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THRESHOLD EFFECTS OF BANKING DEVELOPMENT ON ECONOMIC VOLATILITY: A VIEW FROM DEVELOPING COUNTRIES

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Abstract:

This study investigates the link between banking development and economic growth volatility in developing countries over the period 2004-2019, employing a panel smooth transition regression approach. By examining various dimensions of banking development, our findings suggest a nonlinear relationship between banking development and economic volatility, characterized by abrupt shifts. Our research provides valuable insights to financial regulators, emphasizing that strengthening oversight of the banking sector and monitoring banking activities are crucial for ensuring adequate levels of financing to mitigate economic fluctuations.

JEL classification: E42, E51, G21

Key words: Banking development, Economic growth volatility, Nonlinear relationship, Developing countries, Panel smooth transition regression.

1. INTRODUCTION

The financial liberalization of the 1980s and 1990s led to the emergence of banking development, characterized by both quantitative and qualitative expansion of banking activities and services. This evolution enhanced credit availability, banking stability, and accessibility to banking services, recognized as potential drivers of economic growth (Rajan and Zingales, 1998; Inoue et al., 2017; Önder and Özyıldırım, 2024). Nonetheless, with the increasing macroeconomic volatility in developing countries over recent decades, scholars have assessed their studies to understand the relationship between banking development and economic volatility. Nevertheless, investigation into the effect of various facets of banking development on growth volatility remains relatively limited.

The paradigm of theoretical studies investigating the relationship between financial development and economic volatility reveals a spectrum of perspectives. The first perspective posits that a robust financial system plays a pivotal role in mitigating economic volatility by alleviating financial constraints that may prolong the business cycle (Bernanke and Gertler (1989), Kiyotaki and Moore (1997), and Aghion et al. (1999)). The second perspective emphasizes the variability of this relationship, influenced by factors such as the level of financial development in the country, real and monetary shocks, and opportunities for financial diversification and risk-sharing (Bacchetta and Caminal, 2000; Aghion et al., 2004; Morgan et al., 2004; Mehrotra and Yetman, 2015).

Empirically, a significant corpus of research has examined the impact of financial sector depth on economic volatility. Early studies underscore the role of financial deepening in reducing economic volatility. This is primarily accomplished through the facilitation of efficient capital allocation and the promotion of investment (Da-Silva, 2000; Manganelli and Popov, 2015; Tang and Abosedra, 2020; Kapingura et al., 2022; Abanikanda and Dada, 2023; Singh et al., 2023). Nevertheless, studies emerge by (Easterly et al., 2000; Arcand et al., 2012; Ibrahim and Alagidede, 2017; Ma and Song, 2017; Ghosh and Adhikary, 2023) suggesting a U-shaped relationship. This implies that the initial stages of financial development are associated with reduced economic volatility, but this effect may reverse beyond a certain threshold. Kunieda (2008) delves deeper into this association, revealing a hump-shaped pattern using a GMM method. Additionally, Zouaoui et al., (2018) indicate an S-shaped relationship between financial deepening and economic growth volatility, marked by multiple turning points, employing a semi-parametric approach. More recently, Sebai et al., (2024) shed light on the dynamic interrelationship between banking deepening and economic volatility in emerging countries, using a GMM panel-VAR approach.

Expanding our understanding of the financial sector dynamics, additional research has explored the significance of bank quality as a component of banking sector development. Besides representing banking credit indicators, other aspects of bank quality have emerged

(Hasan et al. 2009; Koetter and Wedow 2010). Building on this perspective, Xue (2020) identifies a nonlinear link between banking profitability and economic volatility through the application of a dynamic panel threshold model. Furthermore, Klein and Weill (2022) emphasize the positive impact of banking performance on economic growth, employing a GMM regression analysis. In a similar vein, Creel et al., (2014), Barra and Ruggiero (2021), Klein and Turk-Ariss (2022) suggest that a stable financial sector significantly contributes to enhanced economic stability.

Additionally, financial inclusion, a crucial element of financial development, is acknowledged as pivotal for providing cost-effective financial services to individuals, thereby stimulating economic growth (Chen et al., 2023). Empirical investigations conducted by Sethi and Acharya (2018), Daud and Ahmad (2023), Chinoda and Kapingura (2024) have consistently demonstrated a positive impact of financial inclusion on economic growth. However, Gopalan and Rajan (2021) suggest that increased digital financial inclusion may lead to elevated economic volatility, using two-way fixed effects and system-GMM methods. In contrast, Cavoli et al., (2019) find a nonlinear association between financial inclusion and economic volatility, employing a GMM approach.

Based on the discussion above, this study investigates the impact of three major dimensions of banking development, such as banking deepening, banking stability, and banking inclusion, on economic growth volatility within developing countries from 2004 to 2019. The relationship between banking development and economic volatility remains a subject of uncertainty and inconclusiveness. Indeed, there is a moderate level of banking development or the "threshold level". Below this level, banking development functions as an economic stabilizer, fostering what is referred to as "good finance". Nonetheless, when banking development surpasses this threshold, it will turn into "bad finance", characterized by resource misallocation, excessive and disorderly lending, and speculative activities, which accentuate economic volatility. This transition is further contingent upon the multifaceted of banking development. By doing so, the paper aims to make two significant contributions to the existing literature.

First, this study employs a panel smooth transition regression (PSTR) approach to scrutinize the potential of nonlinear association between banking development and economic volatility. Unlike traditional methods, panel smooth transition regression accommodates regime-switching behavior, thereby elucidating whether changes are abrupt or progressive. Furthermore, this approach aims to address the limitations of polynomial expressions commonly used in the literature, mitigating multicollinearity issues when examining nonlinear relationships.

Second, to the best of our knowledge, this is the first paper applying principal component analysis (PCA) to consider different facets of banking development. Previous research has predominantly concentrated on indicators of banking depth, often overlooking pivotal dimensions such as the quality and inclusivity of the banking sector. This oversight has resulted in a significant gap in our understanding of how banking development impacts economic volatility.

The remaining sections of the paper are organized as follows. Section 2 furnishes a description of the data and variables. Section 3 outlines the methodology approach. Section 4 presents and discusses the main empirical results. Section 5 draws the key conclusions and provides the main implications for and policymakers.

2. DATA AND VARIABLES

2.1 Data

This paper analyzes the impact of banking development on economic volatility using data from 18 developing countries from 2004 to 2019. Relevant data has been collected from the World Bank's World Development Indicators (WDI), International Monetary Fund (IMF), and Bankscope Financial-Data. The list of developing countries is detailed in Table 1.

Table 1. List of countries

Developing countries	Argentina, Brazil, China, Egypt, India, Indonesia, Kenya, Malaysia, Mexico, Pakistan, Peru, the Philippines, the Federation of Russia, Tunisia, South Africa, Thailand, Turkey and Ukraine.

Note. List of developing countries according to World Bank classifications for 2024[1].

[1] In accordance with this classification, these nations are designated as low- to middle-income countries.

2.2 Variable Measures

2.2.1 Independent variable: Measurement of banking development

Banking development is a multifaceted concept, often examined through three key dimensions: banking deepening, banking sector quality, and banking inclusion (Svirydzenka, 2016; Beck, 2016). Banking deepening encompasses the expansion of bank credit and the enhancement of liquidity to facilitate the efficient use of banking services. Maintaining high-quality banking sectors depends on the stability and efficiency of banking institutions, achieved through prudent regulation, effective risk management, and transparency. Banking inclusion aims to provide individuals from diverse socio-economic backgrounds with formal, secure, and transparent access to banking services affordably. Despite significant study contributions, a standardized consensus on a comprehensive understanding of banking development index remains lacking, as emphasized by Tang and Tan (2014). To contribute to the advancement of this field and address this challenge, this research aims to illuminate critical dimensions that reflect the extent of banking development. Incorporating these dimensions into the analysis enhances comprehension of banking development's implications for economic volatility and facilitates the formulation of targeted policy recommendations to bolster economic stability. To achieve this, a principal component analysis (PCA) is employed. This approach enables the elucidation of the multifaceted nature of banking development by reducing the dimensionality of numerous correlated variables to a smaller set of components that encapsulate the majority of the original variables' variability.

In terms of the banking sector's size: Banking Deepening (B_Deepening)

Extending the research conducted by Tang et Tan (2014), our study considers the following key banking deepening indicators: credit to private sector as a percentage of GDP (Credit_GDP), financial system deposits as a percentage of GDP (Deposit_GDP), bank assets to GDP (ASSETS_GDP), and liquid liabilities to GDP (Liquid Liab_GDP).

In terms of the quality of the banking sector: Banking Stability and Efficiency (B_Stability)

In assessing the quality of banking sector development, the approach proposed by Beck et al. (2000) and Xue (2020) is followed, using a pivotal measures: the ratio of regulatory capital within the banking sector to risk-weighted assets (Capital_adequacy), the ratio of capital to total assets (Capital_TA), net interest margin (NIM) and overhead costs (COST). These measures are fundamental for evaluating a bank's efficiency, risk management practices and overall financial health.

In terms of access to banking services: Banking Inclusion (B_Access)

As a measure of banking access, in alignment with the study conducted by Ahamed and Mallick (2019), this research incorporates specific indicator: number of ATMs (ATM_POP_i) per 100.000 adults, serving as proxy for demographic penetration. Furthermore, geographic penetration is evaluated using the number of ATMs ($ATM\_km_i^2$) per 1.000 square kilometers.

In terms of usage of banking services: Banking Inclusion (B_Usage)

Building upon the research of Barik and Pradhan (2021), this study employs key indicators of banking usage: the percentage of GDP represented by the volume of current credits (OLC) and current deposits (ODC) in the private sector. In accordance with the study conducted by Van et al. (2021), the digitization indicator is incorporated, specifically focusing on the utilization of credit cards per 1.000 adults (Credit_Card) and debit cards per 1.000 adults (Debit_Card).

Using a PCA approach and integrating insights from existing research, this paper develops a robust measurement for banking development. Table 2 presents the results of the principal component analysis for each banking development variable, including the factor scores for each indicator.

Following the approach outlined in Ahamed and Mallick's study (2019), the banking development index for each country has been normalized on a scale from 0 to 1. In this context, a score of zero signifies minimal banking development, while a score of one indicates complete banking development.

Table 2. Banking development indicators in developing countries (2004-2019): Principal component analysis (PCA)

Panel A: Banking sector's size index (B_Deepening)				
	PC_1	**PC_2**	**PC_3**	**PC_4**
Eigen values	2.902	0.728	0.257	0.113
Percentage of variance	0.726	0.182	0.064	0.028
Cumulative percentage	0.7256	0.908	0.972	1.000
Variables				
Credit_GDP	0.417	0.781	0.432	0.172
Deposit_GDP	0.527	0.146	-0.826	0.135
ASSETS_GDP	0.552	-0.225	0.185	-0.781
Liquid Liab_GDP	0.492	-0.564	0.310	0.585

Panel B: Banking sector quality index (B_stability)				
	PC_1	**PC_2**	**PC_3**	**PC_4**
Eigen values	2.209	0.902	0.618	0.272
Percentage of variance	0.552	0.226	0.154	0.068
Cumulative percentage	0.552	0.778	0.932	1.000
Variables				
Capital_adequacy	0.538	-0.240	-0.614	0.525
Capital_TA	0.608	-0.120	-0.087	-0.780
NIM	0.511	-0.130	0.782	0.332
COST	0.281	0.955	-0.059	0.079

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Panel C: Banking Inclusion index (B_usage)				
	PC_1	**PC_2**	**PC_3**	**PC_4**
Eigen values	2.239	1.229	0.412	0.120
Percentage of variance	0.560	0.307	0.103	0.030
Cumulative percentage	0.560	0.867	0.970	1.000
Variables				
OLC	0.604	-0.296	0.181	0.717
ODC	0.605	-0.267	0.288	-0.692
Credit_Card	0.163	0.814	0.555	0.059
Debit_Card	0.492	0.423	-0.759	-0.049

Panel D: Banking Inclusion index (B_access)		
	PC_1	**PC_2**
Eigen values	1.430	0.571
Percentage of variance	0.715	0.285
Cumulative percentage	0.715	1.000
Variables		
ATM_Km²	0.707	0.707
ATM_POP	0.707	-0.707

Note. All variables are reported in Table 3.

2.2.2 Dependent variable and Control variables:

The standard deviation of GDP per capita growth rate over a five-year period[2] is a main indicator of economic volatility, as identified by Zouaoui et al. (2018).

A suite of control variables, including: real shocks (SD_TOT), rule of Law (R_Law), Government regulatory effectiveness (Gov_EFF), inflation rate (INFL), broad money growth (M2_Growth), and logarithm of total life expectancy at birth (Log_Life). Detailed information about all variables utilized in this analysis can be found in Table 3.

[2] The results exhibit consistency regardless of whether the standard deviation is computed over a four-year or three-year window.

Table 3. Variable descriptions

Variables	Definition	Sources
Eco_Vol	Economic growth volatility, calculated as five-year rolling window standard deviations of GDP per capita growth rate.	Authors' calculation, WDI
Credit_GDP	Credit to the private sector divided by GDP.	WDI
Deposit_GDP	Financial system deposits as a ratio of GDP.	IMF
ASSETS_GDP	Deposit money banks assets to GDP.	IMF
Liquid_Liab_GDP	Liquid liabilities to GDP.	WDI
ATM_POP	Number of ATMs per 100.000 adults.	IMF
ATM_Km²	Number of ATMs per 1.000 Km².	IMF
OLC	Outstanding Credits to private sector as a % of GDP.	IMF
ODC	Outstanding Deposit in private sector as a % of GDP.	IMF
Credit_Card	Credit cards per 1.000 adults.	IMF
Debit_Card	Debit cards per 1.000 adults.	IMF
NIM	Net interest margin within a country's banking system.	Bankscope
COST	Ratio of a bank's overhead costs to its total assets.	WDI
Capital_TA	Banking system capital to assets, by country.	Bankscope
Capital_adequacy	Banking regulatory capital to risk-weighted assets, by country.	Bankscope
SD_TOTT	Real shocks are computed as the 5-year rolling window standard deviations of the ratio between export and import prices.	Authors' calculation, WDI
INFL	Inflation, consumer price index.	WDI
Log_Life	Logarithm of total life expectancy at birth.	WDI
M2_ Growth	Broad money growth.	WDI
R_Law	Rule of law index.	WGI
Gov_EFF	Government regulatory effectiveness.	WGI

Note. WDI refers to the World Bank's World Development Indicators database. IMF stands for the International Monetary Fund. Bankscope: is a financial database.

Table 4. Descriptive Statistics

Variables	**Obs**	**Mean**	**ST.D**	**Min**	**Max**
Eco_Vol	270	0.021	0.018	0.001	0.094
B_Deepening	284	0.343	0.235	0	1
B_Stability	245	0.489	0.160	0	1
B_Usage	194	0.197	0.164	0	1
B_Access	283	0.274	0.224	0	1
SD_TOTT	270	0.062	0.049	0	0.258
INFL	272	0.063	0.054	-0.009	0.487
Log_Life	288	4.259	0.077	3.979	4.353
M2_ Growth	288	0.142	0.088	-0.055	0.544
R_Law	288	-0.374	0.372	-1.023	0.529
Gov_EFF	288	-0.080	0.430	-0.867	1.238

Note. This analysis utilizes a dataset that encompasses three aspects of banking development, measured on a scale from 0 to 1. The banking development variables exhibit relatively high standard deviations, with banking deepening reaching its maximum value at 0.235. Regarding the dependent variable (Eco_Vol), its mean falls within the range of 0.001 to 0.094, with a standard deviation of 0.018. Control variables, such as real shocks (SD_TOTT), inflation (INFL), broad money growth (M2_Growth) and logarithm of total life expectancy at birth (Log_Life), demonstrate positive means, with respective values of 0.062, 0.063, 0.142 and 4.259. Conversely, variables such as rule of law (R_Law) and Government regulatory effectiveness (Gov_EFF) display negative means, with respective values of -0.374 and -0.080. All variables are documented in Table 3.

3. METHODOLOGY: PANEL SMOOTH TRANSITION REGRESSION

To assess the nonlinear relationship between different facets of banking development and economic volatility, it is imperative to consider models capable of capturing such nonlinearity. Neglecting this aspect could lead to a downward bias when estimating the relationship between these variables (Arcand et al., 2012). Moreover, the inclusion of quadratic and cubic terms may exacerbate issues related to multicollinearity, which could provide misleading outcomes (Zouaoui et al., 2018). In response to these challenges, this study employs the panel smooth transition regression (PSTR) method, as introduced by González et al. (2005). This approach facilitates the identification of nonlinear patterns, precise threshold levels where the impact of banking development on economic volatility shifts, and the elucidation of their evolving trajectory. Hence, it emerges as the most appropriate approach within this context. Formally, the panel smooth transition regression model (PSTR) is outlined as follows:

$$\mathbf{Y_{it} = \omega_i + \alpha_0' X_{it} + \alpha_1' X_{it} g(q_{it}; \gamma, c) + \varepsilon_{it}} \quad \mathbf{(1)}$$

Where:

The dependent variable, denoted as $\mathbf{Y_{it}}$: is the indicator of the economic growth volatility of the country (i) at year (t). $\boldsymbol{X_{it}}$**:** represents independent variables, encompass both the variable of interest, denoting a measure of banking development, such as banking deepening, banking sector quality, and banking inclusion (both in terms of access and usage) and a set of control variables. Details about other variables are outlined in Table 3.

The transition function $\mathbf{g(q_{it}; \gamma, c)}$: serves as a normalized and constrained function, confined within the interval of 0 to 1. q_{it}: represents the threshold variable. γ: characterizes the velocity of transition between regimes. c: denotes the threshold parameter. $\boldsymbol{\omega_i}$: encapsulates the unobserved individual effect. $\boldsymbol{\varepsilon_{it}}$: is the error term of the model.

The PSTR model presents a nuanced alternative to the threshold method commonly employed in the extant literature, as exemplified by the proposition of Hansen (1999). By integrating smooth effects, it adeptly captures the nonlinear relationships present in data and identifies crucial transition points. Specifically, this approach encompasses an infinite number of regimes characterized by two extreme regimes. These regimes exhibit two distinct types of transitions: logistic transitions, denoted as m=1, and exponential transitions, denoted as m=2, thereby illustrating how changes manifest within the data dynamics, whether gradual or abrupt, respectively. According to Ben Cheikh et al. (2020), the application of the model follows a three-step procedure: specification, estimation, and evaluation. For detailed insights into model specifications, please refer to the study conducted by González et al. (2005).

4. RESULTS OF THE PANEL SMOOTH TRANSITION APPROACH

4.1 Panel unit root test results

To confirm the suitability of the variables for panel smooth transition estimation, an initial examination of stationarity is conducted. This involves applying the augmented Dickey-Fuller (ADF) Fisher-Type unit root test. The results of these assessments confirm the stationarity of the variables at a significance level of 1%. Detailed results of the panel unit root tests are presented in Table 5.

Table 5. Unit root tests

	ADF (Without trend)		ADF (With trend)	
	Levels	**First Difference**	**Levels**	**First Difference**
Eco_Vol	3.164	-12.134***	-4.166***	
B_Deepening	-3.206***		-1.774**	-9.756***
B_Access	2.602	-3.940***	4.456	-2.825***
B_Usage	-1.676**	-7.187***	-1.855**	-3.809***
B_Stability	-1.634	-9.422***	-1.158	-6.336***
SD_TOTT	-0.887	-9.475***	0.084	-6.748***
INFL	-6.092***		-6.295***	
Log_Life	-13.303***		2.610	-7.132***
M2_ Growth	-3.491***		-6.520***	
R_Law	0.413	-11.842***	-0.062	-9.129***
Gov_EFF	0.305	-12.168***	1.274	-9.964***

Note. Statistical significance at 1% and 5% levels is denoted by (***) and (**), respectively. This table presents the results of unit root tests conducted on all variables within developing countries from 2004 to 2019. Comprehensive variable details can be found in Table 3.

4.2 Panel smooth transition results

The first step entails evaluating linearity and establishing the suitable parameter order, then discerning the optimal number of regimes needed to address the nonlinear and temporal instabilities evident in the slope coefficients. Following this, in a subsequent phase, the parameters of the threshold-based model are estimated to gain insight into the elasticity of the relationship between banking development and economic volatility.

Linearity and results

Based on Ben Cheikh et al. (2020), prior to estimating PSTR, it is essential to validate the statistical significance of the regime-switching effect through rigorous linearity tests. Prior to estimating PSTR, it is crucial to validate the statistical significance of the regime-switching effect through rigorous linearity tests. If linearity is rejected, the next step involves identifying the optimal number of transition functions by thoroughly examining for any remaining nonlinearity. The selection between logistic (m=1) and exponential (m=2) panel smooth transition functions relies on two primary criteria. Firstly, preference is given to the function with the lowest p-value in the linear test. Secondly, priority is assigned to the function that exhibits the lowest values of both the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC).

Table 6 demonstrates the rejection of the null hypothesis of linearity across all three tests, particularly notable with a location parameter value of m=2. This rejection suggests that the relationship between various dimensions of banking development and economic volatility in developing countries is indeed nonlinear. Furthermore, based on the Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) criteria, it is evident that the exponential function with m=2 provides a more suitable model. In this context, it is pertinent to underscore that a noticeable abrupt change between banking development and economic volatility is observed. This model effectively encompasses the intricacies of banking development, including aspects such as depth (B_deepening), stability and efficiency (B_stability), and the inclusion of banking institutions (B_Inclusion, considering both accessibility and usage). Detailed results are presented in Table 7.

Table 6. Comparison of Linearity and Non-Linearity Tests

		LM	LMF	LRT
		B_Deepening		
H_0comapred to H_1	**m=1**	10.003 (0.188)	1.341 (0.232)	10.206 (0.177)
H_0compared to H_1	**m=2**	30.207*** (0.007)	2.140** (0.011)	32.160*** (0.004)
		B_Stability		
H_0comapred to H_1	**m=1**	10.217 (0.177)	1.356 (0.226)	10.463 (0.164)
H_0compared to H_1	**m=2**	32.865*** (0.003)	2.358*** (0.005)	35.609*** (0.001)
		B_Usage		
H_0comapred to H_1	**m=1**	28.605*** (0.000)	4.196*** (0.000)	31.454*** (0.000)
H_0compared to H_1	**m=2**	39.813*** (0.000)	3.024*** (0.000)	45.648*** (0.000)
		B_Access		
H_0comapred to H_1	**m=1**	18.972*** (0.008)	2.640** (0.012)	19.728*** (0.006)
H_0compared to H_1	**m=2**	56.845*** (0.000)	4.580*** (0.000)	64.456*** (0.000)

Note. The reported test values, LM (Wald Test), LMF (Fisher Test), and LRT (Likelihood Ratio Test). (m=1): logistic transition function, (m=2): exponential transition function. The hypotheses tested are as follows: $\mathbf{H_0}$: posits a linear model, while $\mathbf{H_1}$: suggests a PSTR model with at least one threshold variable.

Table 7. Model Comparison (m=1 and m=2) with BIC, AIC, and RSS

RSS	AIC	BIC	RSS	AIC	BIC
B_Deepening (m=1)			**B_Deepening (m=2)**		
0.026	-9.145	-8.941	0.023	-9.262	-9.046
B_Stability (m=1)			**B_Stability (m=2)**		
0.020	-9.329	-9.011	0.015	-9.594	-9.251
B_Usage (m=1)			**B_Usage (m=2)**		
0.017	-9.567	-9.364	0.013	-9.753	-9.410
B_Access (m=1)			**B_Access (m=2)**		
0.019	-9.363	-9.045	0.017	-9.421	-9.078

Note. B_Deepening: Dimension of the banking sector's size, B_Stability: Indicator of banking sector quality, B_Usage: Measure of banking inclusion emphasizing utilization of banking services, B_Access: Measure of banking inclusion emphasizing accessibility to banking services.

Table 8 displays the outcomes of the tests conducted to ascertain the number of existing regimes between banking development and economic volatility. The null hypothesis posits that the panel smooth transition (PSTR) model encompasses solely one threshold, while the alternative hypothesis suggests the existence of a minimum of two thresholds within the model. The findings suggest non-rejection of the null hypothesis, indicating that a single threshold (**r=1**) sufficiently reflects the nonlinear effect within the banking deepening indicator across two specifications. Nonetheless, the alternative hypothesis, which posits the existence of two thresholds in the model with measures (B_stability and B_inclusion for both access and usage), cannot be dismissed, thus suggesting that a two-threshold model (**r=2**) effectively captures the nonlinear effect within the three model specifications.

Table 8. Tests for the Number of Regimes

	Wald Test	Fisher Test	Likelihood ratio Test
	B_Deepening (m=2, r=1)		
Statistics	11.797	0.724	12.080
p-value	0.623	0.749	0.600
	B_Stability (m=2, r=1)		
Statistics	32.345	2.141	34.998
p-value	0.004	0.012	0.001
	B_Stability (m=2, r=2)		
Statistics	26.246	1.615	27.957
p-value	0.024	0.080	0.014
	B_Usage (m=2, r=1)		
Statistics	31.844	2.029	35.431
p-value	0.004	0.021	0.001
	B_Usage (m=2, r=2)		
Statistics	28.153	1.640	30.907
p-value	0.014	0.079	0.006
	B_Access (m=2, r=1)		
Statistics	36.337	2.479	39.252
p-value	0.001	0.003	0.000
	B_Access (m=2, r=2)		
Statistics	26.935	1.700	28.493
p-value	0.020	0.058	0.012

Note. $\mathbf{H_0}$: represents PSTR with one threshold (r=1). $\mathbf{H_1}$: indicates PSTR with at least two thresholds (r ≥2).

Results of banking development and economic growth volatility (PSTR Model)

Expanding on the initial findings, the analysis delves deeper into investigating the influence of banking development on economic volatility in developing countries using the Panel Smooth Transition Regression (PSTR) model. The results, presented in Table 9, Table 10 and

Table 11, suggest a nonlinear relationship between the aforementioned facets of banking development, specifically (B_Deepening, B_Stability, and B_Inclusion) and economic growth volatility.

Particularly, the outcomes in Table 9 emphasize the pivotal role of fostering banking deepening to alleviate economic instability. Nevertheless, heightened banking deepening significantly increases economic volatility. The identified inflection points, notably at 0.159. Increased banking deepening may incentivize banks to engage in riskier lending practices. In certain developing nations, inadequate regulatory supervision permits the aggregation of systemic risks within the banking system, further amplifying economic volatility. Furthermore, the vulnerability of these economies to external shocks and structural deficiencies, such as limited diversification and inadequate institutional strength, worsens the effects of banking deepening on volatility. Thus, while fostering banking deepening is crucial for economic development, policymakers must carefully manage the associated risks to ensure sustainable development. These findings support the results drawn in the study conducted by Ibrahim and Alagidede (2017).

Table 10 presents evidence of a nonlinear relationship between the quality of the banking sector (B_stability) and economic volatility, consistent with findings from Xue (2020). Our analysis identifies two thresholds: the first at 0.647 and the second at 0.476. Improvement in banking sector quality is associated with a significant reduction in economic volatility, indicated by a coefficient of -0.856. This reduction is ascribed to enhanced profitability, efficient resource allocation, and strengthened risk management practices within the banking sector. However, surpassing the threshold of 0.647 results in a notable increase in economic volatility, reflected by a coefficient of 0.899, potentially indicating challenges such as regulatory overreach or increased risk-taking behavior among banking institutions. Conversely, upon reaching the lower threshold of 0.476, improvements in banking sector quality initiate a stabilization of economic fluctuations. This stabilization may be attributed to a more balanced regulatory approach, heightened investor confidence, and optimized allocation of banking resources, although its impact is less significant compared to the initial reduction in volatility, as indicated by a negative coefficient of -0.079.

The analysis of banking inclusion, as depicted in Table 11, reveals a non-monotonic link between banking inclusion (encompassing both access and usage of banking services) and economic volatility across three specifications. From one perspective, the results suggest that enhanced accessibility to banking services is associated with a decrease in economic volatility, with a negative coefficient of -0.068. This reduction in volatility may stem from increased banking access for individuals and businesses, facilitating smoother banking transactions and risk-sharing mechanisms. However, once accessibility exceeds a threshold of 0.551, the magnitude of this effect diminishes slightly to -0.040, indicating a saturation point in the benefits of enhanced accessibility. Moreover, surpassing an additional threshold of 0.587, there is evidence of an increase in economic volatility associated with accessibility to banking services. This could be attributed to challenges such as regulatory constraints, expansion of banking services beyond demand, and intensified competition, resulting in more risky credit allocation behaviors. From another perspective, the utilization of banking services initially escalates economic volatility until it reaches a threshold of 0.244. Beyond this point, the effect reverses and becomes negative, potentially attributed to enhanced banking intermediation. However, beyond an additional threshold (0.338), banking inclusion once again amplifies economic volatility, albeit with a lower coefficient of 0.081. This resurgence may suggest challenges such as overheating in the credit market, speculative behavior, or regulatory deficiencies.

An abrupt transition between banking development and economic volatility may ensue as a result of sudden alterations in monetary or regulatory policies, along with external shocks such as fluctuations in commodity prices, which are prevalent in these nations. Such occurrences possess the capacity to disrupt capital flows, diminish investor confidence, and exert an influence on the banking system, thereby exacerbating economic volatility within these nations.

Figs. 1, 2, 3, and 4 illustrate the position of developing countries, particularly in the context of the year 2019, relative to the thresholds identified in this study. It is imperative to note that countries omitted from the presented figures are devoid of available data for this year. These findings underscore the crucial importance of balanced and well-regulated banking systems in fostering economic stability within developing nations, especially within abrupt transition functions. Key recommendations include enhancing banking regulation and supervision, fostering bank resilience, promoting banking inclusion to a certain point, as well as strengthening transparency and communication within the banking sector. Implementing these measures could enable these countries to effectively manage risks associated with banking development and alleviate economic volatility.

Table 9. Effects of banking deepening (B_Deepening) on economic volatility: A panel smooth transition regression analysis

	B_Deepening (m=2, r=1)	
Variables	**Regime (1)**	**Regime (2)**
B_Deepening	-0.087*** (3.679)	0.063*** (2.593)
SD_TOTT	-0.019 (0.465)	0.070 (1.465)
INFL	0.060*** (3.031)	-0.061* (1.996)
Log_Life	-0.177*** (6.378)	-0.002 (0.768)
M2_ Growth	0.065*** (2.692)	-0.051* (1.555)
R_Law	0.008 (0.818)	-0.022* (1.743)
Gov_EFF	-0.019*** (2.679)	0.0427*** (4.943)
Threshold level	**0.159**	
Slope parameter	378.976	

Note. This table presents results obtained through a panel smooth transition regression, as outlined in Eq. (1). Definitions for each variable are available in Table 3. Significance levels are denoted as ***, **, and * for statistical significance at the 1%, 5%, and 10% levels, respectively. Values within parentheses represent the corresponding T-statistics.

Table 10. Effects of banking sector quality (B_Stability) on economic volatility: A panel smooth transition regression analysis

	B_Stability (m=2, r=2)		
Variables	**Regime (1)**	**Regime (2)**	**Regime (3)**
B_Stability	-0.856*** (4.532)	0.899*** (4.746)	-0.079*** (-4.804)
SD_TOTT	0.005 (0.083)	-0.048 (-0.726)	0.093 (2.806)
INFL	-0.507*** (5.929)	0.652*** (7.419)	-0.123*** (4.751)
Log_Life	-0.006 (0.160)	-0.137*** (4.874)	0.010*** (4.650)
M2_ Growth	0.188*** (11.985)	-0.141*** (5.773)	-0.037* (1.775)
R_Law	0.067*** (3.564)	-0.064*** (3.280)	0.001 (0.056)
Gov_EFF	-0.077*** (3.152)	0.078*** (3.241)	0.002 (0.227)
Threshold levels	(**0.648** ; **0.476**)		
Slope parameter	(6.277 ; 0.669)		

Note. This table presents results obtained through a panel smooth transition regression, as outlined in Eq. (1). Definitions for each variable are available in Table 3. Significance levels are denoted as ***, **, and * for statistical significance at the 1%, 5%, and 10% levels, respectively. Values within parentheses represent the corresponding T-statistics.

Table 11. Effects of banking inclusion (both: B_Access and B_Usage) on economic volatility: A panel smooth transition regression analysis

	B_Access (m=2, r=2)			B_Usage (m=2, r=2)		
	Regime (1)	**Regime (2)**	**Regime (3)**	**Regime (1)**	**Regime (2)**	**Regime (3)**
B_Inclusion	-0.068*** (3.521)	-0.040** (2.140)	0.093*** (3.408)	0.157*** (2.994)	-0.234*** (6.061)	0.081*** (2.852)
SD_TOTT	0.070* (1.915)	0.269*** (4.278)	-0.295*** (3.258)	0.077*** (3.184)	-0.020 (0.351)	0.144*** (2.643)
INFL	0.052** (2.086)	-0.311*** (6.047)	0.258*** (3.877)	0.057*** (4.179)	0.049* (1.632)	-0.036 (0.500)
Log_Life	-0.112*** (5.406)	0.006*** (4.333)	-0.012*** (3.939)	-0.314*** (2.855)	0.006* (1.656)	-0.006* (1.778)
M2_ Growth	0.024 (0.869)	-0.021 (0.741)	0.019 (0.433)	0.055** (2.231)	0.010 (0.417)	-0.114*** (2.792)
R_Law	0.022** (2.275)	0.020* (1.972)	-0.047*** (3.030)	0.006 (0.716)	-0.012 (0.748)	-0.027 (0.992)
Gov_EFF	-0.018** (2.056)	-0.025*** (2.643)	0.060*** (4.409)	-0.004 (0.425)	0.024* (1.968)	0.030* (1.825)
Threshold levels	(**0.551** ; **0.588**)			(**0.244** ; **0.338**)		
Slope parameter	(5.384 ; 0.054)			(1.435 ; 0.009)		

Note. This table presents results obtained through a panel smooth transition regression, as outlined in Eq. (1). Definitions for each variable are available in Table 3. Significance levels are denoted as ***, **, and * for statistical significance at the 1%, 5%, and 10% levels, respectively. Values within parentheses represent the corresponding T-statistics.

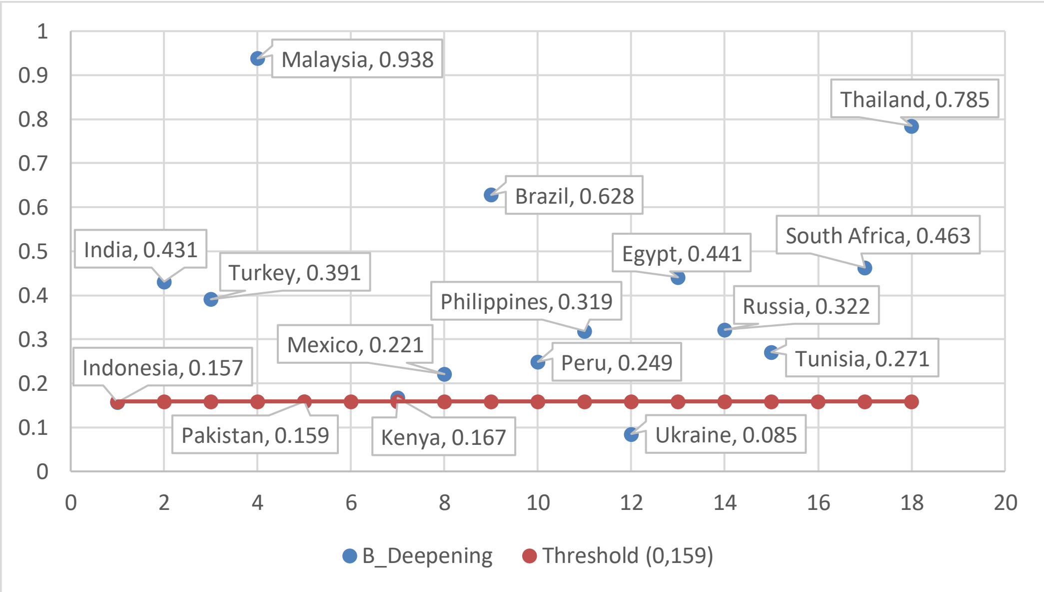

Fig. 1 – Country positions in 2019 relative to the identified threshold value for banking sector size

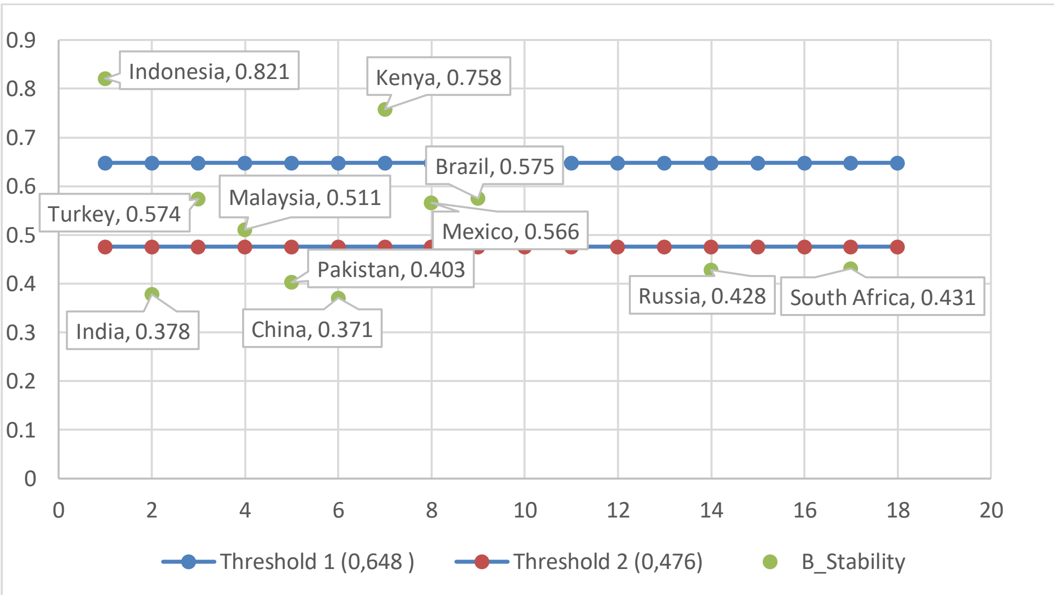

Fig. 2 – Country positions in 2019 relative to the identified threshold values for banking sector quality

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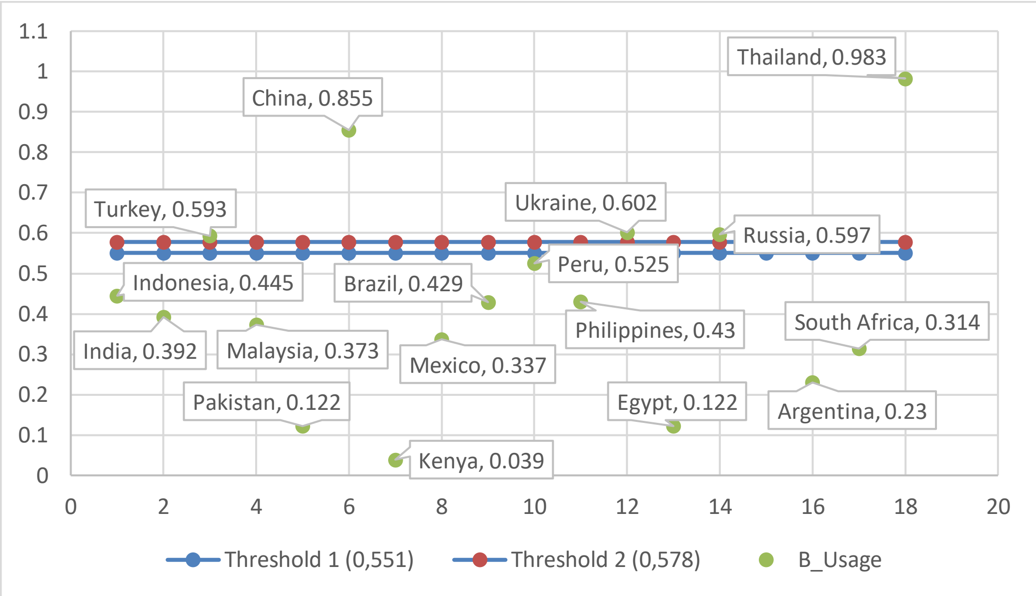

Fig. 3 – Country positions in 2019 relative to the identified threshold values for banking inclusion (in terms of usage)

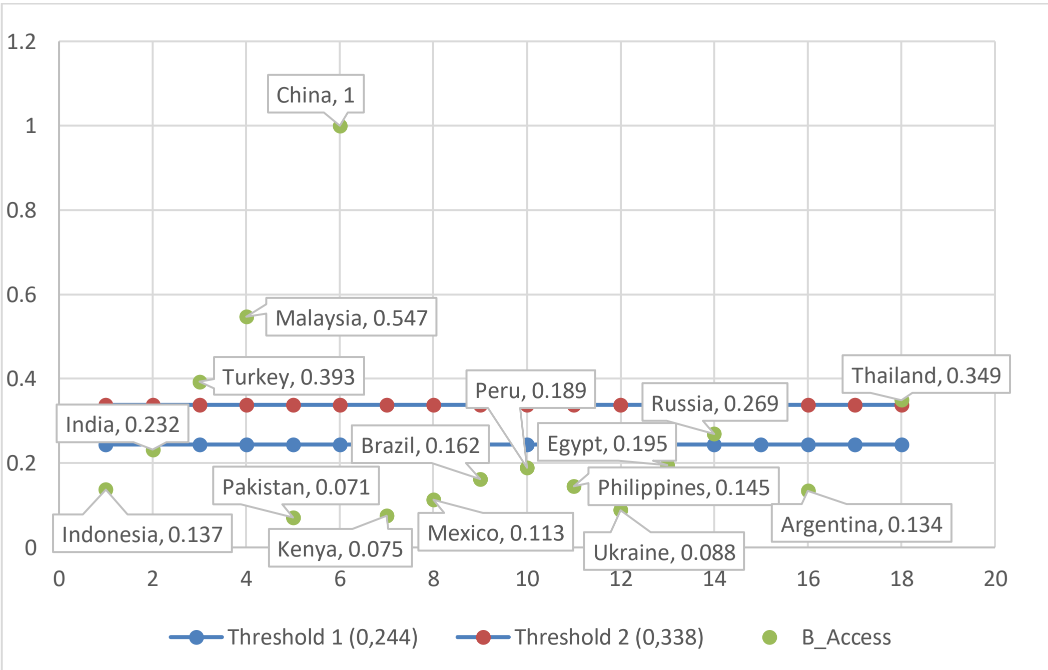

Fig. 4 – Country positions in 2019 relative to identified threshold value for banking inclusion (in terms of access)

5. CONCLUSION

This research examines the impact of banking development on economic volatility within a sample of 18 developing countries from 2004 to 2019. Prior studies have yielded inconclusive results, partly due to limitations in measurement and approaches employed. To address these constraints, a panel smooth transition approach is applied, revealing potential non-linear patterns and offering insights into the dynamic nature of the observed changes. Furthermore, in contrast to prior studies predominantly centered on banking depth measures, overlooking banking inclusion and sector quality indicators, this study utilizes principal component analysis (PCA) to construct banking development indices. By integrating various dimensions, a more holistic perspective on the relationship is provided. Overall, empirical findings reveal a non-monotonic relationship between various proxies of banking development and economic growth volatility. Significantly, the results demonstrate abrupt transitions from one regime to another. This suggests that changes in banking development can lead to sudden shifts in economic growth volatility. These results could arise from various factors, including changes in monetary policies, regulatory environments, economic conditions, or external shocks. This paper provides new evidence of a nonlinear relationship between banking development and economic volatility.

The implications of our findings hold significant importance for financial regulators and supervisors in developing nations. The discerned nonlinear relationship between various facets of banking development and economic growth volatility underscores the pressing necessity to bolster banking sectors. Policymakers are urged to broaden their perspective beyond conventional indicators of banking depth, embracing a comprehensive approach that fosters inclusivity through diversification in deposit and credit allocation sources, while concurrently enhancing standards within the banking industry. Furthermore, policymakers should consider the thresholds unveiled in this study to effectively mitigate the risks of economic crises and instability. Consequently, proactive regulation is deemed crucial to ensure sustainable economic stability in developing economies. This approach can be realized through the implementation of targeted policies aimed at promoting financial literacy, fostering innovation in banking services, and establishing regulatory frameworks that ensure stability and integrity. In future research, due consideration should be given to measures of digital banking inclusion and Fintech advancements.

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