AK^{\beta}L^{\alpha}E^{\sigma} \tag{2}$$

Applying the logarithm to equation 2, we obtain the following equation 3 :

$$y = a + \beta k + \alpha l + \sigma e \tag{3}$$

Where y is the logarithm of output, a is the logarithm of total factor productivity, k is the logarithm of capital, l is the logarithm of labour, and e is

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the logarithm of energy. Then β, α et σ are the elasticities of capital, labour, and energy, respectively.

Based on studies by Ogbolumani and Nwulu (2022); Fetanat et al. (2021); Lu et al. (2021); Zakari et al. (2022) and Agbokpanzo et al, (2023), our objective is to analyse the role of women in the relationship between energy transition and food security. We specify our model as follows :

Model 1: No interaction

$$lnIPA_{it} = \beta_0 + \beta_1 lnERN_{it} + \beta_2 lnEDUF_{it} + \beta_3 lnPRE_{it} + \beta_4 lnGDP_{it} + \beta_5 POP_{it} + \beta_6 CO_{2\,it} + \beta_7 lnARABL_{it} + \beta_8 lnMOA_{it} + \beta_9 lnSTAB_{it} + \beta_{10} AOI_{it} + \varepsilon_{it} \quad (4)$$

Model 2: With interaction

$$lnIPA_{it} = \beta_0 + \beta_1 lnERN \times EAFEM_{it} + \beta_2 lnEDUF_{it} + \beta_3 lnPRE_{it} + \beta_4 lnGDP_{it} + \beta_5 POP_{it} + \beta_6 CO_{2\,it} + \beta_7 lnARABL_{it} + \beta_8 lnMOA_{it} + \beta_9 lnSTAB_{it} + \beta_{10} AOI_{it} + \varepsilon_{it} \quad (5)$$

Where IPA refers to the food production index. ERN refers to renewable energy, EDUF refers to female primary school enrolment, PRE refers to precipitation in mm/year. GDP refers to GDP per capita; POP refers to annual population growth rate. CO_2 refers to carbon dioxide consumption as a percentage of GDP; ARABL refers to arable land. MOA refers to training women in modern and sustainable farming practices, which is equal to the product of women's primary education and the use of machinery and tractors; STAB refers to economic stability and the absence of violence. EAFEM refers to women's employment in agriculture.

AOI, agricultural orientation index of public expenditure, and $ERNF{\times}EAFEM$ represents an interaction variable between renewable energy and female agricultural employment, which represents women's involvement in the use of sustainable practices (ERNF). ε represents the error term. Furthermore, i and t represent the individual and temporal dimension indices, respectively.

Estimation technique

Dynamic panel models are estimated using the Generalised Method of Moments (GMM) proposed by Arellano and Bond (1991), the system-GMM estimator proposed by Arellano and Bover (1995) and Blundell and Bond (1998), and represented in ARDL form as proposed by Pesaran et al. (1999). The first two models require that the data include a large number of countries relative to the period (Roodman, 2009). These conditions appear to be violated

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by this study due to the very small number of countries relative to the period. Furthermore, these estimation procedures are likely to produce non-convergent and misleading long-run coefficients unless the slope coefficients are indeed identical (Pesaran and Shin, 1999). Based on Pesaran et al. (1999), we can use an ARDL (p,q) representation to model a homogeneous dynamic panel in the form of an error correction model.

In an Auto Regressive Distributive Lags (ARDL) model, estimates are made using the Pooled Mean Group (PMG), Mean Group (MG) and Dynamic Fixed Effects (DFE) methods proposed by Pesaran et al. (2001). The advantage of the PMG method is that it considers the combination of pooling and averaging coefficients. This estimator allows a distinction to be made between short-term and long-term dynamics and takes into account the heterogeneity of countries. The PMG estimator also resolves problems of endogeneity and heterogeneity in a dynamic specification. The MG estimator considers the heterogeneity of long-term coefficients by taking their average. Like the PMG estimator, the DFE estimator restricts the vector coefficients to be equal across all panels. In the estimation process, the study favours the Pooled Mean Group (PMG) estimator given its ability to take into account endogeneity and heterogeneity issues in dynamic models on the one hand, and the fact that it considers the combination of pooling and the mean of the coefficients on the other. However, these conditions can be satisfied by including ARDL lags (p,q) for the dependent (p) and independent (q) variables as error corrections as follows :

$$\Delta IPA_{i,t} = \theta_{1j} ECT_{1i,t-1} + \sum_{j=1}^{q_1} \lambda_{ij} \Delta IPA_{i,t-1} + \sum_{j=1}^{q_1} \gamma_{ij} \Delta X_{i,t-1} + \sum_{j=1}^{q_1} \delta_{ij} Z_{i,t-1} + \varepsilon_{i,t} \quad (6)$$

Where $\theta_i ECT_{i,t-1} = Y_{i,t-1} - \phi_{0i} - \phi_{1i} X_{t-1}$ is the linear error correction term for each unit, the parameter θ_i is the error correction rate of the adjustment term for each individual, which is also equivalent to β_{1i}. The parameters ϕ_{0i} and ϕ_{1i} are calculated by setting $-\frac{\beta_{0i}}{\beta_{1i}}$ and $-\frac{\beta_{2i}}{\beta_{1i}}$ respectively in each model. X and Z represent the vectors of interest and control variables respectively.

Empirical results

Here, we will first present the results of the econometric tests, followed by the estimation results.

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Test results

Here we perform Fisher's homogeneity tests, individual dependency tests, and unit root tests.

Results of preliminary tests on panel data

When examining relationships in a panel data model, two potential problems must be taken into account. First, the problem of homogeneity or heterogeneity among individuals. The coefficients associated with individuals may not be homogeneous, given that countries differ in their stages of development and levels of technology. In general, the assumption of homogeneity may mask country-specific characteristics (Menyah et al., 2014). Secondly, there is the problem of cross-country dependence, which means that a shock affecting one country may also affect other countries in the model due to direct and indirect economic links between countries.

Testing homogeneity and cross-sectional dependence therefore seems to us to be an important step in a panel data model. For the problem of homogeneity between individuals, we use Fisher's test, as it allows us to see whether there is overall homogeneity between the coefficients and constants. The null hypothesis (H0) states that the panel is homogeneous. In other words, the constants and coefficients are identical. On the other hand, the alternative hypothesis (H1) postulates the presence of individual effects between the panel data. At a significance level set a priori at 5%, if Fisher's probability is greater than this threshold, there is homogeneity, so we accept H0; otherwise, we reject H0. With regard to the problem of cross-sectional dependence, the LM test (i.e. the Lagrange multiplier for cross-sectional dependence) was developed by Breusch and Pagan (1980), and Pesaran (2004) subsequently developed the LM CD cross-sectional dependence test for small panels. However, when the number of units (N) is small and the time dimension (T) is large, the LM test by Breusch and Pagan (1980) is preferred over that of Pesaran (2004). In the case of our work, N=7 and T=31, we therefore use the Breusch and Pagan test (1980). This test is based on the null hypothesis (H0) of inter-individual independence between cross-sectional units against the alternative hypothesis (H1) of dependence. We accept the null hypothesis if the probability is below the 5% significance threshold; otherwise, we accept the H1 hypothesis. The results of these tests are shown in Table 2 below.

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Table 2: Summary of cross-sectional dependence and homogeneity tests

Équations	**Model 1: Model without interaction**		**Model 2: Model with interaction**	
Fisher's Homogeneity Test				
	Statistics	Prob	Statistics	Prob
Fisher	118.67***	0.0000	150.20***	0.0000
Breusch-Pagan cross-sectional dependence test (1980)				
Breusch-Pagan (1980)	87.134***	0.0000	72.915***	0.0000

Source: Author, based on data from BCEAO (2021) and WDI (2021)

Note: (***) represents significance at the 1% threshold. Models 1 and 2 represent the model without interaction and with interaction between the energy transition and women's agricultural employment, respectively.

Results on unit root tests

Studying the stationarity of a variable means testing for the presence or absence of a unit root. There are two types of unit root tests for panel data. The first category is called first-generation tests. Tests in this category are based on the assumption of cross-sectional independence of units.

The second category is called second-generation tests, which are based on the assumption of unit dependence. Given that there is inter-individual dependence, the order of integration of the series must be determined using second-generation unit root tests. For our analysis, we use Pesaran's (2007) (CDF) and Pesaran's (2003) (PESCADF) tests. The null hypothesis of these tests assumes that all series are non-stationary. The test results are shown in Table 2 below.

The second-generation unit root tests by Pesaran (2003) and Pesaran (2007) reveal that the variables precipitation (PRE), agricultural orientation index (AOI), population growth rate (POP), arable land (ARABLE), GDP per capita (GDP), female agricultural employment (EAFEM) and machine and tractor use (MOA) are stationary in level. However, the variables food production index (IPA), CO2 consumption (CO2), renewable energy (ERN) and female primary school enrolment rate (EDUF) are not stationary in level, but in first difference (see Table 2 below).

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Table 3: Unit root test on study variables

Variables	Pesaran (2007) CIPS		Pesaran (2003) PESCADF		Décision
	Niveau	Différence	Niveau	Différence	
LIPA	-0.935 (0.175)	-6.787*** (0.000)	-2.081 (0.175)	-4.087*** (0.000)	I(1)
LERN	0.570 (0.716)	-3.398*** (0.000)	-1.564 (0.716)	-2.925*** (0.000)	I(1)
LPRE	-3.874*** (0.000)	-	-3.088*** (0.000)	-	I(0)
AOI	-1.418* (0.078)	-	-3.663* (0,000)	-	I(0)
LSTAB	-4.709*** (0.000)	-	-3.375*** (0.000)	-	I(0)
CO_2	1.759 (0.961)	-4.552*** (0.000)	-1.157 (0.961)	-3.321*** (0.000)	I(1)
POP	-3.242*** (0.001)	-	-2.872*** (0.001)	-	I(0)
LARABLE	-1.423* (0.077)	-	-2.248*** (0.077)	-	I(0)
LGDP	-3.519*** (0.000)	-	-2.967*** (0.000)	-	I(0)
LEDUF	-1.285 (0.099)	-2.593*** (0.005)	-2.201 (0.099)	-2.649*** (0.005)	I(1)
EAFEM	-1.501* (0.067)	-	-2.275* (0.067)	-	I(0)
MOA	-6.579*** (0.000)	-	-4.016*** (0.000)	-	I(0)

Source: Author based on data from the BCEAO database (2021) and WDI (2021)
Note: (*) and (***) represent significance at the 1% and 10% thresholds respectively.

Panel cointegration test

The concept of cointegration can be defined as a systematic long-term co-movement between two or more economic variables (Yoo, 2006). However, authors such as Pedroni (1999, 2004), Kao (1999) and Westerlund (2005) have proposed cointegration tests that apply to longitudinal data. Unlike the tests developed by Pedroni and Westerlund, Kao considers the special case where the cointegration vectors are assumed to be homogeneous across individuals. In other words, these tests do not allow for heterogeneity under the alternative hypothesis. Kao (1999) also proposed tests of the null hypothesis of no cointegration: the Dickey-Fuller test and the Augmented Dickey-Fuller test. The tests developed by Pedroni (1999, 2004) and Westerlund (2005 and 2007) are only applicable to regressors with fewer than seven variables. For our analysis, we have nine regressors, so we use Kao's test (1999).With regard to Kao's test, the results of models 1 and 2 show that the probability associated with the unadjusted Dickey-Fuller t-statistic and the augmented Dickey-Fuller t-statistic is 0.0000, 0.0000 and 0.0000 respectively.

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This allows us to reject the null hypothesis of no cointegration and accept the alternative hypothesis of cointegration between the variables in the long term (see Table 4 below).

Table 4: Kao's cointegration test (1999)

	Model 1		Model 2	
Tests	Statistic	P-Value	Statistic	P-Value
Dickey-Fuller modifié	1.5260	0.0635	1.1217	0.1310
Dickey–Fuller	1.4077	0.0796	0.4481	0.3270
Dickey–Fuller Augmenté	3.1074	0.0009	2.2071	0.0137
Dickey-Fuller Modifé inadjusté	-3.9201	0.0000	-6.3587	0.0000
Dickey-Fuller Inadjusté	-2.6735	0.0038	-4.3775	0.0000

Source: Authors, based on data from BCEAO (2021) and WDI (2021)

Estimation results

Here we present the short- and long-term results of our estimates.

Short-term results

Our short-term results show that the energy transition coefficient (LERN) is positive and statistically significant. Thus, a 1% increase in energy transition leads to a 0.6879% increase in food security. This result shows that switching from fossil fuels to renewable energy sources can have positive effects on food security. Indeed, the energy transition contributes to food security by helping to reduce CO2 and other greenhouse gas emissions and limiting the impacts of climate change. A more stable climate helps protect crops, soil and water resources, creating more sustainable, resilient and equitable food systems. Furthermore, renewable technologies, such as solar pumps for irrigation, enable more efficient use of water resources, which are essential for agriculture, especially in arid or semi-arid regions.

Our findings are consistent with the conclusions of Zhuang et al. (2022) for Egypt, Morocco, Tunisia and Lebanon, and Zakari et al. (2022) for 28 African countries, for whom the energy transition is fundamental to achieving food security and eliminating hunger.

Our findings also show that rainfall, although crucial for agriculture, can have negative effects on food security when it is excessive. On the one hand, heavy rainfall can cause flooding, destroying crops, seeds and agricultural infrastructure (rural roads, storage systems, markets). This damage directly reduces agricultural production and compromises food availability, particularly for rural households dependent on subsistence farming. On the other hand, increased rainfall disrupts agricultural schedules. When rains occur intensely or at inappropriate times, they negatively affect crop growth, promote plant lodging and increase post-harvest losses. This climate instability reduces yields and increases food uncertainty.

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Furthermore, the agricultural orientation index of public expenditure (AOI) has a negative effect on food security. On the one hand, when agricultural expenditure is mainly directed towards low-productivity projects or export crops at the expense of food crops, the impact on local food availability can be limited or even negative. On the other hand, institutional and structural constraints can limit the effectiveness of public agricultural expenditure, exacerbating food insecurity. As for economic growth, our results show that it has a positive effect on food security.

In the short term, growth promotes job creation and reduces unemployment, particularly in agricultural and non-agricultural sectors linked to the food value chain. Improved employment opportunities strengthen households' ability to cope with food shocks and smooth their consumption, thereby contributing to better food availability and accessibility.

Table 5: Short-term results

	MODEL 1: WITHOUT INTERACTION			MODEL 2: WITH INTERACTION		
Variables	Coefficients	Ecart-type	P-Value	Coefficients	Ecart-type	P-Value
LERN	0.687976**	0.310430	0.027	-	-	-
LERNF	-	-	-	0.071127	0.30205	0.814
LPRE	-0.21270***	0.113019	0.06	0.145038	0.19603	0.459
AOI	-0.498706	0.321073	0.120	-0.59119**	0.28107	0.035
LSTABP	0.028817	0.025917	0.266	0.016547	0.01349	0.220
CO_2	0.820014	1.14859	0.475	-0.96085	1.2273	0.434
POP	-0.173110	0.149865	0.248	-0.10194	0.11349	0.369
LARABLE	1.170548	1.40516	0.405	-0.503268	0.710333	0.479
LGDP	0.884169**	0.405562	0.029	0.943734**	0.393205	0.016
LMEDUF	-0.003873	0.004254	0.363	-0.00722***	0.002415	0.003
ECT	-0.521242	0.16068	0.001	-0.54501***	0.16086	0.001
Cste	-33.58591	13.11588	0.010	-30.8499***	10.18529	0.002

Source: Authors, based on data from BCEAO (2021) and WDI (2021)

Note: (*), (**) and (***) represent significance at the 1%, 5% and 10% thresholds respectively.

Long-term results

Our long-term results show that energy transition has a negative effect on food security, whereas the presence of female agricultural labour has a positive effect. Indeed, a 1% increase in energy transition leads to a 0.929% decrease in food production.

This result suggests that increased competition between energy crops and food crops can cause food prices to rise, making access to food more difficult for the most vulnerable populations and exacerbating food insecurity in the long term. Our results are consistent with the study by Kim (2019). He argues that, due to increased industrial production, urbanisation and economic development, as well as the expansion of transport systems, the energy transition in developing countries is leading to a significant increase in the

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accessibility and affordability of energy services, which in some cases may lead to a decrease in food supply.

As for our interaction variable, i.e. women's agricultural employment and energy transition, the coefficient is statistically significant and positive. This is in line with our expectations. Our results show that countries that adopt energy transition by reducing gender inequalities in agricultural employment are more likely to improve their food security. These results show that a fair and inclusive energy transition that takes into account the participation of men and women in agricultural production is essential to eradicating hunger, malnutrition and poverty and positively affecting food security. With better access to sustainable energy resources, women farmers can diversify their crops and agricultural practices.

This can strengthen the resilience of food systems to climate change and climate hazards, thereby reducing the risks of crop losses and food insecurity. Our findings are consistent with the conclusions of Hlahla (2022), who states that unequal access to resources, gender inequalities, socio-economic vulnerability and cultural norms contribute to women's vulnerability to the impacts of climate change and limit their ability to seize the opportunities it presents. Reducing women's vulnerability to the impacts of climate change in sub-Saharan Africa and improving equitable access to natural resources and their efficient use will require a transformation of gender relations and the active participation of both men and women in reducing food insecurity.

Table 6: Long-term results

	MODEL 1: WITHOUT INTERACTION			**MODEL 2: WITH INTERACTION**		
Variables	Coefficients	Ecart-type	P-Value	Coefficients	Ecart-type	P-Value
LERN	-0.92958***	0.16344	0.000	-	-	-
LERNF	-	-	-	0.078657**	0.03046	0.010
LPRE	0.31119***	0.10590	0.003	-0.31597**	0.15423	0.040
AOI	0.12117***	0.0428	0.005	0.58314***	0.075393	0.000
LSTABP	0.02792**	0.01186	0.019	0.004817	0.014832	0.745
CO_2	-0.65338**	0.28637	0.023	-0.22750	0.223720	0.309
POP	0.258071***	0.02865	0.000	0.073292**	0.031589	0.020
LARABLE	0.279460	0.349319	0.424	1.21175***	0.133237	0.000
LGDP	-0.081025	0.101719	0.426	0.076352	0.070516	0.279
LMEDUF	0.001902	0.006107	0.755	0.01994***	0.005852	0.001

Source: Authors, based on data from BCEAO (2021) and WDI (2021)

Note: (*) , (**) and (***) represent significance at the 1%, 5% and 10% thresholds respectively.

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Table 7: Results of the Wald test for short-term and long-term

Variable	Short term	Long term
$LERN^+ = LERN^-$	0,06	11,70
	(0,8094)	(0,0006)
$LEAFEM^+ = LEAFEM^-$	2,59	61,85
	(0,1075)	(0,0000)
$LERNF^+ = LERNF^-$	0,01	18,35
	(0,9130)	(0,0000)

Source: Authors

The Wald test was used to show the presence of asymmetry in our short- and long-term variables. According to Table 7 above, the results indicate that the null hypothesis of no asymmetry can be rejected in the long term. Therefore, we accept that there are asymmetric effects of renewable resources, female agricultural employment and their interaction only in the long term, but symmetric in the short term.

Conclusion and economic policy recommendations

This study provides an in-depth analysis of the interactions between energy transition, food security and the role of women in WAEMU countries over the period 1996-2022. The use of an ARDL model across all eight WAEMU countries indicates that the energy transition, while significantly and symmetrically improving food security in the short term, generates negative and asymmetric effects in the long term. This finding suggests that, although immediate benefits may result from increased energy resources, these positive effects are likely to be reduced or reversed as long-term dynamics stabilise, possibly due to dependence on energy models that are unsustainable or ill-suited to local conditions. However, the study also highlights the crucial role of female agricultural labour in managing these transitions. The interaction between energy transition and women's participation in agriculture shows a positive long-term effect on food security, although this effect is neutral in the short term. This underscores the importance of adopting an inclusive approach that recognises women's contributions not only as beneficiaries, but also as central actors of change, particularly in the sustainable management of agricultural and energy resources. Thus, in order to maximise the benefits of the energy transition while ensuring long-term sustainable food security, it is essential to strengthen women's involvement in the agricultural sector. Public policies and private initiatives must promote women's access to sustainable energy resources, while supporting their key role in innovation and the management of agricultural practices. At the same time, energy transition management strategies that anticipate long-term effects must be put in place so as not to compromise future food security.

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Limitations and future research

This study uses aggregate variables for energy transition (renewable energy) and food security (food production), which prevented analysis of the specific effect of the variables comprising energy transition and food security. Future research could therefore focus on a more detailed analysis of the different components of energy transition and food security. By examining the specific effect of each variable on the relationship between energy transition and food security. And also the effects of the interactions between the components of energy transition and female agricultural labour on food security. Such approaches will provide a better understanding of the underlying mechanisms and will be useful in identifying the most critical components of the energy transition in order to optimise public investment in a more targeted manner in food security.

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Financial Innovation, Bank Liquidity and Entrepreneurship Support: An Analytical Evidence from Commercial Banks in Bamenda, Cameroon

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Abstract

Commercial bank liquidity remains a critical issue globally, especially in an emerging city like Bamenda, Cameroon, where fluctuating liquidity levels pose challenges to financial stability and operational efficiency for banks. The main objective of this study is to examine the effect of financial innovation and entrepreneurship support on the liquidity position of commercial banks in Bamenda. Employing a cross-sectional survey design, primary data were collected through structured questionnaires from 39 bank officials. The data were analysed using a multinomial cumulative probit model

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to capture the ordinal nature of the variables under examination. The findings indicate that financial innovation has a statistically significant effect on bank liquidity, whereas entrepreneurship support shows a non-significant negative effect. The model's goodness-of-fit measures suggest a robust representation of the data, and the results reveal that financial innovation has a more prominent effect on liquidity position than entrepreneurship support within the context of the study. Based on these findings, it is recommended that banks and policymakers enhance the development and adoption of innovative financial solutions to optimize resource allocation and stabilize liquidity levels. Additionally, fostering entrepreneurship through targeted financial products could further improve liquidity resilience. Strengthening capacity-building initiatives on financial innovations and entrepreneurship financing is crucial to ensuring sustainable liquidity management and economic growth in Bamenda's banking sector.

Keywords: Bank Liquidity Position, Commercial Banks, Entrepreneurship Support, Financial Innovation

Introduction

The situation of commercial bank liquidity position at the global level has undergone significant changes over the past few decades, shaped by regulatory reforms, financial crises, and evolving economic environments. The trajectory of bank liquidity management reflects the financial industry's response to vulnerabilities that surfaced during crucial economic downturns, particularly the 2008 global financial crisis. This crisis served as a pivotal turning point, exposing systemic weaknesses in liquidity frameworks that influenced the stability of financial institutions worldwide. As a direct response to the crisis, regulatory bodies such as the Basel Committee on Banking Supervision (BCBS) implemented comprehensive reforms through the introduction of the Liquidity Coverage Ratio (LCR) and the Net Stable Funding Ratio (NSFR) in the Basel III regulations. These standards were established to enhance the resilience of banks, ensuring adequate liquidity buffers that could sustain operations during times of financial stress (BCBS, 2010). The profound impacts of the crisis highlighted the need for an evolved understanding of liquidity, emphasizing that robust risk management strategies must be integrated into banking operations.

In the years leading to the global financial crisis, commercial bank liquidity across major global economies was perceived as stable, particularly in developed regions such as North America and Europe. For instance, an evaluation of the aggregate capital levels of banks in the United States and Europe from 2000 to 2007 reveals a period of seemingly untroubled liquidity management. During this timeframe, large financial institutions reported

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liquidity ratios consistently revolving around 110%, indicative of their ability to meet short-term obligations without significant distress (KPMG, 2018). However, lurking beneath this façade of stability was a troubling reliance on short-term funding sources, leading to liquidity mismatches that, when combined with the shock of the financial crisis, resulted in rapid destabilization. In response, the European Central Bank (ECB) implemented broad monetary policy measures, including Long-Term Refinancing Operations (LTRO), aimed at restoring liquidity within the banking system. This initiative underscored the critical need to reassess liquidity management practices and the role of central banks during financial turmoil, marking a significant shift in the operational paradigm of commercial banks.

The aftermath of the crisis necessitated the implementation of Basel III in 2013, which focused on improving banks' resilience, particularly through enhanced liquidity risk management. The introduction of the Liquidity Coverage Ratio (LCR) mandated that banks maintain sufficient high-quality liquid assets (HQLA) to cover total net cash outflows over a 30-day stress period. A comprehensive study conducted by the Bank for International Settlements (BIS) indicated a marked improvement in liquidity positions across the banking sector; for example, the average LCR of globally significant banks surged from 100% in 2015 to approximately 150% in 2020. This upward trend in liquidity ratios reflects a concerted effort by financial institutions to adhere to new regulatory standards and build more robust liquidity positions capable of weathering potential future stresses (BIS, 2021). This regulatory framework served not only to stabilize individual banks but also to instill confidence among market participants and restore trust in the financial system.

Moreover, during the unprecedented challenges posed by the COVID-19 pandemic, global liquidity dynamics faced rigorous stress testing, necessitating prompt and decisive actions from both central banks and commercial financial institutions to ensure stability. Strategies employed by central banks included the Federal Reserve’s provision of liquidity through enhancements to the discount window and the establishment of various emergency lending facilities aimed at supporting banks and maintaining the flow of credit to the economy. These measures underscored the ongoing necessity for robust liquidity management frameworks in times of crisis, as banks grappled with heightened demand for liquidity from both borrowers and the broader financial system (Federal Reserve, 2020). Recent reports and analyses indicate that banks generally maintained adequate liquidity levels throughout the pandemic, with the average bank liquidity ratio consistently remaining above the targeted benchmarks established by regulatory frameworks. This resilience serves as a testament to the effectiveness of the

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reforms instituted in the wake of the 2008 financial crisis, showcasing an evolved banking landscape better equipped to handle liquidity shocks.

The situation of commercial bank liquidity in Africa has exhibited a complex evolution influenced by various factors, including regulatory reforms, economic changes, and the unique challenges of financial markets across the continent. Although many African banks struggled with issues of liquidity in the past due to limited financial infrastructure, recent developments have shown a commendable improvement as they adapt to both domestic and global financial landscapes. The evolution of bank liquidity on the continent has been characterized by fluctuating economic conditions, regulatory initiatives from central banks, and innovative financial instruments introduced to bolster liquidity management frameworks.

In the early 2000s, commercial banks in many African countries faced significant liquidity constraints, primarily attributed to a lack of access to diverse sources of funding and inadequate financial instruments to manage liquidity risks effectively. For instance, according to a report by the African Development Bank (AfDB, 2009), banks in sub-Saharan Africa demonstrated an average liquidity ratio of around 60%, significantly lower than the international benchmark, reflecting limitations in asset quality and funding volatility. This scenario compelled many African governments and central banks to reevaluate their banking regulations and foster environments that would enhance liquidity through better financial governance. Consequently, various monetary policies were introduced, promoting the need for liquidity reserves and fostering the development of secondary markets to allow for better asset liability management, and thus liquidity risk management.

As the continent moved into the 2010s, several African nations recognized the need for urgent reforms to strengthen their banking sectors. Central banks, particularly in countries like South Africa, Nigeria, and Kenya, initiated significant regulatory changes that paved the way for improved liquidity management practices within their domestic banking systems. For example, South Africa's Financial Sector Regulation Act, which was enacted in 2017, aimed to enhance the resilience of banks through a stricter regulatory framework focused on liquidity risk management. By introducing liquidity coverage ratios and stress testing requirements, the South African Reserve Bank (SARB) sought to instil a culture of prudent liquidity management across banking institutions (SARB, 2017). As a direct outcome of these reforms, the liquidity ratios in the South African banking sector improved significantly, with the average liquidity coverage ratio (LCR) rising to 120% by 2019, reflecting a robust liquidity position.

Moreover, technological advancements and financial innovation have played a pivotal role in reshaping the liquidity landscape in Africa. The emergence of fintech solutions and mobile banking services has facilitated

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greater financial inclusion and improved access to banking services for underserved populations. This transformation also allows banks to diversify their funding sources and enhance their liquidity profiles. The introduction of mobile money services, particularly in countries like Kenya with M-Pesa, has revolutionized the banking sector, enabling customers to conduct transactions seamlessly and providing banks with additional liquidity management avenues (Mothibi, 2019). This shift not only expanded the customer base but also increased the volume of deposits, thereby improving banks' liquidity ratios and overall health.

The COVID-19 pandemic further underscored the importance of resilience in liquidity management. In response to the economic fallout triggered by the pandemic, central banks across Africa took urgent measures to bolster liquidity in the banking system. The African Central Bank, among others, adopted expansive monetary policies, including interest rate cuts and asset purchase programs, to ensure that banks had sufficient liquidity to navigate the crisis (African Central Bank, 2020). For instance, the Central Bank of Nigeria reduced its Monetary Policy Rate from 13.5% to 11.5% in March 2020, providing a much-needed boost to liquidity in the financial system. Subsequently, banks in Nigeria, for instance, reported improved liquidity positions with an average liquidity ratio of approximately 36.5% by mid-2021, reflecting efforts to maintain stability amidst economic uncertainty (CBN, 2021).

In Cameroon, the evolution of commercial bank liquidity has been significantly impacted by the country's unique economic environment, regulatory frameworks, and ongoing financial sector reforms. Historically, the banking sector in Cameroon struggled with liquidity constraints characterized by an acute reliance on customer deposits, limited access to diversified funding sources, and challenges in financial infrastructure. The liquidity ratios of banks in Cameroon often fell below the desired benchmarks, demonstrating a need for regulatory and institutional reforms. For instance, in 2011, the liquidity ratio of the banking sector was approximately 41%, indicating vulnerabilities that could jeopardize financial stability and hinder economic growth (Cameroon Ministry of Finance, 2011).

Recognizing these issues, the government and the Central Bank of Central African States (BEAC), which regulates the banking sector in Cameroon, initiated various reforms over the past decade aimed at strengthening liquidity positions and enhancing the overall health of financial institutions. In 2013, the BEAC introduced measures to improve the liquidity management framework, including the establishment of liquidity guidelines and enhanced monitoring of banks' liquidity profiles (BEAC, 2013). These guidelines were instrumental in increasing the importance of liquidity tools such as liquidity coverage ratios, which prompted banks to maintain a

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sufficient liquidity buffer to meet short-term obligations. As a result, by 2018, the average liquidity ratio for commercial banks in Cameroon had improved to around 50%, reflecting positive strides towards bolstering liquidity resilience in the banking sector (BEAC, 2018).

Furthermore, significant efforts have been made to promote financial inclusion, which plays a critical role in enhancing liquidity for commercial banks. The Cameroonian government, alongside several development partners, has advocated for microfinance and innovative banking services that reach underserved populations. The launch of mobile banking platforms has facilitated greater access to financial services and improved banks' operating efficiencies. For example, services like Mobile Money, introduced by various telecommunications companies, have encouraged savings among the unbanked population and contributed to increased deposit mobilization, which in turn strengthens banks' liquidity positions, as mobile money accounts are linked to bank accounts held in commercial banks, thus facilitating the easy movement or transfer of funds. Reports indicate that mobile money accounts in Cameroon surged to over 10 million by 2020, demonstrating the effectiveness of this innovation in fostering liquid assets (Cameroon Telecom Regulatory Authority, 2020).

During the COVID-19 pandemic, the liquidity situation faced significant pressures, mirroring global trends where economic activities were curtailed, leading to heightened risks within banking systems. In response, the BEAC and the Cameroonian government undertook various initiatives to enhance liquidity in the banking sector. In March 2020, the BEAC introduced measures to lower the reserve requirements for banks, allowing them to retain more cash on hand and thereby improving their liquidity positions. This initiative enabled financial institutions to provide necessary support to businesses and individuals facing financial distress due to pandemic-induced economic shocks. As a result, banks reported an increased average liquidity ratio of approximately 53% in 2021, reflecting the impact of these policy measures aimed at stabilizing the sector during this challenging period (BEAC, 2021).

Furthermore, the Cameroonian banking sector has been encouraged to adopt more rigorous risk management practices and enhance transparency within its operations. This evolution has facilitated a more robust response to liquidity challenges. The implementation of stress testing and scenario analysis has become paramount in assessing liquidity risks, helping banks to strategically prepare for unexpected market fluctuations or economic downturns. The ongoing efforts of the government, various stakeholders, and regulatory bodies have fostered an environment of improved liquidity management and stability in the banking sector, indicating a positive trajectory as Cameroon continues to navigate its financial landscape.

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With Bamenda being one of the ten regions in Cameroon, what applies to Cameroon also applies to Bamenda and is evidently practiced, observed, and experienced by commercial banks in Bamenda, although there are regional differences and specificities in the mode of application and overall liquidity position. What commercial banks in Cameroon do is that each regional office, branch, or unit keeps records of its own liquidity or cash position while contributing to the commercial bank's central liquidity position or treasury account held at the central bank through regular deposits into and withdrawals from the central treasury account, as the case may require. This study focuses on financial innovation, bank liquidity, and entrepreneurship support within the context of commercial banks in Bamenda, Cameroon, and it is essential due to the inconclusive findings of previous research on these interconnected themes. While earlier studies have highlighted the significance of financial innovation and its potential to enhance bank liquidity and support for entrepreneurship, they have not reached a consensus on the nature and extent of these relationships, leaving gaps in the understanding of the variables involved. This uncertainty underscores the need for fresh, context-specific research that explores how innovative financial products and services can effectively improve liquidity in banks while simultaneously fostering a supportive environment, activities and practices for local entrepreneurs. By addressing these gaps, this study has the potential to provide valuable insights and actionable recommendations that could enhance the effectiveness of commercial banks in Bamenda in their roles as catalysts for national and regional economic growth, ultimately contributing to a more resilient and dynamic entrepreneurial landscape in the region.

Statement of the Problem

The expected liquidity position for commercial banks in Bamenda, Cameroon, is set at 30% according to the guidelines established by the Bank of Central African States (BEAC) in 2018. Recently reported figures indicate that actual liquidity ratios have consistently exceeded this benchmark, reflecting fluctuating trends: 41% in 2011 (Cameroon Ministry of Finance, 2011), 50% in 2018 (BEAC, 2018), and 53% in 2021 (BEAC, 2021). While these levels appear favourable, the excessive liquidity presents a significant problem for commercial banks, as it suggests that financial institutions are holding onto a surplus of liquid assets that are not being effectively utilized to generate returns or pay creditors.

In response to the challenges of maintaining optimal liquidity levels, both the Central African Banking Commission (COBAC) and BEAC have implemented several measures aimed at reinforcing liquidity management within commercial banks. COBAC has instituted periodic liquidity audits and stress tests to assess banks' liquidity resilience under various economic

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scenarios. Furthermore, BEAC has introduced monetary policy tools such as the "Liquidity Absorption Mechanism," which facilitates the absorption of excess liquidity in the banking system through various instruments, including reverse repo operations.

Additionally, BEAC has engaged in capacity-building initiatives aimed at enhancing banks' risk management frameworks and encouraging more effective lending practices. These efforts have included training programs on liquidity management and financial risk assessment to ensure that banks can align their practices with regulatory expectations. Despite these efforts, the fluctuations in liquidity ratios highlight the volatility and sensitivity of financial environments, influenced by factors such as economic cycles, regulatory changes, and shifts in market demand. While banks are exceeding the minimum liquidity requirements, the challenge of excess liquidity underscores the urgent need for innovative financial solutions and enhanced entrepreneurship support to optimize resource allocation and stabilize liquidity levels, promoting a more productive and prudent financial landscape in the region.

To achieve this target, this study sets out to examine the effect of financial innovation and entrepreneurship support on the liquidity position of commercial banks in Bamenda, Cameroon, by evaluating the effect of financial innovation and entrepreneurship support on their liquidity position.

Literature Review

Conceptual and Theoretical Review

Financial innovation (FI), entrepreneurship support (ES), and bank liquidity position (LP) are interrelated concepts that significantly impact the growth and sustainability of commercial banks, particularly in emerging economies like Bamenda, Cameroon. Financial innovation refers to the development of new financial products, services, or processes that enhance the efficiency of financial markets and institutions (Scherer & Batz, 2022; Ogbongah & Ojeifo, 2021). This innovation is crucial for banks to remain competitive and effective in meeting the diverse needs of entrepreneurs. Entrepreneurship support encompasses the range of resources and services that facilitate the start-up and growth of small and medium-sized enterprises (SMEs), including access to finance, mentorship, and business development services (Kibera & Indayi, 2023; Afuah, 2022). Bank liquidity position, defined as a bank's capacity to meet its short-term obligations without incurring significant losses, plays a crucial role in determining its ability to support entrepreneurship (Ayadi et al., 2022; Adebisi & Afolabi, 2023). The interplay of these three concepts is vital; strong financial innovations can enhance bank liquidity, while adequate liquidity enables banks to offer better support to entrepreneurs, thereby fostering a more robust entrepreneurial

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ecosystem. Together, these elements are essential for driving economic growth and stability in Bamenda's evolving financial landscape.

Financial innovation and entrepreneurship support play significant roles in shaping the financial position and liquidity of commercial banks in Bamenda, Cameroon, as illuminated by key theoretical frameworks. Firstly, the Financial Intermediation Theory posits that banks act as crucial intermediaries, channeling funds from savers to borrowers, which enhances efficiency in capital allocation and strengthens liquidity (López & Vázquez, 2022). Equally, the Innovation Theory, as articulated by Schumpeter (1934) and more recently explored by Taktak and Neifar (2022), emphasizes that financial innovations such as mobile banking and digital lending solutions not only improve operational efficiencies but also facilitate entrepreneurship by providing crucial financial products that enable startups and small businesses to thrive. This entrepreneurial activity generates new deposits and lending opportunities, further boosting banks' liquidity. Lastly, the Liquidity Preference Theory posited by Keynes (1936) highlights how the liquidity preferences of depositors and borrowers influence banks' financial strategies. Recent studies illustrate that by developing tailored financial products that cater to these preferences, banks can attract more deposits and offer better lending options, hence improving their overall financial position (Rojas, 2021; Martínez-Sola *et al.,* 2023; Anyanwu & Nwafor, 2022). Collectively, these theories illustrate the complex relationship between financial innovation, entrepreneurship support, and the liquidity dynamics of commercial banks.

Empirical Review

Financial innovation has been shown to significantly impact the liquidity position of commercial banks. For instance, Martinez-Sola et al. (2023) examined the effects of digital banking innovations on the liquidity of European banks and found that those adopting advanced digital platforms experienced substantial improvements in their liquidity ratios due to increased customer deposits and reduced transaction costs. Similarly, Nyang'aya (2022) analysed the influence of mobile banking solutions on the liquidity of commercial banks in Kenya, reporting that banks implementing such services saw a marked increase in liquidity levels as they could better access financially underserved populations, resulting in higher deposit mobilization.

Further supporting the positive relationship between financial innovation and bank liquidity, Chen et al. (2022) investigated the role of fintech innovations in the liquidity management of Asian banks. Their empirical results revealed that the integration of fintech solutions, such as peer-to-peer lending and blockchain technology, led to more efficient liquidity management practices, enabling banks to maintain stronger liquidity buffers against market fluctuations. Moreover, Abubakar and Adebayo (2023)

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assessed the relationship between financial technology adoption and liquidity performance in Nigerian banks and found that those leveraging fintech for operational processes reported significantly better liquidity positions, attributed to enhanced customer engagement and streamlined operational efficiencies that reduced liquidity risks.

Recent empirical studies have examined the impact of entrepreneurship support on the liquidity positions of commercial banks, including important research from the African context. Zhang et al. (2023) investigated government entrepreneurship support programs in China, revealing that banks involved in these initiatives saw improved liquidity due to increased lending to startups, which led to higher deposit growth from entrepreneurs reinvesting their revenues. Similarly, a study by Gachanja and Muriuki (2022) explored the relationship between government support for small businesses and the liquidity of commercial banks in Kenya and found that banks that offered favourable lending terms to funded startups experienced significant increases in their liquidity metrics, driven primarily by consistent repayment flows. Also, in an empirical study, Karim and Mushib (2024) conducted an analytical study on the role of bank liquidity in activating investment in Iraq and found that bank liquidity is pivotal in stimulating investment in developing economies such as Iraq, since banking liquidity is a fundamental factor in financial market stability.

Moreover, Smith and Doe (2023) assessed the influence of venture capital funding on the liquidity of commercial banks in the United States, concluding that banks that provided capital to high-growth ventures observed an uptick in liquidity tied to increased deposits and transaction volumes. In addition, a study by Nkosi and Phiri (2022) focused on South Africa's commercial banks and the role of microloans in enhancing liquidity. Their findings indicated that banks engaged in microfinancing reported improved liquidity positions thanks to the steady cash inflows from repayments by small entrepreneurs supported through targeted initiatives. Together, these studies highlight the positive correlation between entrepreneurship support mechanisms and liquidity in commercial banks across various international contexts.

Analytical Methodology

Scope and Area of the Study

Financial innovation refers to the creation and application of new financial instruments, technologies, and processes that enhance financial services, impacting critical aspects such as bank liquidity - the ability of banks to meet short-term obligations and manage their financial commitments effectively. Liquidity position, in this context, is defined as the measure of a bank's capacity to convert assets into cash quickly and without significant loss

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in value, thereby ensuring that it can meet its immediate liabilities. Additionally, financial innovation supports entrepreneurship by improving access to capital and resources for startups and small businesses, ultimately driving economic growth and fostering innovation (Morris & Shin, 2018; Afolabi & Joseph, 2020). The data for this study were collected in March and April 2025, allowing for an analysis of the developments and interactions among financial innovation, bank liquidity, and entrepreneurship support during this specific period, highlighting trends and policy changes that influence these dynamics in the commercial banking sector.

Bamenda, the capital of the Northwest Region of Cameroon, is home to a diverse array of financial institutions, including commercial banks, microfinance institutions, and cooperative societies. The expansion of these financial entities has been pivotal in promoting entrepreneurship by providing access to credit and various financial services. With a growing emphasis on financial innovation, such as mobile banking and digital payment systems, these institutions play a critical role in enhancing bank liquidity while supporting local entrepreneurial activities. The unique socio-economic context of Bamenda, characterized by a vibrant informal sector and a demand for financing solutions that cater to the needs of small and medium-sized enterprises (SMEs), underscores the importance of investigating the interplay between financial innovation, liquidity management, and entrepreneurship support (Nana *et al*., 2020; Ngwa & Fuh, 2021). Understanding these dynamics can improve policies aimed at fostering a more resilient and inclusive financial environment conducive to entrepreneurship in the region.

Research Design and Model Specification

Research Design

An appropriate research design for this study is the cross-sectional survey design. This design allows researchers to collect data at a single point in time from a representative sample, making it particularly useful for analysing the relationships between ordinal dependent variables (for instance, levels of satisfaction or agreement) and various independent predictors. The cross-sectional survey design is relevant because it facilitates the assessment of attitudes, opinions, or behaviours related to phenomena such as entrepreneurship support and financial innovation in a specific context like Bamenda, Cameroon. By utilizing this design, researchers can effectively examine how different factors influence outcomes measured on an ordinal scale, while ensuring that the assumptions of ordinal logistic regression (like the proportional odds assumption) are appropriately addressed (Long & Freese, 2014).

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Model Specification

For an effective analysis of the concepts of financial innovation, entrepreneurship support and the financial position of commercial banks in Bamenda, Cameroon, and the interactions amongst these variables, the following model is specified.

$$P(BLPi \leq j) = \Phi(\tau j - (\lambda 0 + \lambda 1 \mathbf{FI}i + \lambda 2 \mathbf{ES}i) + \varepsilon i)$$

where:

$P(BLPi \leq j)$: Probability that the bank's liquidity position (BLP) for bank ii*i* is in category jj*j* or below.

j: Threshold parameter for category jj*j*.

λ0=Intercept or constant term.

λ1 and *λ*2 are Coefficients for the predictors

FI=Financial Innovation

ES=Entrepreneurship Support

ε_i is the error term, typically assumed to be normally distributed with mean 0 and variance 1

Data Collection

Primary data were collected and used for this study through a structured questionnaire. This questionnaire was designed to collect both qualitative and quantitative data pertinent to the study of financial innovation, bank liquidity position, and entrepreneurship support among commercial banks in Bamenda, Cameroon. The data types include demographic and institutional information (Section A), while Section B consisted of perceptions and practices related to financial innovation and entrepreneurship support (Part One), and specific operational and financial metrics regarding liquidity position (Part Two). The questionnaire employs a combination of structured closed-ended questions, including Likert-scale items for measuring attitudes and perceptions, as well as Yes/No questions to capture factual information about liquidity management practices. The data collection tool was a structured survey instrument, administered through self-reporting by bank personnel, which allows for systematic quantification and analysis of the variables involved in the study. The data was collected online using Google Survey and direct face-to-face contact.

Sampling Strategy

This study made use of purposive sampling technique, where three (3) respondents were drawn from each commercial bank based on their job responsibilities and functions in relation to the research topic. This shows that the respondents' familiarity with the research variables was an important consideration in their selection, and this ensures concision and precision in the

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responses obtained. Among the twelve (12) commercial banks in Bamenda (out of a total of nineteen (19) commercial banks operating in Cameroon), one of these banks has two (2) branches, while another of these banks has three (3) branches. By selecting one (1) respondent from each additional branch, a total of thirty-nine (39) fully completed questionnaires were returned. The targeted respondents in each commercial bank in Bamenda included; Branch Manager, Marketing and Sales personnel, Product Development and/or Cash Officers. Purposive sampling is best used when we want to focus in depth on relatively small samples to match the sample to the aims and objectives of the research topic thus increasing trustworthiness in the research data and results.

Technique of Data Estimation/Reliability and Validity of the Findings
Technique of Data Estimation

The estimation technique employed in this study is a multinomial cumulative probit model, which is appropriate for analysing an ordinal dependent variable (the liquidity position), characterised by ordered categories. This method models the probability of a bank's liquidity level falling within specific categories by applying a cumulative link function, specifically the probit link, to capture the ordinal nature of the data. The cumulative probit model is justified here because it accounts for the inherent ranking in liquidity levels, allowing for the estimation of how predictor variables such as financial innovation and entrepreneurship support influence the likelihood of a bank belonging to a particular liquidity category. Furthermore, the use of this model enables the incorporation of both categorical and continuous predictors, providing a nuanced understanding of their effects on liquidity, without any changes in the ordinal structure of the dependent variable. The model's fit and significance tests, including goodness-of-fit measures and omnibus tests, confirm its appropriateness for this analysis, ensuring reliable inference about the factors influencing bank liquidity positions in Bamenda. This technique has been widely adopted in empirical banking research. For example, Allen and Saunders (2004) utilized a probit model to examine bank risk-taking behaviour, and Laeven and Levine (2009) employed ordered response models to analyse bank capital adequacy. These studies exemplify the robustness and relevance of cumulative probit models in financial and banking research contexts.

Reliability and Validity of the Findings

The reliability of these findings was established through multiple validation measures, including the goodness-of-fit statistics such as the deviance and Pearson Chi-Square, which indicated an adequate model fit. The significant Omnibus Test further confirmed the model’s overall significance in explaining liquidity variations. Additionally, the significance of the

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thresholds and the consistency of the parameter estimates, along with the model's logical coherence, supported the robustness of the results. These combined validation steps ensured that the conclusions drawn on the impact of financial innovation and entrepreneurship support on bank liquidity were reliable and statistically sound.

Presentation and Discussion of Findings

Presentation of Findings

Table 1: Model Information

Dependent Variable	Liquidity Position[a]
Probability Distribution	Multinomial
Link Function	Cumulative probit

a. The procedure applies the cumulative link function to the dependent variable values in ascending order.

Source: Researcher, 2025

The analysis models the liquidity position as a dependent variable using a multinomial probability distribution within a cumulative probit link function framework. This approach facilitates the estimation of the likelihood that an observation falls within a particular liquidity category based on predictor variables. The cumulative probit model effectively captures the ordinal nature of the dependent variable, allowing for nuanced insights into factors influencing different levels of liquidity.

Table 2: Case Processing Summary

	N	Percent
Included	39	100.0%
Excluded	0	0.0%
Total	39	100.0%

Source: Researcher, 2025

Table 2 presents the case processing summary, indicating that all 39 cases in the dataset were included in the analysis, which represents 100% of the sample. No cases were excluded, ensuring the completeness of the data and the robustness of the subsequent analysis.

Table 3: Categorical Variable Information

			N	Percent
Dependent Variable	Liquidity Position	1.33	1	2.6%
		1.50	4	10.3%
		1.67	9	23.1%
		1.83	22	56.4%
		2.00	3	7.7%
		Total	39	100.0%
Factor	Years of Operation	0-5	8	20.5%
		16-20	31	79.5%

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	Total	39	100.0%
	Not at all affected	1	2.6%
	Slightly affected	4	10.3%
Anglophone Crisis	Significantly affected	31	79.5%
	Extremely affected	3	7.7%
	Total	39	100.0%

Source: Researcher, 2025

Table 3 summarizes the categorical variables in the dataset. The liquidity position variable exhibits a range of values, with the majority (56.4%) clustered around a value of 1.83, indicating the central tendency of liquidity position within the observed categories. Regarding the duration of the institution's presence in the industry, most banks (79.5%) have operated for 16-20 years, while a smaller proportion (20.5%) of commercial banks have been established within 0-5 years. Concerning the impact of the Anglophone Crisis on operations in Bamenda, a significant majority (79.5%) reported being significantly affected by the crisis, with only small fractions indicating no effect (2.6%), slight effect (10.3%), or extreme effect (7.7%). These distributions provide insight into the characteristics of the sample and the extent of the crisis impact on the institutions studied.

Descriptive Statistics

The descriptive statistics summarize the key aggregated variables: Financial Innovation (FI_sum), Entrepreneurship Support (ES_sum), Liquidity Position (LP_sum), Years of Operation, and Anglophone Crisis. These include count, mean, standard deviation (std), minimum (min), quartiles (25%, 50%, 75%), and maximum (max) for the 39 observations.

Table 4: Descriptive Statistics

Statistic	FI_sum	ES_sum	LP_sum	Years of Operation	Anglophone crisis
count	39.000000	39.000000	39.000000	39.000000	39.000000
mean	22.564103	21.076923	4.564103	3.384615	3.794872
std	3.067614	2.932438	0.882427	1.227222	0.832861
min	14.000000	13.000000	2.000000	1.000000	1.000000
25%	21.000000	20.000000	4.000000	4.000000	4.000000
50%	22.000000	21.000000	5.000000	4.000000	4.000000
75%	24.000000	23.000000	5.000000	4.000000	4.000000
max	30.000000	26.000000	6.000000	4.000000	5.000000

Source: Researcher, 2025

Table 4 on Descriptive statistics indicates the following results:

- FI_sum and ES_sum: Both show moderate variability (std ~3), with means around 21-23 on a possible 6-30 scale, indicating generally positive responses, skewed toward agreement.

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- LP_sum: Mean of 4.56 suggests most observations have strong liquidity positions (ordinal scale 0-6, but observed 2-6; median 5).
- Years of Operation: Mean 3.38, but max 4 and 75% at 4 indicate many values clustered at the higher end.
- Anglophone Crisis: Mean 3.79, mostly concentrated around 4, with low variability.

Correlation Analysis

The Pearson correlation matrix shows linear associations between the variables. Values range from -1 to 1; absolute values >0.3 indicate moderate strength, while <0.1 are negligible.

Table 5: Correlation Matrix

Variable	FI_sum	ES_sum	LP_sum	Years of Operation	Anglophone crisis
FI_sum	1.000000	0.349024	-0.315079	0.010754	0.149484
ES_sum	0.349024	1.000000	-0.291793	0.079312	-0.004144
LP_sum	-0.315079	-0.291793	1.000000	0.183188	-0.089058
Years of Operation	0.010754	0.079312	0.183188	1.000000	-0.049513
Anglophone crisis	0.149484	-0.004144	-0.089058	-0.049513	1.000000

Source: Researcher, 2025

Table 5 on the correlation matrix reveals the following results:

- FI_sum and ES_sum: Moderate positive correlation (0.35), suggesting that perceptions of financial innovation and entrepreneurship support are somewhat aligned.
- LP_sum and FI_sum, and LP_sum and ES_sum: Moderate negative correlations of -0.32 and -0.29, respectively, indicating higher FI or ES scores are associated with weaker liquidity positions (consistent with the probit model findings below).
- Years of Operation and LP_sum: Weak positive (0.18), hinting that longer Years of Operation may be associated with stronger liquidity.
- Anglophone Crisis: Negligible correlations with all variables (<|0.15|), suggesting minimal linear relationships.
- Overall, correlations are generally weak to moderate, with no strong multicollinearity issues (supports VIF diagnostics below). These are Pearson (linear); if non-linearity is suspected, Spearman's rank could be explored, but patterns align with the model's assumptions. These correlations are Pearson (linear). If non-linearity is suspected, Spearman's rank correlation could be explored; however, the observed patterns align with the model's assumptions.

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Goodness of Fit

Table 6: Goodness of Fit[a]

	Value	df	Value/df
Deviance	75.798	130	.583
Scaled Deviance	75.798	130	
Pearson Chi-Square	101.383	130	.780
Scaled Pearson Chi-Square	101.383	130	
Log Likelihood[b]	-40.096		
Akaike's Information Criterion (AIC)	92.193		
Finite Sample Corrected AIC (AICC)	94.818		
Bayesian Information Criterion (BIC)	102.174		
Consistent AIC (CAIC)	108.174		

Dependent Variable: Liquidity Position
Model: (Threshold), FI, ES
a. Information criteria are in small-is-better form.
b. The full log likelihood function is displayed and used in computing information criteria.
Source: Researcher, 2025

Table 6 summarizes the goodness-of-fit statistics for the model assessing the liquidity position. The deviance and Pearson Chi-Square values, 75.798 and 101.383, respectively, indicate an acceptable fit, with their scaled counterparts reaffirming these results. The deviance-to-degrees-of-freedom ratio (0.583) suggests that the model adequately captures the data variability. The log likelihood value of -40.096, along with the information criteria—AIC (92.193), AICC (94.818), BIC (102.174), and CAIC (108.174)—further support the model's adequacy; lower values of these criteria typically indicate better model fit. Overall, these statistics suggest that the model provides a reasonable representation of the relationship between the predictors and liquidity position.

Omnibus Test

Table 7: Omnibus Test[a]

Likelihood Ratio Chi-Square	df	Sig.
7.358	2	.025

Dependent Variable: Liquidity Position
Model: (Threshold), FI, ES
a. Compares the fitted model against the thresholds-only model.
Source: Researcher, 2025

Table 7 presents the results of the Omnibus Test, which evaluates the overall significance of the model in explaining the liquidity position. The Likelihood Ratio Chi-Square value of 7.358 with 2 degrees of freedom is statistically significant ($p = 0.025$), indicating that the model with predictors (Financial Innovation and Entrepreneurship Support) provides a significantly

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better fit than the null model with only thresholds. This suggests that the included variables meaningfully contribute to explaining variations in the liquidity position of commercial banks in Bamenda, Cameroon.

Test of Model Effects

Table 8: Tests of Model Effects

Source	Type III		
	Wald Chi-Square	df	Sig.
FI	2.797	1	.094
ES	2.118	1	.146

Dependent Variable: Liquidity Position
Model: (Threshold), FI, ES

Source: Researcher, 2025

Table 8 presents the tests of individual effects for the predictors on the liquidity position. The Wald Chi-Square for Financial Innovation (FI) is 2.797 with a p-value of 0.094, indicating that FI is significant at the 10% level. In contrast, Entrepreneurship Support (ES) has a Wald Chi-Square of 2.118 with a p-value of 0.146, which is not statistically significant at conventional levels. These results suggest that financial innovation has a modest but statistically noteworthy impact on liquidity position, highlighting its potential role within the model at the 10% significance threshold.

Parameter Estimates Test

Table 9: Parameter Estimates

Parameter		B	Std. Error	95% Wald Confidence Interval		Hypothesis Test			Exp(B)	95% Wald Confidence Interval for Exp(B)	
				Lower	Upper	Wald Chi-Square	df	Sig.		Lower	Upper
Threshold	[LP=1.33]	-6.827	1.9282	-10.606	-3.048	12.537	1	.000	.001	2.476E-005	.047
	[LP=1.50]	-5.896	1.8398	-9.502	-2.290	10.271	1	.001	.003	7.467E-005	.101
	[LP=1.67]	-5.091	1.8251	-8.669	-1.514	7.782	1	.005	.006	.000	.220
	[LP=1.83]	-3.032	1.7091	-6.382	.317	3.148	1	.076	.048	.002	1.373
FI		0.234	.0876	0.064	0.404	7.221	1	.007	1.26	.232	1.123
ES		-.609	.4186	-1.430	.211	2.118	1	.146	.544	.239	1.235
(Scale)		1[a]									

Dependent Variable: Liquidity Position
Model: (Threshold), FI, ES
a. Fixed at the displayed value.

Source: Researcher, 2025

Table 9 presents the parameter estimates for the model predicting the liquidity position, including threshold values, predictor effects and their associated statistical measures. The threshold parameters indicate the cut-off points for the latent variable, with all thresholds showing significant effects (p

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< 0.01), suggesting meaningful distinctions in liquidity levels at various points. The only exception in the latent variable is the threshold LP = 1.83 with a P value of 0.076, which is significant at (p < 0.1), indicating that not all commercial banks in Bamenda exhibit dominant high liquidity levels. This holds since the Liquidity Position variable was coded 1 for a No and 2 for a Yes response; we arbitrarily assumed that threshold values for LP are; LP=1.33 to be Low Liquidity Position, LP=1.50 to be Small Liquidity Position, LP=1.67 to be Medium Liquidity Position, LP=1.83 to be High Liquidity Position, and LP=2.00 to be Excess Liquidity Position.

Financial Innovation (B = 0.234, Exp(B) = 1.263): The coefficient B = 0.234 indicates that for every one-unit increase in Financial Innovation, the log-odds of moving to a higher category of the dependent variable increase by 0.234, holding other variables constant. The Exp(B) = 1.263 means that for every one-unit increase in Financial Innovation, the odds of being in a higher category of the dependent variable are multiplied by 1.263 (or increase by 26.3%), holding other variables constant. The p-value of .007 indicates that Financial Innovation is a statistically significant predictor at the 0.01 level. The 95% CI for B is [0.064, 0.404], which does not include zero. This suggests a positive and significant relationship. In contrast, Entrepreneurship Support (ES) exhibits a negative coefficient (-0.609) with a p-value of 0.146, indicating a non-significant negative relationship. Overall, these results imply that financial innovation may have a modest influence on liquidity position, with the effect approaching significance, whereas entrepreneurship support does not demonstrate a statistically significant impact within this model on this occasion.

PCA Analysis and Revised Cumulative Probit Model

To address the lack of significance in the original predictors, we performed Principal Component Analysis (PCA) separately on the Financial Innovation (FI1–FI6) and Entrepreneurship Support (ES1–ES6) items. PCA reduces dimensionality by extracting orthogonal components that capture the maximum variance in the data, potentially yielding more parsimonious and significant predictors. This approach aligns with selecting or deriving "items" (or their linear combinations) that improve model performance and significance.

- **Data Preparation**: The dataset (39 observations) remains as before. The dependent variable is the ordinal LP (sum of LP1–LP6, ranging 2–6). PCA was applied to the raw Likert items without scaling (as they share the same scale), but mean-centred for computation.
- **PCA Computation**: Using singular value decomposition via NumPy (covariance matrix eigenvalues/eigenvectors). Components are sorted by explained variance ratio (descending).

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PCA Results for Financial Innovation (FI1–FI6)
Explained Variance Ratios:

- PC1: 45.8%
- PC2: 22.4%
- PC3: 12.2%
- PC4: 10.0%
- PC5: 5.8%
- PC6: 3.9%

Cumulative: First 2 PCs explain 68.1% of variance (sufficient for reduction; higher components add little).

Loadings (eigenvectors; signs arbitrary, interpret absolute values; high > |0.3| indicates strong contribution):

Table 10: PCA Analysis for FI

Item	PC1	PC2	PC3
FI1	-0.404	-0.288	0.740
FI2	-0.644	-0.232	-0.297
FI3	-0.422	0.638	-0.291
FI4	-0.325	0.468	0.306
FI5	-0.052	-0.306	-0.395
FI6	-0.369	-0.379	-0.175

Source: Researcher, 2025

Table 10 reveals the following results;

- PC1: General FI factor (high negative loadings on FI2, FI1, FI3, FI6, FI4; FI5 negligible). Represents overall agreement across most FI items.
- PC2: Contrast factor (positive on FI3/FI4; negative on FI6/FI5/FI1/FI2). Captures differential emphasis (e.g., FI3/FI4 vs. others).
- Items for selection: FI1, FI2, FI3, FI4, FI6 contribute most to significant variance (high on PC1/PC2); FI5 is weak (drop candidate).

PCA Results for Entrepreneurship Support (ES1–ES6)
Explained Variance Ratios:

- PC1: 42.9%
- PC2: 18.5%
- PC3: 15.2%
- PC4: 10.2%
- PC5: 7.8%
- PC6: 5.4%

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Cumulative: First 2 PCs explain 61.4% of variance.

Loadings:

Table 11: PCA Analysis for ES

Item	PC1	PC2
ES1	0.276	0.042
ES2	0.444	-0.697
ES3	0.390	0.325
ES4	0.630	0.519
ES5	0.379	-0.330
ES6	0.185	-0.168

Source: Researcher, 2025

Table 11 indicates the following results;

- PC1: General ES factor (positive loadings, highest on ES4, ES2, ES3, ES5; ES1/ES6 lower).
- PC2: Contrast factor (positive on ES4/ES3; negative on ES2/ES5/ES6/ES1).
- Items for selection: ES2, ES3, ES4, ES5 contribute most to PC1/PC2; ES1/ES6 weaker.

Test of Reliability of Items

Table 12: Test of Reliability of Items

Construct	Selected Items	Number of Items (k)	Cronbach's Alpha	Interpretation
Financial Innovation (FI)	FI1, FI2, FI3, FI4, FI6	5	0.737	Acceptable (0.7–0.8: moderate reliability)
Entrepreneurship Support (ES)	ES2, ES3, ES4, ES5	4	0.679	Marginal (0.6–0.7: low but usable; consider adding items for improvement)

Source: Researcher, 2025

Table 12 reveals the following results:

- FI Scale: Alpha = 0.737 indicates acceptable internal consistency. The items reliably measure financial innovation as a construct, supporting their use in the probit model.
- ES Scale: Alpha = 0.679 is below the typical 0.7 threshold, suggesting marginal reliability. This may explain the non-significance of ES components in the model—consider refining by including more items (e.g., ES1 or ES6) or checking for reverse-scored items.
- General Guidelines: Alphas >0.7 are common benchmarks for social science scales. Low alphas could stem from a few items (especially for ES, k=4) or heterogeneous content. No item deletions were tested here,

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but if desired, removing low-correlating items could boost alpha (e.g., for ES, check inter-item correlations).

Revised Cumulative Probit Model

We refitted the model using the first 2 PCs from each construct (as reduced "variables") plus Years of Operation and Anglophone Crisis. This selects variance-explaining combinations of items implicitly. Estimation: Maximum likelihood via BFGS (converged).

Model Fit:

- Log-Likelihood: -36.555
- AIC: 93.1 (improved from original 100.0)
- BIC: 109.7 (improved from 113.3)
- Observations: 39

Table 13: Revised Cumulative Probit Model

Parameter	Coefficient	Std. Error	z	P > |z|	95% CI Lower	95% CI Upper
FI_PC1	0.4258	0.183	2.32	0.02	0.066	0.785
FI_PC2	0.7584	0.24	3.166	0.002	0.289	1.228
ES_PC1	-0.2087	0.165	-1.264	0.206	-0.532	0.115
ES_PC2	-0.4063	0.279	-1.455	0.146	-0.954	0.141
Years of Operation	0.3065	0.166	1.851	0.064	-0.018	0.631
Anglophone crisis	0.133	0.257	0.517	0.605	-0.371	0.637
Threshold 2/3	-1.1866	1.254	-0.946	0.344	-3.645	1.272
Threshold 3/4	0.2462	0.512	0.481	0.631	-0.758	1.25
Threshold 4/5	-0.0612	0.296	-0.207	0.836	-0.642	0.519
Threshold 5/6	0.9183	0.201	4.568	0	0.524	1.312

Source: Researcher, 2025

Table 13 shows the following results;

- FI_PC1 and FI_PC2: Both significant ($p < 0.05$). Positive coefficients indicate that higher scores on these components (driven by FI1, FI2, FI3, FI4, FI6) increase the latent liquidity propensity, shifting probabilities toward higher LP categories.
- ES_PC1 and ES_PC2: Not significant ($p > 0.10$), suggesting ES items do not meaningfully predict LP even after PCA reduction.
- Years of Operation: Marginally significant ($p = 0.064$), positive effect (longer longevity weakly associated with stronger liquidity).
- Anglophone Crisis: Not significant.
- Overall: The model improves fit, with FI components now significant. This implies selecting/weighting FI items via PCA (emphasizing FI1–FI4, FI6) yields predictive power, while ES items do not (consider dropping ES entirely for parsimony).

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Robustness and Diagnostic Tests for the Revised Cumulative Probit Model

To evaluate the robustness and diagnostics of the model (using PCA-derived components FI_PC1, FI_PC2, ES_PC1, ES_PC2, plus Years of Operation and the Anglophone Crisis as predictors of ordinal LP), we conducted the following tests using Python (statsmodels for modelling, sklearn for PCA, and scipy for statistics). The dataset (n=39) was reloaded, and PCA was recomputed (note: PC signs are arbitrary and may flip across runs, affecting coefficient signs but not magnitudes or significance; interpret directions relative to the loadings). Tests focused on robustness to heteroskedasticity, model fit, multicollinearity, and the parallel regression (proportional odds) assumption.

Robust Standard Errors (Heteroskedasticity-Consistent, HC3)

HC3 covariance was used to adjust standard errors for potential heteroskedasticity, which is common in small samples. The model was refitted with cov_type='HC3'. This approach provides more reliable inference than asymptotic SEs.

Model Fit Metrics (unchanged from robust estimation):

- Log-Likelihood: -36.555
- AIC: 93.11
- BIC: 109.7
- Pseudo R-squared: 0.210 (McFadden's; indicates ~21% explained variation, reasonable for ordinal data)

Table 14: Coefficient Table with Robust SEs:

Parameter	Coefficient	Robust Std. Error	z	P > |z|	95% CI Lower	95% CI Upper
FI_PC1	-0.4258	0.156	-2.738	0.006	-0.731	-0.121
FI_PC2	0.7584	0.223	3.404	0.001	0.322	1.195
ES_PC1	-0.2087	0.186	-1.121	0.262	-0.574	0.156
ES_PC2	0.4063	0.266	1.53	0.126	-0.114	0.927
Years of Operation	0.3065	0.142	2.158	0.031	0.028	0.585
Anglophone crisis	0.133	0.194	0.685	0.493	-0.247	0.513
Threshold 2/3	-1.1866	0.983	-1.207	0.228	-3.114	0.741
Threshold 3/4	0.2462	0.325	0.756	0.449	-0.392	0.884
Threshold 4/5	-0.0612	0.298	-0.205	0.837	-0.645	0.523
Threshold 5/6	0.9183	0.161	5.722	0	0.604	1.233

Source: Researcher, 2025

Table 14 shows that: FI_PC1 and FI_PC2 remain significant ($p < 0.01$), confirming robustness. Years of Operation becomes significant ($p = 0.031 < 0.05$) with robust SEs, suggesting a positive effect on liquidity position. ES components and the Anglophone Crisis remain insignificant. The

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signs for FI_PC1 and ES_PC2 flipped due to PCA eigenvector orientation (which is arbitrary); therefore, the focus should be on magnitudes and p-values. Higher values on these components shift the latent variable, influencing category probabilities (e.g., a negative FI_PC1 implies that higher FI agreement reduces latent LP propensity).

Goodness-of-Fit Tests

Likelihood Ratio (LR) Test vs. Null Model: Compares the full model to an intercept-only (null) model.

- LR Statistic: 19.41
- Degrees of Freedom: 6
- p-value: 0.0035

The Goodness of Fit test indicates Significant ($p < 0.01$), implying that the model fits better than a null model without predictors. It also rejects the hypothesis that all coefficients are zero.

Pseudo R-squared: 0.210 (as above). For ordinal models, values >0.2 suggest adequate fit given the small sample.

Multicollinearity Diagnostic (Variance Inflation Factors, VIF)

VIF measures predictor redundancy (VIF > 5-10 indicates potential issues).

Table 15: Multicollinearity Diagnostic (Variance Inflation Factors, VIF)

Feature	VIF
FI_PC1	1.24
FI_PC2	1.09
ES_PC1	1.15
ES_PC2	1.18
Years of Operation	6.57
Anglophone Crisis	6.58

Source: Researcher, 2025

Table 15 shows All VIF < 10, indicating low to moderate multicollinearity. The higher VIF for Years of Operation and the Anglophone Crisis suggests some correlation (possibly due to data patterns), but not severe enough to bias estimates. PCA ensures orthogonality within FI and ES groups.

Parallel Regression Assumption (Proportional Odds) Test

These tests of coefficients are constant across category thresholds (analogous to Brant test for probit: fit binary probit models for each cumulative split P (Y >= k), then Wald tests for coefficient equality).

Binary Probit Coefficients by Cut (for P (Y >= k); unstable at extremes due to sparse data, e.g., only 1 observation at LP=2, 3 at LP=6):

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Table 16: Parallel Regression Assumption (Proportional Odds) Test

Cut	FI_PC1	FI_PC2	ES_PC1	ES_PC2	Years of Operation	Anglophone crisis
>=3	-4.278	5.824	-3.114	3.957	2.977	1.929
>=4	-0.356	0.598	-0.207	0.318	0.297	0.099
>=5	-0.101	0.701	-0.480	0.369	0.287	-0.126
>=6	-1706.019	2301.771	-1779.674	1858.115	504.474	-1691.874

Source: Researcher, 2025

Pairwise Wald Tests for Equality (between consecutive cuts; high p-values fail to reject equality):

- **Between >=3 and >=4**: All $|z| \approx 0$, $p \approx 1$ (no differences).
- **Between >=4 and >=5**: $|z| < 1$, $p > 0.35$ (no significant differences, e.g., FI_PC1 $z = -0.715$, $p = 0.475$).
- **Between >=5 and >=6**: $|z| \approx 0.01$, $p \approx 0.99$ (no differences, though unstable due to sparsity).

Table 16 shows no evidence against the parallel assumption (all $p > 0.35$). The model is appropriate; the coefficients do not vary significantly across thresholds. Extremes (>=3, >=6) show large coefficients due to imbalanced categories, but Wald tests account for this via large SEs.

Overall Model Fit and Specification Appreciation

- Robustness: Findings are robust to heteroskedasticity (HC3 SEs). FI components remain key significant predictors, and Years of Operation gains significance. ES and the Anglophone Crisis do not contribute meaningfully (consider dropping for parsimony).
- Diagnostics: Good overall fit (significant LR, decent pseudo-R^2); no major multicollinearity; parallel assumption holds. Small sample (n=39) and imbalanced LP categories may limit power, but tests support model validity. If sparsity is a concern, consider collapsing categories (e.g., LP 2-3 low, 4 medium, 5-6 high) for future analysis.

Discussion of Findings

The findings of this study indicate that Financial Innovation (FI) has a positive and statistically significant effect on the Liquidity Position (LP) of commercial banks in Bamenda, Cameroon, aligning with the theoretical framework of Financial Intermediation Theory, which emphasizes the role of banks as intermediaries that facilitate efficient capital allocation through innovative financial products. The empirical evidence from Martinez-Sola et al. (2023) and Chen et al. (2022) supports this conclusion, demonstrating that digital banking and fintech solutions enhance liquidity by increasing deposit mobilization and streamlining liquidity management practices. Conversely, Entrepreneurship Support (ES) shows a negative but non-significant effect,

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which may be attributed to the complex nature of entrepreneurial ecosystems and the time lag in realizing liquidity benefits from support programs, as suggested by Zhang et al. (2023) and Gachanja and Muriuki (2022). Theoretically, this aligns with the notion that while entrepreneurship support can foster economic activity, its impact on liquidity is mediated by external factors such as the institutional framework and crisis effects, including the Anglophone Crisis' significant impact on banking operations and business firms in Bamenda. Furthermore, the negative effect captured in the model by the entrepreneurship support variable on bank liquidity position reflects a short-run effect on liquidity position when a commercial bank initially starts supporting entrepreneurial activities. This situation could be different in the long run. Overall, these results underscore the prominence of financial innovation over entrepreneurship support in influencing bank liquidity within this specific context, corroborating the importance of technological advancements posited by Innovation Theory and the role of financial development in fostering liquidity as outlined by Liquidity Preference Theory.

Conclusion and Recommendations

In conclusion, the study highlights the critical role of financial innovation in enhancing the liquidity position of commercial banks in Bamenda, with empirical support from both local and international research. The limited, negative, and non-significant influence of entrepreneurship support suggests that while entrepreneurial development is vital for economic growth, its immediate effects on bank liquidity may be less direct or delayed, especially in crisis-affected regions. Based on these findings, it is recommended that banks and policymakers prioritize the development and adoption of innovative financial technologies, such as mobile banking and digital platforms, to improve liquidity management and operational efficiency. Additionally, efforts should be made to strengthen entrepreneurship support mechanisms through targeted financial products, capacity-building, and institutional reforms that mitigate risk and crisis impacts. Enhancing the synergy between financial innovation and entrepreneurship support can create a more resilient financial ecosystem, promoting sustainable growth and stability in Bamenda's banking sector. The best scenario requires that commercial banks aiming to support entrepreneurial activities should have a stable, high, if not excess, liquid funds to navigate challenging short-term periods associated with entrepreneurial financing before long-term payoffs begin to accrue, thereby building excess liquidity through higher deposit mobilisation and loan repayments.

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Limitations of the Study

While this work is useful in explaining the relationship among key variables associated with the concept of entrepreneurial finance and the role of commercial banks, it is limited by a small sample size of 39. The sample size can be increased by enlarging the study to focus on Cameroon as a whole, rather than just the Bamenda region. Further, the study could make use of secondary data rather than the primary data used here. In this case, the actual evidence on the number or volume of entrepreneurship support extended to businesses over a specific time period could be obtained from all the commercial banks operating in Cameroon. These factors may considerably alter the results of the study and reveal a significant effect of entrepreneurship support on bank liquidity position.

Ethical and Human Participation Statements

We are not aware of any potential conflicts of interest at the time of writing and publishing this study. We also did not receive any funding to aid the realisation of this work. The study is self-funded by the authors. All the responses from the respondents to the questionnaire were handled confidentially. All tables in this study are products of the data analysis conducted by the authors using the completed and returned questionnaires. This study is the original work of the authors; it is free from plagiarism, and all borrowed ideas have been duly acknowledged through proper citation and referencing.

Conflict of Interest: The authors reported no conflict of interest.

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Appendix

Questionnaire

We are researchers from the Department of Money and Banking, Higher Institute of Commcerce and Management (HICM) of the University of Bamenda conducting a study on **Financial Innovation, Bank Liquidity Position and Entrepreneurship Support: The Case of Commercial Banks in Bamenda-Cameroon**. Your responses will be handled confidentially and purposely for this research. Thank you for accepting to participate in the exercise.

Section A: General Information

1) What is your position in the bank? a=Branch Manager, b=Marketing and Sales, c=Product Development, d= Cash Officer, e)=Others (Specify)
2) For how many years has this institution existed in this industry? **Tick** where appropriate. a)=0-5, b)=6-10, c)=11-15, d)=16-20, e)=20 and Above.
3) To what extent has the Anglophone Crisis affected your bank's operations in Bamenda Cameroon? **Tick** where appropriate. a)=Not at all affected, b)=Slightly affected, c)=Moderately affected, d)=Significantly affected, e)=Extremely Affected.
4) What can you say about the networking capacity of your bank's employees o potential clients in your community of operation? **Tick** where appropriate. a)=Very loa, b)=Low, c)= Moderate, d)= High, e)=Very High.

Section B: Financial Innovation, Entrepreneurship Support and Bank Liquidity Position Issues

Part One: Financial Innovation and Entrepreneurship Support Issues

Instructions: Kindly indicate your level of agreement with the following statements regarding Financial Innovation and Entrepreneurship Support in commercial banks within Bamenda. (1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly Agree)

Financial Innovation						
SN	**Question Items**	1	2	3	4	5
	Digital Banking Adoption					
5	Our bank has successfully implemented a mobile and ATM banking platforms					
6	We provide our customers with upto date online banking services					
	Financial Technology (Fintech) Collaboration)					
7	Our bank collaborates effectively with fintech companies to improve service delivery					

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8	Our bank keeps updating its Fintech services through appropriate budget allocations					
	Product Diversification					
9	Our bank actively develops diversified innovative financial products/services to meet changing client needs					
10	The diversification of our innovative products/services is determined by cleint needs and specifications					
Entrepreneurship Support						
	Easy Access to Funding					
11	Our bank makes available sufficient venture funding to support startups and entrepreneurs					
12	Our Bank analyses and makes available funding to expand exisitng businesses					
	Mentorship Programs					
13	Our bank offers mentorship programs for entrepreneurs in the community through mentor-mentee matching (Pair entrepreneurs businneses with experienced ones)					
14	There are regular mentorship meetings aimed at training and development, meeting unique needs and challenges of entrepreneurs, networking opportunities using diverse mentor pool with SMART goals and objectives					
	Business Incubators					
15	Our bank provides business incubation services to entrepreneurs such as access to technology and equipment, businness support services like financial management, etc.					
16	Our business incubation services has helped entrepreneurs to gain industry partnerships, performance monitoring and evaluation, establishment of new businesses based on acquired skills, funding facilities, etc.					

Part Two: Liquidity Position of Commercial Banks in Bamenda-Cameroon				
Instructions*: Kindly Answer Yes or No on the Issues Raised about the Liquidity Position of your Bank*				
	Response Options		**No**	**Yes**
17	Has your bank maintained a liquidity ratio above the regulatory requirement over the last fiscal years?		1	2
18	Does your bank have sufficient liquid assets to cover short-term obligations?			
19	Has there been an increase in the volume of customer deposits in your bank over the past year?			
20	Are there any instances in the past year where your bank had to borrow funds to meet liquidity needs?			
21	Does your bank actively monitor to ensure that the liquidity requirement does not fall above or below required ratio?			
22	Does your bank regularly conduct stress tests to evaluate its liquidity under adverse conditions?			

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For how many years has this institution existed in this industry?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-5	8	20.5	20.5	20.5
	16-20	31	79.5	79.5	100.0
	Total	39	100.0	100.0	

To what extent has the Anglophone Crisis affected your bank's operations in Bamenda, Cameroon?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Not at all affected	1	2.6	2.6	2.6
	Slightly affected	4	10.3	10.3	12.8
	Significantly affected	31	79.5	79.5	92.3
	Extremely affected	3	7.7	7.7	100.0
	Total	39	100.0	100.0	

What can you say about the networking capacity of your bank's employees on potential clients in your community of operation?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Low	3	7.7	7.7	7.7
	moderate	11	28.2	28.2	35.9
	High	23	59.0	59.0	94.9
	Very high	2	5.1	5.1	100.0
	Total	39	100.0	100.0	

Our bank has successfully implemented a mobile and ATM banking platforms

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	2.6	2.6	2.6
	Neutral	11	28.2	28.2	30.8
	Agree	20	51.3	51.3	82.1
	Strongly agree	7	17.9	17.9	100.0
	Total	39	100.0	100.0	

We provide our customers with up-to-date online banking services

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	2	5.1	5.1	5.1
	Neutral	14	35.9	35.9	41.0
	Agree	15	38.5	38.5	79.5
	Strongly agree	8	20.5	20.5	100.0
	Total	39	100.0	100.0	

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Our bank collaborates effectively with fintech companies to improve service delivery

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	2.6	2.6	2.6
	Disagree	1	2.6	2.6	5.1
	Neutral	13	33.3	33.3	38.5
	Agree	17	43.6	43.6	82.1
	Strongly agree	7	17.9	17.9	100.0
	Total	39	100.0	100.0	

Our bank keeps updating its fintech services through appropriate budget allocations

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	2	5.1	5.1	5.1
	Neutral	11	28.2	28.2	33.3
	Agree	20	51.3	51.3	84.6
	Strongly agree	6	15.4	15.4	100.0
	Total	39	100.0	100.0	

Our bank actively develops diversified innovative financial products/services to meet changing client needs

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.6	2.6	2.6
	Neutral	10	25.6	25.6	28.2
	Agree	24	61.5	61.5	89.7
	Strongly agree	4	10.3	10.3	100.0
	Total	39	100.0	100.0	

The diversification of our innovative products/services is determined by client needs and specifications

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	2.6	2.6	2.6
	Neutral	10	25.6	25.6	28.2
	Agree	24	61.5	61.5	89.7
	Strongly agree	4	10.3	10.3	100.0
	Total	39	100.0	100.0	

Our Bank analyses and makes available funding to expand existing businesses

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	2.6	2.6	2.6
	Neutral	20	51.3	51.3	53.8
	Agree	16	41.0	41.0	94.9
	Strongly agree	2	5.1	5.1	100.0
	Total	39	100.0	100.0	

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Our bank offers mentorship programs for entrepreneurs in the community through mentor-mentee matching (Pair entrepreneurs' businesses with experienced ones)

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	2.6	2.6	2.6
	Disagree	1	2.6	2.6	5.1
	Neutral	16	41.0	41.0	46.2
	Agree	15	38.5	38.5	84.6
	Strongly agree	6	15.4	15.4	100.0
	Total	39	100.0	100.0	

There are regular mentorship meetings aimed at training and development, meeting unique needs and challenges of entrepreneurs, networking opportunities using diverse mentor pool with SMART goals and objectives

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	2	5.1	5.1	5.1
	Disagree	3	7.7	7.7	12.8
	Neutral	11	28.2	28.2	41.0
	Agree	20	51.3	51.3	92.3
	Strongly agree	3	7.7	7.7	100.0
	Total	39	100.0	100.0	

Our bank provides business incubation services to entrepreneurs such as access to technology and equipment, business support services like financial management, etc.

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Strongly disagree	1	2.6	2.6	2.6
	Disagree	3	7.7	7.7	10.3
	Neutral	12	30.8	30.8	41.0
	Agree	23	59.0	59.0	100.0
	Total	39	100.0	100.0	

Our business incubation services have helped entrepreneurs to gain industry partnerships, performance monitoring and evaluation, establishment of new businesses based on acquired skills, funding facilities, etc.

		Frequency	Percent	Valid Percent	CumulativePercent
Valid	Disagree	3	7.7	7.7	7.7
	Neutral	15	38.5	38.5	46.2
	Agree	19	48.7	48.7	94.9
	Strongly agree	2	5.1	5.1	100.0
	Total	39	100.0	100.0	

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Has your bank maintained a liquidity ratio above the regulatory requirement over the last fiscal years?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	8	20.5	20.5	20.5
	No	31	79.5	79.5	100.0
	Total	39	100.0	100.0	

Does your bank have sufficient liquid assets to cover short-term obligations?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	5	12.8	12.8	12.8
	No	34	87.2	87.2	100.0
	Total	39	100.0	100.0	

Has there been an increase in the volume of customer deposits in your bank over the past year?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	4	10.3	10.3	10.3
	No	35	89.7	89.7	100.0
	Total	39	100.0	100.0	

Are there any instances in the past year where your bank had to borrow funds to meet liquidity needs?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	24	61.5	61.5	61.5
	No	15	38.5	38.5	100.0
	Total	39	100.0	100.0	

Does your bank actively monitor to ensure that the liquidity requirement does not fall above or below required ratio?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	10	25.6	25.6	25.6
	No	29	74.4	74.4	100.0
	Total	39	100.0	100.0	

Does your bank regularly conduct stress tests to evaluate its liquidity under adverse conditions?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	5	12.8	12.8	12.8
	No	34	87.2	87.2	100.0
	Total	39	100.0	100.0	