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The Optimal Level of Financial Growth in View of a Nonlinear Macroprudential Policy Regime Model: A Bayesian Approach

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Abstract: A panel data analysis of nonlinear financial growth dynamics in a macroprudential policy regime was conducted on a panel of 10 African emerging countries from 1985–2021, where there had been a non-prudential regime from 1985–1999 and a prudential regime from 2000–2021. The paper explored the validity of the inverted U-shape hypothesis in the prudential policy regime as well as the threshold level at which excessive finance boosts growth using the Bayesian Spatial Lag Panel Smooth Transition Regression (BSPSTR) model. The BSPSTR model was adopted due to its ability to address the problems of endogeneity and heterogeneity in a nonlinear framework. Moreover, as the transition variable often varies across time and space, the effect of the independent variables can also be time- and space-varying. The results reveal evidence of a nonlinear effect between finance and growth, where the optimal level of financial development is found to be 92% of GDP, above which financial development decreases growth. The findings confirmed the Greenwood and Jovanovic hypothesis of an inverted U-shape relationship. Macroprudential policies were found to trigger the finance–growth relationship. The policy recommendation is that the financial sector should be given adequate consideration and recognition by, for example, implementing appropriate financial reforms, developing a suitable investment portfolio, and keeping spending on technological investment in Africa's emerging countries below the threshold. Again, caution is needed when introducing macroprudential policies at a low level of the financial system.

Keywords: BPSTR model; economic growth; financial development; macroprudential policy; unconventional monetary policy

JEL Classification: G15; F36; C40

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1. Introduction

Over the last few decades, scholars have focused on the relationship between financial development and economic growth. Financial development has been identified as a critical driver of growth. So far, there have been disagreements in both theoretical predictions and empirical research on the significance of financial development on growth. The historical background on this subject may be traced back to Schumpeter's (1934) notion. Five decades after Schumpeter's profound work, Goldsmith (1969), McKinnon (1973), Shaw (1973), and others conducted significant research on the subject, producing substantial evidence on this subject. In the 1980s, another significant piece of work was documented by Greenwood and Jovanovic (1990), who argued that the nature of financial growth is nonlinear and defined by an inverted U-shape, which completely changed the direction of the finance–growth relationship from its traditional way. Given the advice and recommendations in the literature, African countries have responded by implementing significant changes in their financial systems in an attempt to transition the sector from a state-owned to a market-oriented financial one, allowing the financial sector to carry out its fundamental mandate of financial intermediation more efficiently, following the advice of both theoretical predictions and empirical literature. The fundamental purpose of these reforms was to widen financial development in order to mobilize more finances, initiatives, and resources with the best chance of success, thereby promoting growth and reducing inequality. However, these financial advancements result in slow growth as well as a high levels of poverty and inequality in African countries. In light of the above statement, it seems that these policy reforms are not working for Africans in achieving high growth and income distribution. This has been supported by the data as well, as can be seen in Figure 1. Figure 1 graphically demonstrates the mean of financial development and economic growth covering the period 1985–2021. The graph demonstrates that most of the African countries have achieved more than 10% financial development, however, without much growth.

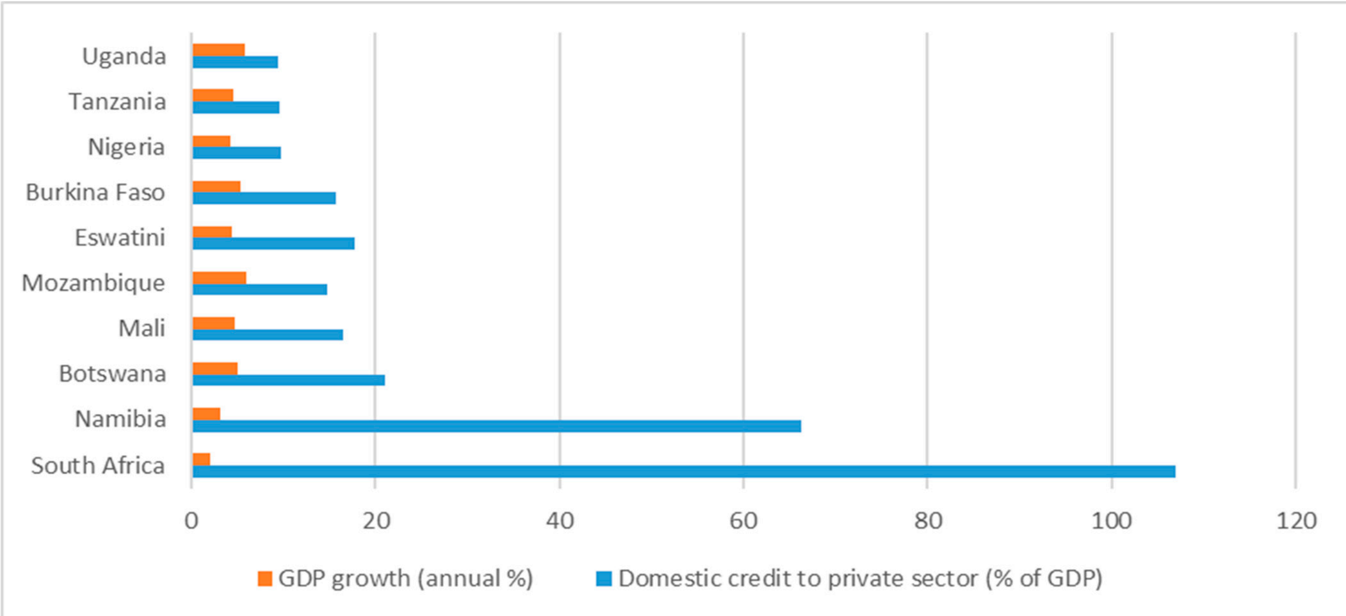

Figure 1. Graphical analysis of the mean of financial development and economic growth from 1985 to 2021. Source: Authors' illustration based on WDI (2022).

However, the insight gained from this figure is that countries with a level of financial development above 15% have low growth. However, all those countries with financial development below 15% seem to have improving economic growth. This poses the question of whether excessive growth in financial development is not improving growth for African economies.

After scrutinizing the literature, we find a strong contradiction and conflicting outcomes on this subject matter have accumulated following the two theoretical foundations of the study (Schumpeter's and the GJ's inverted U-shape). Some of the studies have found the Schumpeter hypothesis (Goldsmith 1969; Ufuo and Alagidede 2018; Jobarteh and Kaya 2019; Elijah and Hamza 2019; Abeka et al. 2021). While others inverted the U-shape (Swamy and Dharani 2019; Abu-Lila et al. 2021; Machado et al. 2021), others discovered the U-shape (Abdul Bahri et al. 2019; Bandura and Dzingirai 2019). Lastly, others found conclusive results (Erkisi 2018). The inconsistency in these results may be attributable to, but not limited to, the different model specifications, data sets, and estimating strategies used in assessing the subject matter.

Our work builds on the study documents by Zungu (2022), which examined a panel of 10 African emerging economies using the PSTR model over the period 1993–2020. His objective was to examine the current subject in the macroprudential policy regime and compare it with the non-macroprudential policy regime. His study confirmed a U-shape relationship accompanied by 60.5% of GDP as a minimum level of financial development, above which growth for African countries increases. The financial-institution targeted instruments, inflation, investment, trade openness, and government expenditure as control variables were included to expand the concept of the finance–growth relationship. However, his profound work only provides the minimum level of finance that is required to improve growth in African countries, which then poses some concerns about what optimal level of finance is required in these countries to sustain growth, considering the current state of financial reform, which is failing to improve growth. As a result, more studies that shed light on the finance–growth relationship, especially in a macroprudential policy regime, are needed on these subjects.

It is because of these ambiguous and frequently contradictory viewpoints that this study strives to expand the literature by addressing the following hypotheses:

- There is no optimal level of financial development required for growth in African countries.
- There is no nonlinearity in the data for African countries after controlling for spatial correlation problems.
- A transition from a non-macroprudential policy regime to a macroprudential policy regime has no effect on the traditional impact of the finance–growth relationship in African economics.
- Monetary policy through unconventional policy has no impact on the finance–growth relationship.
- The model adopted does not affect the finance–growth inequality.

Most of the prior studies have ignored the potential issue of a spatial correlation problem in the data and empirically ignored examining the subject matter in accordance with macroprudential and unconventional monetary policy. Apart from the study by Zungu (2022), who included two macroprudential policy variables in examining the finance–growth relationship, in this study we seek to include more macroprudential policy variables in trying to understand how they trigger the current subject matter in African countries. We believe that macroprudential policies have an indirect or direct influence on the finance–growth relationship.

We propose to clarify the ongoing debate by using a Bayesian panel smooth transition regression model with spatial correlation covering the period 1985–2021. Therefore, we believe that this study will strengthen the argument made by Zungu (2022) and further provide the nature of the finance–growth relationship after controlling for the spatial correlation problem in the data. The Bayesian method will further play a crucial role in finding accurate results. The PSTR is not a new model in the African context. However, in this study, we aim to extend the PSTR by including a Bayesian case with spatial correlation. Furthermore, the selected model is relevant because it incorporates the benefits of both the smooth transition and the spatial econometric in our model and can be used to deal with panel data with a wide range of heterogeneity and cross-section correlation at the same time. The Bayesian method has the advantage of completely utilizing a priori and a posteriori information, resulting in improved estimation accuracy and resilience. We believe that the model, the countries being studied, and the variables included in the model will bring new insight into the burgeoning literature. Finally, the rationale for this research is not due to a lack of studies examining the nonlinear effect of financial development on African growth, but rather the fact that this relationship may differ from the one found in the literature due to differences in smoothness and the macroeconomic variables used, and furthermore, because Zungu's study provides the minimum point above which finance can improve growth. The findings provide evidence of a nonlinear relationship between financial development and economic growth, with the ideal level of financial development determined to be 92% of GDP, above which financial development reduces growth. Greenwood and Jovanovic's idea of an inverted U-shape relationship was validated by the data. The finance–growth relation has been discovered to be triggered by macroprudential and unconventional monetary policy measures in African economics.

The remainder of the paper is structured as follows: Section 2 provides a quick overview of the associated literature. The model is summarized in Section 3. Section 4 covers the SLPSTR model findings. Section 5 concludes with remarks and examines policy implications.

2. Literature Review

2.1. Theoretical Channels of Financial Development and Economic Growth

A number of channels have emerged concerning the subject matter. The central theoretical debate still revolves around four hypotheses: the Schumpeter hypothesis (Schumpeter 1934), the "supply-leading" and "demand-following" hypothesis (King and Levine 1993), endogenous growth theory (Patrick 1966; Romer 1986), and Greenwood and Jovanovic's (1990) non-monotonic relationship, which traces its roots back to Schumpeter's (1934) hypothesis, emphasizing the importance of financial institutions in supporting productive investments, and according to this school of thought, finance is just a byproduct of progress. Later, King and Levine (1993) developed the "supply-leading" hypothesis, which holds that financial development is required for improving growth. According to the theory's proponents, the size and composition of financial development determinants significantly enhance savings in the form of financial assets, leading to capital creation and growth. Their supporters say that the amount and composition of financial development determinants have an influence on growth by directly boosting savings in the form of financial assets, which leads to capital creation and, eventually, economic expansion. In contrast, Patrick (1966) and Romer (1986) extended Schumpeter's theoretical model by formulating the endogenous growth theory. The financial sector, according to their idea, may contribute to growth by mobilizing savings, allocating resources effectively, monitoring costs, diversifying risks, and enabling the trade of goods and services. Five decades later, a transition to the finance–growth relationship emerged after the study by Greenwood and Jovanovic (1990). Their theoretical model, which is well known as the GJ inverted U-shape, proposes that all the existing theoretical models of finance–growth failed to account for the full relationship, as their model proposed that finance–growth is explained by a non-monotonic relationship and that endogenously emerging financial institutions generally have a positive effect on growth, though the magnitude varies with the level of economic development; that is, as financial development increases, economic growth may increase as well before a certain level of financial development is reached, after which it decreases.

2.2. Empirical Literature Review

2.2.1. The Empirical Relationship between Financial Development and Economic Growth

The finance–growth relationship has been a topical issue in the existing literature, with a number of studies on board. However, among the existing studies, there is a diverse and strong contradiction, as some studies support the traditional theory of financial growth while others believe in the new approach of the non-monotonic relationship. The traditional Schumpeter and endogenous growth theory approach (Goldsmith 1969; King and Levine 1993; Ram 1999; Arcand et al. 2012; Puatwoe and Piabou 2017; Bist 2018; Ufuo and Alagidede 2018; Jobarteh and Kaya 2019; Ibrahim and Imhotep 2018; Elijah and Hamza 2019; Abeka et al. 2021), and the new approach of the non-monotonic relationship (Samargandi et al. 2015; Ufuo and Alagidede 2018; Swamy and Dharani 2019; Abu-Lila et al. 2021; Machado et al. 2021). Even in the non-monotonic approach, a further contradiction emerged as some found the U-shape theory (Jinqi 2020; Zungu 2022), while others found conclusive results (Erkisi 2018).

Going as far back as the study by Khan and Senhadji (2000), in which a panel of 159 countries were categorized as developed or developing over the period from 1960 to 1999, the researchers revealed that financial development is beneficial to economic growth. However, six years later, a contradiction emerged from the study by Gouider and Trabelsi (2006), which used a panel of 66 countries and a dynamic panel technique. Their findings confirmed a negative relationship in developed countries while indicating an insignificant relationship in developing countries. Gouider and Trabelsi (2006) were supported by Arcand et al. (2012) in a panel of 16 countries, contradicting the study by Khan and Senhadji (2000). Their work revealed that finance begins to have a negative effect on output growth when credit to the private sector reaches 100 percent of GDP. Mohamed et al. (2022) took over the argument in the case of Indonesia using autoregressive distributed lag model (ARDL) analysis over the period 1980–2013. GDP per capita was used to capture economic growth, while domestic credit to the private sector was used to measure financial development as an independent variable. Their findings confirm a positive relationship (Khan and Senhadji 2000) and contradict those studies that believed in a negative relationship in this subject matter (Gouider and Trabelsi 2006; Arcand et al. 2012).

A significant contradiction emerged from these studies following Samargandi et al. (2015) in a panel consisting of 52 middle-income countries covering the period 1980–2008 using pooled mean group estimations. Their findings validated the presence of an inverted U-shaped relationship between the two variables. However, Puatwoe and Piabou (2017), in the case of Cameroon, contradict those studies that believe in the negative (Gouider and Trabelsi 2006) and those that believe in a non-monotonic relationship (Samargandi et al. 2015). Two years later, a further confirmation of the nonlinearity was documented by Abdul Bahri et al. (2019) in a panel of 65 developing countries for the period 2007–2015, using a generalized method of moments (GMM). However, apart from confirming the nonlinearity, they created a further contradiction on the nature of the relationship between financial development and growth, as Samargandi et al. (2015) found the inverted U-shape, while Abdul Bahri et al. (2019) documented the U-shaped relationship. In the same year, further support for the positive relationship was further documented by Faathih and Mansur (2018) in the case of Bangladesh, using nonlinear autoregressive distributed lag covering the period 1972–2016. However, this contradicts those studies that documented nonlinearity (Samargandi et al. 2015; Abdul Bahri et al. 2019) as well as those that believed in a negative relationship (Gouider and Trabelsi 2006; Arcand et al. 2012).

Even studies conducted in African economies support the argument of nonlinearity between financial development and economic growth, as reported in the study by Ibrahim and Alagidede (2018), covering the period 1980–2014, using a threshold estimation technique. Their findings confirmed the findings documented by Samargandi et al. (2015) while contradicting those documenting positive (Khan and Senhadji 2000; Gouider and Trabelsi 2006; Mohamed et al. 2022) and negative relationships (Gouider and Trabelsi 2006; Arcand et al. 2012). The inconclusive results were documented by Erkisi (2018) in a case study of BRICS countries and Turkey using the PMG estimator covering 1996–2016. In their study, they documented that it is not certain if financial growth is a determinant of growth for the selected countries, which then contradicts all the studies that documented a positive, negative, and nonlinear relationship between the two variables.

The study by Ibrahim and Alagidede (2018) was further supported by Swamy and Dharani (2019) in a panel of 24 advanced economies covering the period 1983–2013. Their finding contradicts studies that believe in negative (Arcand et al. 2012), positive (Mohamed et al. 2022), and inconclusive (Ibrahim and Alagidede 2018) relationships, as well as those that believe in nonlinearity but claim that the relationship is characterized by a U-shape (Abdul Bahri et al. 2019), supporting the argument behind the inverted U-shaped relationship. Another sub-Saharan African study was conducted by Bandura and Dzingirai (2019), using the GMM technique, following the study by Ufuo and Alagidede (2018). These studies further add a contradiction to the literature because they documented differing results pertaining to the nature of the relationship. Their findings supported the argument behind the U-shaped relationship between two variables, while Ufuo and Alagidede (2018) documented the inverted U-shape. The argument was taken further by Mahmoud et al. (2019) for Egypt and Jobarteh and Kaya (2019) for African countries. These studies arrived at the same conclusion, which supports the “more finance, more growth” hypothesis.

Jinqi (2020) investigated the same topic in the case of China, covering the years 1989–2017, and employed a dynamic threshold model to confirm the nonlinearity between the two variables. However, the author found the relationship to be insignificant in the high region of financial development, while Abu-Lila et al. (2021) confirmed the inverted

U-shape in a time series of Jordanians during the period 1990–1999. Both of these findings contradict what those studies believe to be negative (Arcand et al. 2012), positive (Mohamed et al. 2022), and inconclusive (Ibrahim and Alagidede 2018). Abeka et al. (2021) examined the financial development and economic growth nexus in a panel of 44 sub-Saharan African countries from 1996 to 2017, using the GMM technique. Their findings indicated that a telecommunications infrastructure improves the impact of financial development on economic growth. Lastly, in a recent study by Zungu (2022), who studied the nonlinear dynamics of the finance–growth nexus in African emerging economies over the period 1983–2020 using a PSTR model, there was a U-shaped relationship discovered, with the lowest amount of finance determined to be 60.5% of GDP. These findings were in line with studies by Ufuo and Alagidede (2018) and others.

2.2.2. The Empirical Analysis of Macroprudential Policies and Economic Growth

We then expanded the finance–growth relationship by incorporating the macroprudential policies into the system in order to find out whether they triggered the finance–growth relationship. This section will provide a quick overview of the literature on the impact of macroprudential policy on economic growth. In the literature, a negative impact of macroprudential policy on economic growth has been evidenced (Boar et al. 2017; Kim and Mehrotra 2017; Alin and Florentina 2019; Belkhir et al. 2022), while few have shown the positive effects (Andries and Melnic 2019).

Boar et al. (2017) documented that macroprudential policies are detrimental to growth in a panel of 64 developing and developed countries using the GMM. Their findings were in line with the study by Kim and Mehrotra (2017) in the case of the Asia-Pacific region, using structural panel vector autoregressions. Boar et al. (2017) and Kim and Mehrotra (2017) were further supported by Belkhir et al. (2022), who studied the same subject matter during the banking crises in a panel of 134 countries, covering the time span 2000–2017, using the Early Warning System model. A contradiction emerged following the study by Andries and Melnic (2019) in a panel of 61 countries over the period 2000–2015, using System-GMM. Their findings support the premise that macroprudential interventions are good for growth.

2.2.3. The Empirical Literature concerning the Impact of Unconventional Monetary Policy on Economic Growth

The finance–growth relationship was then broadened by integrating the unconventional monetary policies into the system to determine whether they triggered the finance–growth relationship. This part would provide a comprehensive overview of the studies on the impact of unconventional monetary policy on economic growth. For decades, advanced economies' central banks utilized a policy interest rate as a tool for conducting monetary policy. In reaction to the global financial crisis of 2007–2009 and the significant recession it generated in certain areas of the world, the central banks of several industrialized countries reduced policy interest rates to near-zero levels. As economic growth remained subdued, interest rates remained around zero, and several central banks utilized unconventional monetary policy to boost economic activity. The research on this topic contends that unconventional monetary policies have favorably contributed to growth (Lombardi et al. 2018; Inoue and Rossi 2018), although some studies contend that these policies are growth-stifling (Tatiana 2013). Lombardi et al. (2018) surveyed the international data and lessons learned about unconventional monetary policy. The findings indicated that UMP can prevent economic collapse but is not intended to foster longer-term economic growth. Inoue and Rossi (2018) observed similar findings. Their results show that an overall unconventional monetary policy has similar effects to a conventional expansionary monetary policy, leading to an increase in both output growth and inflation; the response is hump-shaped, peaking around one to one and a half years after the shock. The new procedure has the advantage of identifying monetary policy shocks in a unified manner during both conventional and unconventional monetary policy periods and can be applied more generally to other economic shocks; on the other hand, Tatiana (2013) claims that these policies are growth-hindering in developing economies.

3. Methodology Framework

3.1. Justification of Variables

The current study employs panel data covering the period 1985–2021. However, since the aim of the study is to evaluate the finance–growth relationship in a macroprudential policy regime in African emerging markets, based on the availability of data, we identify the prudential policy regime as beginning in 2000 and ending in 2021, whereas the non-prudential policy regime is defined as starting in 1985 and ending in 1999. Variables identified in the literature as potentially explaining the relationship between financial development and economic growth were used. Our data are separated into these time periods based on the implementation of macroprudential and unconventional monetary policies. We used domestic credit to the private sector as a share of GDP to proxy for financial development (FD), while GDP per capita at constant prices (USD) was used to proxy for economic growth (ECNO). Following the literature (Swamy and Dharani 2019; Abu-Lila et al. 2021; Machado et al. 2021; Zungu 2022), we used credit to the private sector as a proxy for financial development in this study, since it reflects the outstanding debts at the end of the year of securities issued and loans taken out by non-financial firms and families (including non-profit institutions serving households). While GDP per capita was employed since long-term economic growth raises average earnings and is highly associated with poverty reduction. GDP per capita measures the value of output per person and is an indirect indication of per capita income. GDP growth and GDP per capita are two broad metrics of economic growth (Samargandi et al. 2015; Ufuo and Alagidede 2018). We then expand the finance–growth definition to include two unconventional monetary policy instruments (income composition, and portfolio composition channels) in the system, as they were not included in the Zungu (2022) study. The equity index (ICEIUN) was used to capture the income composition channel, while the house price index (PCHPUN) was used to capture the portfolio composition channel, as it was confirmed in the literature to be the significant variable in understanding the interaction between monetary policy and economic growth by Alves and Silva (2020). Most households, particularly low-income households that own their own house, have a major portion of their portfolio invested in real estate. Portfolio rebalancing, on the other hand, can occur only if there is an increased supply of risky securities. Controlling such a factor (i.e., freshly issued securities) is thus important for this investigation. Nevertheless, based on data availability, the author used the home price index to capture the portfolio composition channel. We then control for macroprudential measures such as foreign exchange and/or countercyclical reserve requirements (FCRRM), macroprudential index (0–12) (MI-12), capital-related (CRIM), and borrower-related (BRIM). We employed borrower-related and capital instruments in our model, with the borrower-related instruments obtained by adding the loan-to-value ratio and the debt-to-income ratio, and the capital instruments derived by applying the general counter-cyclical capital buffer requirement (GCBRM). We also included fiscal policy instances through government expenditure (GE) (captured by government spending as a percentage of GDP) in our model to capture the impact of financial development on economic growth, given that the government is used as a tool to trigger output, which then increases employment and economic growth at the same time. According to the production argument, investment (INVE) is included because greater capital investment necessitates the creation of commodities that are not immediately consumed but are instead utilized to manufacture other things, such as capital goods, that contribute to an increase in economic growth. Lastly, trade openness (TRD), inflation (INFL) and tourism development (TOD) were included as well in the model. For the robustness model, we adopted the claims on the private sector by financial intermediaries to capture financial development and measure financial development. The variables were extracted from WDI data (WDI 2022) and Cerutti data (Cerutti et al. 2017).

3.2. Spatial Lag Panel Smooth Transition Regression Model

The SPSTR model, an extension of the PSTR established by González et al. (2017), was used to assess the development–growth relationship. The SPSTR model developed in this paper was formulated as follows:

$$ECNO_{it} = \rho(WK)_{\mathrm{it}} + \beta_0\, X'_{it} + \beta_1 X'_{it} g(\mathrm{q}_{it};\gamma,c) + \beta_2 \mathrm{A}_{it} + \mu_i + \varepsilon_{it} \\ i = 1,\ldots,N, \text{ and } t = 1,\ldots,T \tag{1}$$

where $ECNO_{it}$ denotes the dependent variable, while i,t specifies cross-section i-th and the time period t-th, correspondingly. Then, the vector of dependent variables which is $NT \times 1$ is denoted by $K = (k_{11}, k_{21}, \ldots, k_{\mathrm{N1}},\ k_{12}, \ldots k_{\mathrm{NT}})'$ and W is an $NT \times$ NT spatial weight matrix in the model, while A_{it} is a $k \times 1$ vector of independent variables (FD, FCRRM, GCBRM, CRIM, BRIM, ICEIUN, PCHPUN, INFL, TRD, GEF, INVE, TOD), and β_0, β_1, β_2 are $k \times 1$ vectors of coefficients, whereas μ_i represents the individual fixed effects, and the random-errors term is denoted by ε_{it}. Following Granger and Terasvirta (1993) and González et al. (2017):

$$\varepsilon_{it} \sim N\left(O,\sigma^2\right), g(\mathrm{q}_{it};\gamma,\ c) = \left(1+\exp\left(-\gamma \prod_{j=1}^{m} (\mathrm{q}_{it} - cj)\right)\right)^{-1} \tag{2}$$

The transition function is given in Equation (2), where evidently we have $0 < g(\mathrm{q}_{it};\gamma,\ c) < 1$), while $c_j = (c_1,\ldots,c_m)'$, $e = (1,1,\ldots 1)'$ is the vector of location parameters which take the form $m \times 1$, while $\gamma > 0$ is the scale parameter. We then set $m = 1$, in avoiding the loss of generality, and to simplify mathematical deduction. For our SLPSTR model, given i, it can be written as follows:

$$Y_i = \rho(WK)_{\mathrm{i}} + \beta_0\, X'_i + \beta_1 G_i X'_i + \mu_i e + \varepsilon_i \tag{3}$$

where $Y_i = (y_{11}, y_{21}, \ldots, y_{\mathrm{iT}},\ \mathrm{e} = (1.1,\ldots 1)'$ is a vector with all elements valued at 1, $\mathrm{X}_i = (x_{\mathrm{i1}}, x_{\mathrm{i2}}, \ldots, y_{\mathrm{iT}},\ G_i = \mathrm{diag}(g(\mathrm{q}_{it};\gamma,\ c),\ldots,g(\mathrm{q}_{i\mathrm{T}};\gamma,\ c))$, and $\varepsilon_i = (\varepsilon_{i1}, \varepsilon_{i2}, \ldots, \varepsilon_{i\mathrm{T}},)'$ which take T $\times$ 1. The assumption in the case is that when $Y = (Y'_1, Y'_2, \ldots, Y'_N,)'$, $X = (X_1, X_2, \ldots, X_N)'$, and $E = (E'_1, E'_2, \ldots, E'_N,)'$, where $E_i = (0,e,0)$ is the $T \times N$ matrix in which the elements of the i-th column are 1 and other elements are 0, $G_i = \mathrm{diag}(\mathrm{G}_1, \mathrm{G}_2, \ldots, \mathrm{G}_N))$, $Z = (\mathrm{E} \vdots \mathrm{X} \vdots \mathrm{GX})$, $\Theta = (\mu_1, \mu_2, \ldots, \mu_N, \beta'_O, \beta'_1)'$, and $\varepsilon = (\ \varepsilon'_1,\ \varepsilon'_2, \ldots\ \varepsilon'_N)'$, then the simplified Equation (4) is SLPSTR with two regimes,

$$Y = \rho WK + Z\Theta + \varepsilon,\ \varepsilon \sim N\left(O,\sigma^2 I\right) \tag{4}$$

Then, in this next section, Equuation (4) will be discussed in cooperation with the Bayesian approach.

Building a Bayesian Estimation for the PSTR Model

Before providing a specific estimation phase, we first construct the Bayesian analytical framework for model [1]. Equation (5) is the likelihood model function of Equation (4) given $(\gamma,\ c)$; let $A = (I - \rho W)$,

$$L\left(Y|\Theta,\gamma,\ c,\sigma^2\right) \propto \sigma^{-NT}|A| exp\left\{-\frac{1}{2\sigma^2}(AY - Z\Theta)'((AY - Z\Theta)\right. \tag{5}$$

The prior distribution of parameter ρ is often considered to be a uniform distribution with probability density function $\pi(\rho) = \frac{1}{\lambda_{max}^{-1} - \lambda_{min}^{-1}}$, where λ_{max}, λ_{min} are the highest and minimum eigenvalues of a spatial weight matrix W, respectively, indicating $\sim (\lambda_{min}^{-1}, \lambda_{max}^{-1})$. The parameter's Θ prior distribution is specified to be multiple normal distribution $N(\mu_0, \Sigma_0)$, where μ_0 and Σ_0 are the prior expectation and covariance. We also assume the previous distribution of parameter σ^2 as the inverse gamma distribution $IG(\mu_0, \Sigma_0)$, and set prior and c as gamma and normal distributions, respectively; that is $\gamma \sim G(a,b)$, $(c \sim N(\mu_c, \Sigma_c)$. We may obtain the joint distribution of all variables by combining all priors with likelihood functions as follows:

$$P\left(Y,\ \rho, \Theta, \gamma,\ c, \sigma^2\right) = L\left(Y\middle|\rho, \Theta, \gamma,\ c, \sigma^2\right) \cdot \pi(\rho) \cdot \pi(\Theta) \cdot \pi(\gamma) \cdot \pi(\ c) \cdot \pi\left(\sigma^2\right) \tag{6}$$

where $\pi(.)$ is the prior probability density function of each parameter. The joint posterior distribution of all parameters is determined with the Bayesian theorem which is given by

$$P\left(\rho, \Theta, \gamma,\ c, \sigma^2\right) \triangleq P\left(\rho, \Theta, \gamma,\ c, \sigma^2\middle|Y\right) \tag{7}$$

The conditional posterior distribution of each parameter may be calculated using the joint distribution and joint posterior distribution as follows:

$$P\left(\ \Theta|\rho, \gamma,\ c, \sigma^2\right) \propto N(\mu, \Sigma) \tag{8}$$

where $\mu = \left(Z'Z + \sigma^2 \sum_0^{-1}\right)^{-1}\ \mu = (Z'AY + \sigma^2 \sum_0^{-1} \mu_0)$. When given additional parameters, the conditional posterior distribution is multiple normal distributions, as shown by Equation (8). Other parameters' conditional posterior distributions are as follows:

$$\begin{gathered} P(\sigma^2|\rho, \Theta, \gamma,\ c) \propto IG\left(\tfrac{NT}{2}\right) \propto,\ \tfrac{(AY-Z\Theta)'(AY-Z\Theta)}{2} + \beta) \\ P\left(\Theta|\rho, \gamma,\ c, \sigma^2\right) \end{gathered} \tag{9}$$

$$\propto |A\ (\rho)|exp\left\{-\tfrac{1}{2\sigma^2}(A(\rho)Y - Z\Theta)'(A(\rho)(Y - Z\Theta)\ .\frac{1}{\lambda_{max}^{-1} - \lambda_{min}^{-1}}\right. \tag{10}$$

$$P\left(\gamma,\ c|\Theta, \rho, \sigma^2\right) \propto exp\left\{-\tfrac{1}{2\sigma^2}(AY - Z\Theta)'((AY - Z\Theta) \cdot \pi(\gamma) \cdot \pi(\ c)\right. \tag{11}$$

where $A(\rho) = (I—\rho W)$. We can see from the conditional posterior distributions of all parameters that the probability density functions of, γ, c and ρ are more complicated, and these parameters cannot be sampled directly. To solve this problem, we employ the Metropolis–Hastings method. Assume that the current value of ρ is ρ_t, and that $P\left(\ \rho_t|\Theta, \gamma,\ c, \sigma^2\right) > 0$,, and that the candidate value ρ^* is created from the suggested distribution $F(\rho^*|\ \rho_t) = f(\rho^* - \rho)$, where $f\ (.)$ is the probability density function, and the transfer process is $^*\rho^* = \rho_t + \lambda z$, where $z \sim N(0, I)$ and λ is a transfer parameter. Then the reception ratio of $\rho^*\ is\ \ A_i(\rho^*|\ \rho_t) = \min\{1,\ R_1\}$, where

$$R_1 = \frac{P(\rho^*|\Theta, \gamma,\ c, \sigma^2) F(\ \rho_t|\rho^*)}{P(\ \rho_t|\Theta, \gamma,\ c, \sigma^2)\ F(\rho^*|\ \rho_t)} \tag{12}$$

Similarly, suppose the current values of $(\gamma,\ c)$ are $(\gamma_t,\ c_t)$, and the candidate values $(\gamma^*,\ c^*)$ are derived from the suggested distributions $\gamma^* \sim N\left(\gamma_t, \sigma^2{}_y\right)$ and $c^* \sim N\left(c_t, \sigma^2{}_c I\right)$. The reception ratio of $(\gamma^*,\ c^*)$ is hence $A_2((\gamma^*,\ c^*)|\gamma_t,\ c_t)) = \min\{1,\ R_2\}$, where

$$R_2 = \frac{P((\gamma^*,\ c^*|\rho, \Theta, \sigma^2) f_\gamma\left(\gamma_t\middle|\gamma^*, \sigma_y^2)\right)\ (f_c(c_t|c^*, \sigma_c^2))}{P((\gamma_t{}^*,\ c_t{}^*|\rho, \Theta, \sigma^2) f_\gamma\left(\gamma^*\middle|\gamma_t, \sigma_y^2)\right)\ (f_c(c^*|c_t, \sigma_c^2))} \tag{13}$$

$f_\gamma\left(\gamma_t\middle|\gamma^*, \sigma_y^2)\right)$ denotes the normal distribution probability density function of γ_t with mathematical expectation γ^* and variance $\sigma_y^2 . f_c(\left(c_t\middle|c^*, \sigma_c^2\right))$ denotes the normal distribution probability density function of c_t with mathematical expectation c^* and variances σ_c^2, with σ_c^2 and σ_y^2 being adjustment parameters. Z^* and Z_t represent the value of Z at the times when the values of $(\gamma,\ c)$ are $(\gamma^*,\ c^*)$ and $\gamma_t,\ c_t$, respectively.

To begin, we use the Gibbs sampling approach to produce parameters Θ and σ^2 from their conditional posterior distributions. The Metropolis–Hastings method is then used to sample parameters ρ, γ and c. The Bayesian estimate approach for the SLPSTR model is as follows. (1) Set the starting values of parameters $(\rho, \Theta, \gamma,\ c, \sigma^2)$ to $(\rho_0, \Theta_0, \gamma_0,\ c_0, \sigma_0{}^2)$, and let $(\rho_t, \Theta_t, \gamma_t,\ c_t, \sigma_t{}^2)$ be the results of t-th sampling. (2) Sample Θ_{t+1} from the conditional distribution $P(\Theta|\rho_t, \gamma_t,\ c_t, \sigma_t{}^2)$. (3) Sample $\sigma^2{}_{t+1}$ from the conditional distribution $P(\sigma^2|\rho_t, \gamma_t,\ c_t, \Theta_{t+1})$. (4) First, produce a random number r from uniform distribution $U(0,1)$, and then generate $(\rho^*, \gamma^*,\ c^*)$ using the random technique described below: $\rho^* = \rho_t + \lambda z$, the normal distribution $N(\gamma_t, \sigma^2{}_y)$ and the normal distribution $N(c_t, \sigma^2{}_{,c}\ I)$, respectively, from which we derive $(\rho_{t+1}, \gamma_{t+1},\ c_{t+1})$ defined as:

$$\rho_{t+1} = \begin{cases} \rho^*,\ if\ r < A_1 = min\{1,\ R_1\} \\ \rho_t,\ others \end{cases} \tag{14}$$

$$(\gamma_{t+1},\ c_{t+1}) = \begin{cases} (\gamma^*,\ c^*),\ if\ r < A_2 = min\{1,\ R_2\} \\ (\gamma_t,\ c_t),\ others \end{cases} \tag{15}$$

(5) When $t = t + 1$ repeat steps (ii)–(iv) until convergence.
Then the criterion of the convergence takes this form:

$$\frac{\|\rho_t, \gamma_t,\ c_t, \sigma_t{}^2\|}{\|\rho_{t-1}, \Theta_{t+1}, \gamma_{t-1},\ c_{t-1}, \sigma_{t-1}{}^2\|} < \tag{16}$$

This is utilized in the estimation process, where $\|.\|$ represents the Euclidean norm and a is the accuracy requirement.

4. Analysis of the Study

Similar to the PSTR model, the BSPSTR goes through three stages before estimating the execution: finding the appropriate transition variable among all the candidate variables, testing the linearity, and finding the sequence for selecting the order m of the transition function using the LM-type test, with the proposed WCB and WB serving as robustness checks.

The results of the three steps are provided in the sections that follow. For the estimation process of our model, please have a look at Appendix A, Figure A1. The descriptive statistics are presented in Appendix A, Table A1.

4.1. The Results of the Testing Procedure of the BSPSTR Model

To determine the appropriate transition variable, the study considered FD, FCRRM, GCBRM, CRIM, BRIM, ICEIUN, PCHPUN, INFL, OPEN, GEF, INVE, and TOD as candidates. Table 1 shows the results of all stages of the BSPSTR. The transition variable in a panel regression of financial development and economic growth is shown in the first section of Table 1. Where the LM_F-test (0.00054) and LM_X-test (0.00009) p-values indicate that FD is the best choice of transition variable for this study, as the p-values are lower when compared to the other variables included as candidates.

Table 1. Results of selecting the transition variable.

		Transition Variable FD_{it-1}			**Results of the H_0**	**Selecting Order m**		
		***m*=1**	***m*=2**	***m*=3**	***m*=1**	***m*=1; H^*_{01}**	***m*=2; H^*_{02}**	***m*=3; H^*_{03}**
LM_F	Fs	2.90	5.22	2.54	16.89	4.90	15.98	9.89
	pv	0.00054	0.00000	0.056	0.0000	0.60	10.209×10^{-09}	5.984×10^{-10}
LM_χ	Fs	20.22	15.58	14.89	7.50	9.98	60.89	8.21
	pv	0.00009	0.00004	00000	0.0000	0.70	6.985×10^{-02}	0.00009
WB	pv	-	-	-	0.00	-	-	-
WCB	pv	-	-	-	0.00	-	-	-

Growth is the dependent variable. Using the LM-type test, all variables, as mentioned in Section 4.1, were considered as possibilities for determining the proper transition variable. The p-values are denoted by p-v, while the F statistics are denoted by Fs. Source: Authors' calculation based on WDI (2022) data.

To test for linearity, we generated the F statistics together with their p-values for both LM_F (0.00) and LM_χ (0.00), while for robustness check we used the WB (0.00) and WCB (0.00). The p-values of all these tests indicated the rejection of the linearity null hypothesis, confirming that there is nonlinearity between two variables in these countries studied. Finally, in the third section of Table 1, the results of the sequence for selecting order m are reported. When $m = 1$, the p-values of both LM_F(0.60) and LM_χ(0.70) reject $H0$, indicating that when $\mathrm{FD}_{i,\,t-1}$ was chosen as the best transition variable, the model had one regime that separated the low level from the high level of financial development.

4.2. Model Evaluation and the Estimated Threshold of the BSPSTR Model

The results of the threshold as well as the model evaluation of the estimated BSPSTR are summarized in this section. Table 2 shows the results of the Parameter Constancy test (PC), No Remaining Nonlinearity (NRN), and estimated threshold. In the first section of Table 2, the results of the LM_F and LM_χ indicate that the parameters are constant, while the adequateness of our model with one transition is tested using both WB and WCB which take heteroskedasticity as well as possible within cluster dependence into account, suggesting that the estimated model with one transition is adequate as their p-values are equal to one. Finally, in the last section of Table 2, the estimated threshold for the baseline and robustness model outcomes is shown.

Table 2. Results of the evaluation test and the estimated threshold.

	Parameter Constancy test	
LM_F	6.384 (5.958×10^{-18})	
LM_χ	98.89 (5.745×10^{-78})	
	No Remaining Nonlinearity	
WB	1 (p-value)	
WCB	1 (p-value)	
	The estimated threshold model	
	Model 1:Baseline	Model 2:Baseline
c	0.92 ***(0.02)	0.58 ***(0.05)
γ	18.11 ** (4.20)	13.99 **(2.90)

Growth is the dependent variable. ***, ** represent the 1% and 5% level of significance. Source: Authors' calculation based on WDI (2022) data.

According to the findings, the projected financial development threshold in African emerging regions during the macroprudential policy regime is 92 percent of GDP, while it was 58 percent of GDP during the non-prudential policy regime.

Zungu (2022) found a minimum level of financial development estimated to be 60.5 percent of GDP, above which financial development increases growth in these countries. The current study adds to the literature by demonstrating that, after controlling for spatial effects and data problems in the model using the spatial and Bayesian approaches within the PSTR, there is a switched relationship in this subject matter in these countries. This is due to the fact that, before the prudential policy regime, the relationship supported the U-shape relationship, which is in line with the finding documented by Zungu (2022). During the time of these policy involvements, however, it switched to the inverted U-shape. In a nutshell, this shows that prudential policies indeed triggered the finance–growth relationship.

As a result, the first regime, in which financial development is less than 93 percent of GDP, reduces the level of growth. The logic behind this is that, in the low-finance regime, financial development may reduce growth by increasing economic fragility. Higher systemic risk implies more frequent and/or severe crises, which reduces growth rates. However, when the level of finance exceeds 92 percent of GDP (threshold), it promotes growth by encouraging capital accumulation and technological advancement, by accumulating savings, mobilizing and pooling savings, creating investment information, opening opportunities for entrepreneurship, enabling and encouraging foreign capital inflows, and optimizing capital allocation.

Figure 2 illustrates that, with the exception of South Africa, African emerging economies are at the lower end of financial development, with a mean GDP score of 10,000 (2020). There are several factors that might cause these countries to be on the lower end of the GJ curve, one of which is their high degree of inequality. Another element to examine is the execution of policies that do not assist the people in terms of enhancing their living standards. It has been demonstrated that per capita income is a good indicator of an institution's overall development and complexity. As a result, rapid finance leads to rapid growth. Some countries below the threshold have an average GDP per capita of less than USD 2000 (2000–2021), supporting the argument that nations with low levels of development also have low levels of financial development.

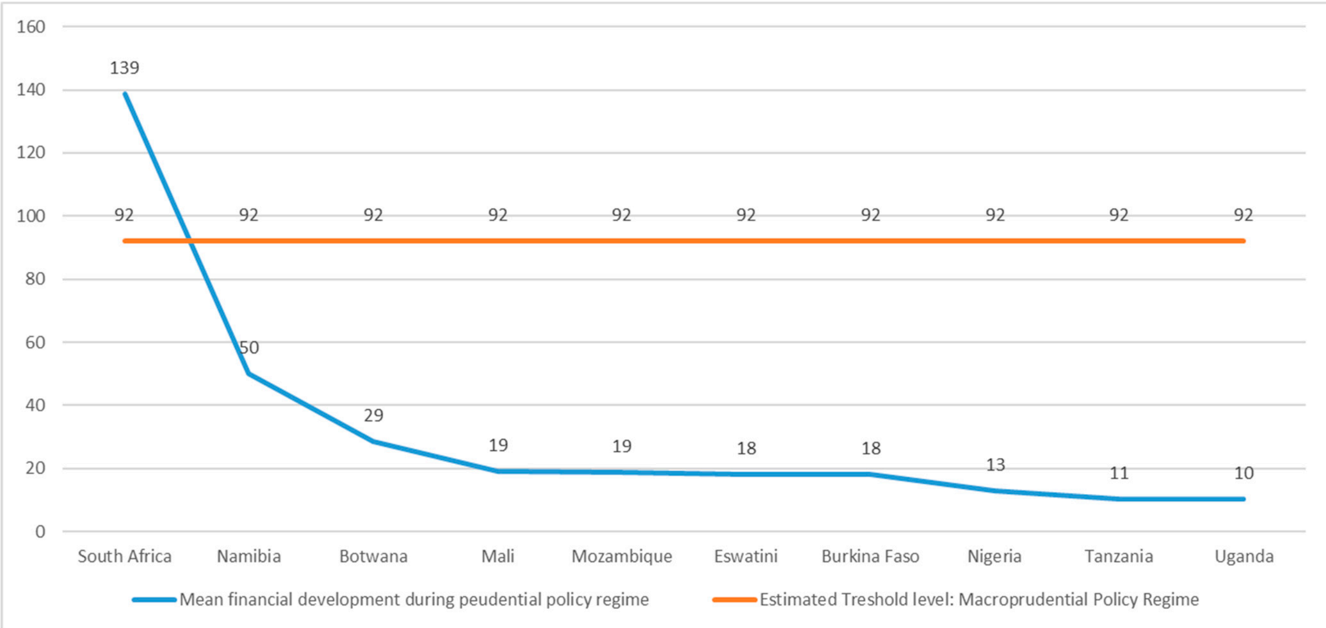

Figure 2. The mean GDPs per capita and the estimated thresholds. Source: Authors' calculation based on WDI (2022) data.

4.3. Empirical Results of the BSPSTR and Discussion

Table 3 presents the results of the BSPSTR model, which is a two-regime lag model. The BSPSTR findings give two important insights for this study and policy formulation, as they show that financial development improves growth, as measured by β_{0j}, in Model 1, the macroprudential policy regime, while it decreases growth in Model 2, the non-macroprudential policy regime. We set the number of years for macroprudential policy to start from 2000–2021 and non-macroprudential policy to start from 1985–1999 due to data and policy execution, as well as by following Zungu (2022). As reported in Table 1, the results confirm the homogeneity test: the effects of financial development on growth are strongly nonlinear. In fact, the coefficient of the model's nonlinear component, β_{1j}, is negative and significant during the prudential policy regime, but positive during the non-prudential policy regime. In a nutshell, our findings in Model 2 support the study by Zungu (2022), as we reported the U-shape relationship before macroprudential policies were introduced in these countries, which then contradicts his study on macroprudential policies as we reported an inverted U-curve. Looking at these results, they contradict what has been reported by Zungu (2022) and others. Which then simply highlights the fact his results suffered due to the method adopted.

Table 3. Finance–growth relationship; BSPSTR, for African Emerging Markets.

Variables: *ECNO*	Model 1: Financial Growth: Macroprudential Policy Regime (2000–2021) BSPSTR		Model 2: Financial Growth: Non-Macroprudential Policy Regime (1983–1999) BSPSTR	
	Low Regime $\beta_{0j} \times 100$	**High Regime** $(\beta_{0j}+\beta_{0j}) \times 100$	**Low Regime** $\beta_{0j} \times 100$	**High Regime** $(\beta_{0j}+\beta_{0j}) \times 100$
$FD_{i,\ t-1}$	8.23 **(2.02)	−3.99 **(0.21)	−1.98 ***(0.09)	5.88(1.99) **
$FCRRM_{i,\ t-1}$	−2.34 **(0.14)	−4.67 **(1.00)		
$GCBRM_{i,\ t-1}$	−0.76(0.17)	2.98 **(0.50)		
$CRIM_{i,t-1}$	4.09 **(1.23)	−5.90 **(1.00)		
$BRIM_{i,\ t-1}$	−2.33 ***(0.20)	1.60 **(0.87)		
$ICEIUN_{i,\ t-1}$	1.40 **(0.89)	−4.80 **(0.90)		
$PCHPUN_{i,\ t-1}$	3.04(0.56)	2.94 **(1.00)		
$INFL_{i,\ t-1}$	2.06 **(0.91)	−0.76 **(0.05)	2.99 ***(0.02)	−3.90 **(4.60)
$TRD_{i,\ t-1}$	3.56 **(1.00)	2.78 **(0.67)	3.80 **(0.40)	0.3(0.10)
$GEF_{i,\ t-1}$	5.04 **(2.08)	−2.45 **(0.05)	4.00 **(1.94)	−0.99 **(0.02)
$INVE_{i,\ t-1}$	3.56 ***(1.22)	4.90 **(1.70)	2.99 **(0.09)	4.30 **(0.20)
$TOD_{i,\ t-1}$	2.99 **(1.00)	3.10 **(0.04)	0.99 **(0.03)	2.00 **(0.20)
Dummy	Yes	No	Yes	No
Threshold (c)	0.92 ***(0.02)		0.58 *(0.05)	
Slope (γ)	15.09 **(3.90)		13.99 **(7.90)	
ESD	0.089		0.010	
# of obs.	220		170	
# of countries	10			

Take note that the dependent variable is ECNO. The standard errors in brackets are derived by employing the cluster-robust and heteroskedasticity-consistent covariance estimator, which allows for error dependence within individual nations. ***, **, and * represent the 1%, 5%, and 10% levels of significance, respectively. ESD is estimated standard deviation (residuals), while p-v stands for p-values. Source: Authors' calculation based on WDI (2022) data.

The impact of financial development on growth is dependent on the level of development. This means that changes in growth due to financial development range from β_{0j} to β_{1j}, with financial development ranging from low to high. After controlling for spatial and data issues and comparing macroprudential and non-macroprudential policy regimes across the estimation tool, we find evidence that the adopted macroprudential policies in these countries triggered the finance–growth relationship. This is due to the fact that during the non-prudential policy regime, the finance–growth relationship is explained by the U-shape, while in the prudential policy regime, it switched to the inverted U-shape.

Even if we extend the argument by comparing the magnitude coefficient of FD in these two policy regimes, when the level of finance begins to develop, the macroprudential policy regime has a larger impact than the non-macroprudential policy regime. When financial development exceeds the threshold, the FD has a higher impact on the common man in model 1 than in model 2. According to our model, the magnitude in the low regime is 8.23 for the macroprudential policy regime and 1.98 for the non-macroprudential policy regime, while in the high regime it is 3.99 and 5.88. The logic behind the inverted U-shape relationship in African countries follows Greenwood and Jovanovic's (1990) argument. Furthermore, the argument for financial development being anti-growth beyond the optimal level during this policy regime could be that the more the financial system expands, the more it promotes risk and ineffective resource allocation, which may reduce the rate of savings, resulting in lower economic growth. Higher systemic risk implies more frequent and/or severe crises, which would harm growth rates. The recent financial crisis of 2008 is an excellent example of this. This finding is consistent with previous empirical studies that found a significant positive and negative effect of financial development on economic growth (such as Samargandi et al. 2015; Ufuo and Alagidede 2018; Swamy and Dharani 2019; Abu-Lila et al. 2021; Machado et al. 2021), as well as those that found a significant positive and negative effect of financial development on economic growth (Abdul Bahri et al. 2019; Bandura and Dzingirai 2019; Jinqi 2020; Zungu 2022).

One of the primary goals of our study was to determine how macroprudential policy instruments influenced the finance–growth relationship in selected countries, following Zungu (2022). Unlike the policy instruments adopted in his study, the current study extended his model by including FX and/or countercyclical reserve requirements (FCRRM) and a general counter-cyclical capital buffer requirement (GCBRM). The current study goes beyond this by empirically envistigating the impact of unconventional monetary policy programs that were initiated during the financial crisis. Those unconventional monetary policy channels were the income composition channel and the portfolio composition channel.

The FCBRM is designed to counter procyclicality in the financial system. When cyclical systemic risk is judged to be increasing, institutions should accumulate capital to create buffers that strengthen the resilience of the banking sector during periods of stress when losses materialize. FGBRM has a statistically negative effect on growth in both regimes. This finding is consistent with studies reporting that this policy reduces growth (Ductor and Grechyna 2015). The explanation underlying this is that, when the value of a bank's assets (mostly loans) falls below the value of its debt (deposits and bonds), the value of the bank to its owners (capital) becomes negative, and the bank becomes insolvent. GCBRM has a negative and statistically insignificant effect on growth in the low regime, while in the high regime it is positive and statistically significant. The finding is similar to the results documented by Ductor and Grechyna (2015). CRIM has a positive impact on growth in the low regime, while it has a negative impact on growth in the high regime of financial development. This is consistent with the findings documented by Husam-Aldin et al. (2012) and others. The logic behind these is that human capital accumulation is negatively affected by capital market imperfections. BRIM has a negative impact on growth in the low regime of financial development, while it is positive in the high regime.

By incorporating the unconventional monetary policy channels in our model, it helps us find out whether these policy formulations further triggered the finance–growth relationship in these countries. The income-composition channel was captured through the equity index (ICEIUN), while the portfolio composition was proxied by the house-price index (PCHPUN) following Alves and Silva (2020). ICEIUN has a positive and statistically significant impact on growth in the low regime of financial development, while in the high regime it is negative and significant. This is consistent with previous empirical findings on the impact of unconventional monetary policy on growth, such as the study by Gillman and Harris (2004). The explanation underlying this is that negative equity occurs when the market value of a house is below the outstanding mortgage secured on it. As house prices fall, the number of households with negative equity tends to rise. Portfolio composition through the PCHPUN has a statistically positive impact on growth in both regimes of financial development in African emerging markets. The findings are consistent with the empirical studies documented in the literature (Mosesov and Sahawneh 2005) and others. The logic behind this line is that rising house prices generally encourage consumer spending and lead to higher growth due to the wealth effect. A sharp drop in house prices adversely affects consumer confidence and construction and leads to lower growth. Therefore, decreasing house prices can contribute to an economic recession.

In both models of macroprudential and non-macroprudential policy regimes, inflation (INFL) has a positive and statistically significant impact on economic growth in the low regime of financial development and a negative impact in the high regime. The findings are consistent with the study documented by Vinayagathasan (2013) and Chu et al. (2022). This is due to the fact that a decrease in the productivity of production factors brings about the negative effect of financial development on economic growth. Thus, it is necessary for countries with a higher inflation-rate threshold to have access to an efficient financial system in order to achieve low inflation rates. Trade openness (TRD) was found to be a great source of growth, as we found it to have a positive and statistically significant impact on growth in both regimes of financial development, during a macroprudential policy regime and a non-macroprudential policy regime. Our findings are in line with those of Keho and Wang (2017), Rose and Odhiambo (2018). After controlling for fiscal policy through government expenditure (GEF) in our model, we find it to have a positive impact on growth in the low regime of finance, while it is negative in the high regime in both models. This could be due to a number of factors, including an increase in government activity, which could stymie economic activities such as transfer payments and discourage people from seeking employment, lowering output. It may also appear when government expenditures are funded by tax revenues. This finding is consistent with previous research by Jain et al. (2021) and Zungu and Greyling (2022).

Investment (INVE) has a positive and statistically significant impact on growth in both regimes. This finding supports the argument documented by Brenner (2014) and others. Due to the close correlation between investment and growth, an increase in uncertainty would probably also have a negative effect on economic growth. In addition to the effect of the degree of irreversibility on the investment–uncertainty relationship, the development of the financial market also matters. Lastly, tourism development (TOD) has a positive, statistically significant effect on growth in both regimes of financial development. This finding supports the results documented by Asif et al. (2020), Khan and Senhadji (2000) and Samimi et al. (2011).

4.4. Sensitivity Analysis and Robustness Checks

For the robustness model, we use claims on the private sector by financial intermediaries to capture financial development, following the study by Zungu (2022). The variables are defined in the same way as in the baseline methodology. For the sensitivity analysis, we added the macroprudential index (0–12) (MI–12) in Model 3 given the availability of the combination index of 12 macroprudential regulations. The results of the robustness and sensitivity analyses are reported in Table 4 for both macroprudential and non-macroprudential policy regimes. Again, all the testing procedures for these models were followed.

Table 4. Finance–Growth: Robustness Check Model.

Model 3: Macroprudential Policy Regime (2000–2021)	ECNO = 5.56DCPS *** − 0.78FCRRM ** + 2.65GCBRM *** + 2.40CRIM *** + 3.55MI-12 ** − 1.11BRIM * + 3.23ICEIUN − 2.95PCHPUN ** + 0.98INFL ** + 2.01TRD ** + 3.57PINVE **3.080GEF** + 4.10TOD ** − $[13.34^{**}_{\gamma},\ 90.04^{***}_{C}]$−2.67DCPS *** − 3.10FCRRM *** + 1.33GCBRM ** − 3.20CRIM *** + 2.00MI-12 *** − 2.09BRIM * + 1.10ICEIUN ** + 3.05PCHPUN ** + 0.67INFL + 1.08TRD ** + 3.57PINVE ***1.080GEF *** + 2.88TOD **
Model 4: Non-macroprudential Policy Regime (1985–1999)	ECONO = −3.70DCPS *** + 1.56INFL ** + 3.39TRD *** + 3.00GEF *** + 1.90PINVE ** + 2.13TOD ** $[12.45^{**}_{\gamma},\ 60.00^{***}_{C}]$ + 4.51DCPS *** − 3.35INFL * + 4.09TRD ** − 2.30GEF ** + 2.00PINV ** + 0.87TOD **

***, **, * denote the levels of significance at 1%, 5%, and 10%, respectively. Source: Authors' calculation based on WDI (2022) data.

This was done to check if the results of the baseline technique were sensitive to the variables chosen as control variables. The estimated findings revealed that the variables used to capture financial development, as well as those included in the model as control variables, had no effect on the nonlinear impact of financial development on economic growth in these nations. The results were, indeed, comparable to those obtained with our first model. When macroprudential policy tools are controlled for, we find that the macroprudential index (0–12) (MI-12) enhances growth in both regimes, indicating that it has a positive and statistically significant influence on growth. This suggests that the overall macroprudential policy has an increasingly positive effect on growth in these countries.

5. Conclusions and Policy Recommendations

The finance–growth relationship is marked by controversy surrounding the nature of the relationship between these variables in both emerging and advanced economies. Even the theoretical and empirical literature studies are controversial and have produced contradictory results. Zungu's (2022) study documented that the finance–growth relationship is characterized by a U-shape, with the minimum level of financial development found to be 60.5% of GDP, above which financial development increases growth in African emerging countries, leaving room for concern for both policymakers and politicians on how much is the optimal point of finance required for these countries to achieve high growth. Moreover, adopting a different model ensures that the results documented in his study are not sensitive to the model adopted. The introduction of time and cross-sectional effects to represent individual heterogeneity, which then satisfy the assumption that the coefficients of explanatory variables are assumed to be constant for all section units and periods, is one of the major weaknesses in the existing literature investigating the same subject in a panel framework. In practice, however, this assumption is not always correct.

For example, the model by Zungu (2022) permits coefficients to vary with cross-sectionality and time, which is a suitable relaxation of the heterogeneity assumption in panel-data models. Consider the following scenario: in the general equilibrium model, the local equilibrium prices of all local markets are correlated, individuals in the network model are interconnected, and in a competitive market one participant's decision is influenced by the decisions of other participants, and so on. When dealing with the aforementioned research topics, the traditional econometric model will no longer be appropriate. Then the spatial method plays a significant role in such a problem. Furthermore, his study focuses on a few macroprudential policy instruments, leaving other instruments that are believed to trigger the finance–growth relationship.

The current study seeks to go beyond his study by accounting for several weaknesses that were spotted in his study in order to find the possibility of the optimal level of finance required in these countries to achieve high growth. The current study adopted the same data that were utilized in his study and further extended his argument by incorporating more macroprudential instruments that were omitted in his study. In order to determine how these policies triggered the finance–growth relationship, we further control policy instances using unconventional monetary instruments.

Considering the nature of the relationship between financial development and economic growth revealed in this study, we find that the optimal level of financial development is found to be 92% of GDP, above which the financial system promotes risk and ineffective resource allocation, which may reduce the rate of savings and reduce risk, resulting in lower economic growth. In almost all countries included in this study, the estimated threshold is still far below the calculated mean of GDP per capita, except for South Africa, where the mean is estimated at 139% of GDP. In this case, more policies aimed at ensuring improvement, financial inclusion, and increasing social mobility and investment are significant. Having more financial institutions and systems will ease the exchange of goods and services through the provision of payment services and mobilising and pooling of savings from a large number of investors, which then creates job opportunities, ultimately stimulating growth. The results seemed to be resistant to the control variables applied, since the author achieved the same results after including the macroprudential index (0–12) (MI–12) in the system. Adopting macroprudential policies, such as financial institution-targeted instruments aimed at the balance sheets of banks, which influence the provision of credit to the economy, was found to reduce growth in the lower regime while improving it in the higher regime. What is interesting in this study is that, when comparing the macroprudential with the non-macroprudential policy regime, the magnitude of the financial development was found to have a profound impact on growth during the macroprudential policy. As the study found, in the lower regime, the magnitude was 4.64% in the policy regime and 0.88% in the non-policy regime. Furthermore, at a high level of finance, the magnitude was found to be 3.63 and 1.03%. The impact on the non-prudential policy regime was found to be insignificant. It is evident that the macroprudential policy adopted triggered the finance–growth relationship in the African emerging countries.

The study also shows that an increase in trade openness, investment, and tourism development boosts economic growth in both macroprudential and non-macroprudential policy regimes. Inflation and government spending are found to improve the level of growth up to a certain point, but after that point, they are found to have a negative effect on economic growth.

In terms of policy, the study's findings could have a number of implications. Firstly, the optimal point of financial development found in this study is the challenge to policymakers to recall the two major functions of the financial system. The first one is credit provision, which encourages economic activity. Then governments may invest in infrastructure projects by lowering tax revenue cycles and correcting expenditure, firms can invest more than their cash reserves, and consumers can buy houses and other utilities without having to save the whole cost up front. Banks and other financial service providers provide this credit facility to all stakeholders. The second one is when the policymakers look closer at the liquidity provision, where banks provide the facility of demand deposits, which the business or individual can withdraw at any time, or further provide credit and overdraft facilities to businesses, which can stimulate demand and lead to economic growth.

Finally, the findings may encourage policymakers in African emerging economies to exercise caution when implementing macroprudential policies. Concisely, these policies promote growth when the level of the financial system exceeds the 0.92% minimum of domestic credit to the private sector as a share of GDP. Future research, according to the author(s), should focus on a comparative study in which African developing countries are compared to European or other countries. We suggest that future studies look at financial inclusion in the system. This will be a substantial contribution. Future studies will demand the use of many indicators to assess financial development. On the other side, the inclusion of economic development captured by GDP per capita, following the study by Zungu et al. (2022) will be a crucial contribution to the upcoming study. Future research must include factors aimed at controlling government effectiveness. The study's shortcomings arose from a lack of data as well as the inclusion of financial inclusion characteristics.

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Appendix A

Table A1. Descriptive Statistics (Dependent and Independent Variables).

Variables	Mean	Std. Dev	Min	Max
FD	8.8093	1.1997	5.0865	9.4870
FCRRM	67.5594	7.9258	28.6367	80.919
GCBRM	70.2006	0.7838	9.6878	6.4411
CRIM	45.5768	0.3430	6.0412	11.2325
BRIM	21.6721	8.0535	2.6315	52.9388
ICEIUN	44.1316	5.3089	2.7740	60.8798
PCHPUN	29.1318	1.3086	2.8490	70.9998
INFL	10.2707	1.2594	24.326	29.1781
TRD	21.1218	8.0537	2.6315	52.9388
GEF	52.3199	1.3688	6.7408	70.7989
INVE	70.1187	0.3086	10.3679	60.77779
TOD	56.33789	3.2598	24.326	29.1781

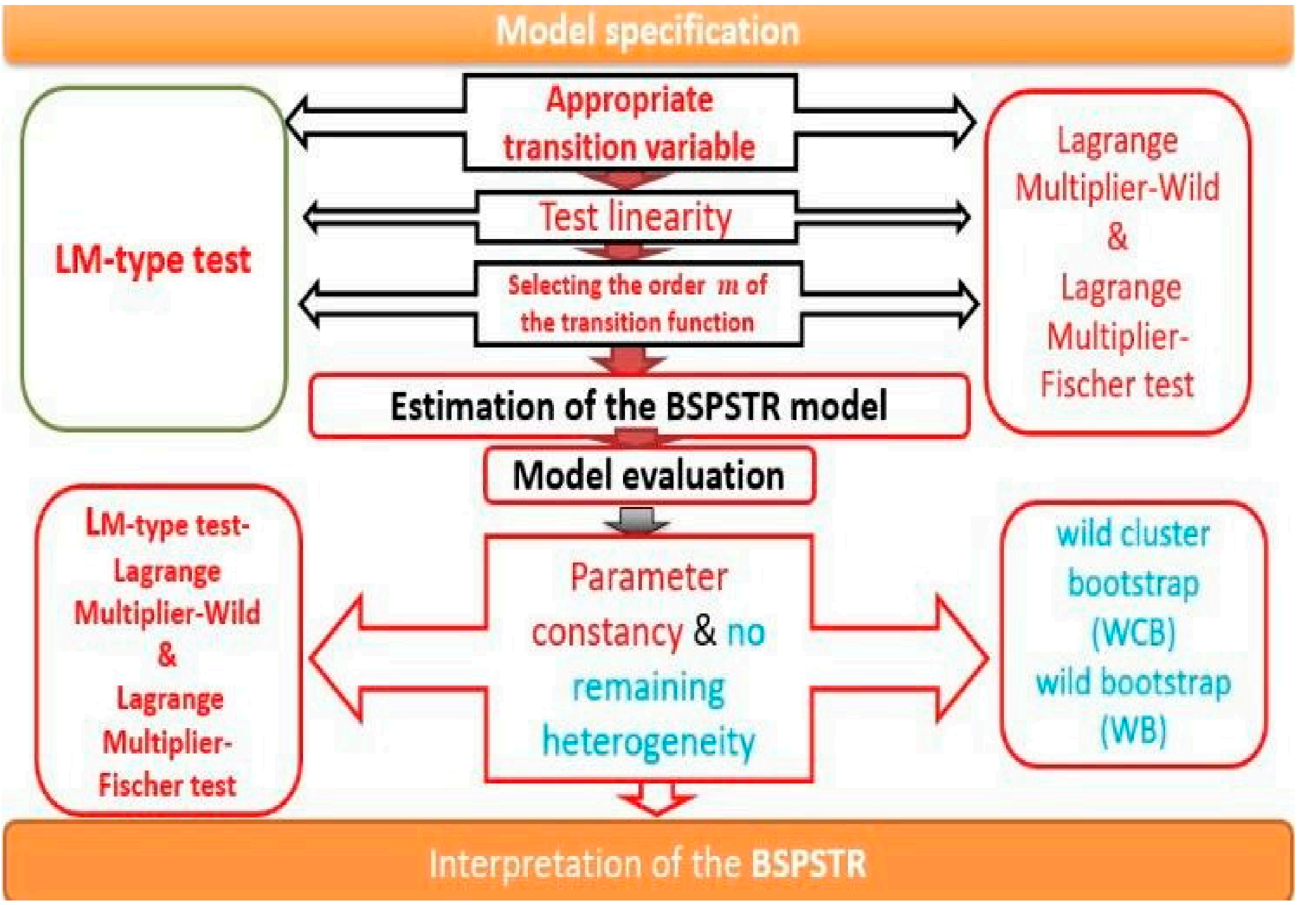

Figure A1. Methodological sequence or structure.

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