Revisiting the Finance-Growth Nexus in Ghana: Evidence from Threshold Modelling

Kwadwo Boateng Prempeh, Joseph Magnus Frimpong, Newman Amaning

Abstract

This article examines the nonlinearities in Ghana's finance-growth nexus from 1960 to 2019. A nonlinear relationship between finance and growth was established using Hansen's sample-splitting technique suggesting that finance contributes to growth only up to a certain level. Beyond that, any further financial development will likely be detrimental to economic growth. Additionally, the study discovered that the threshold value is conditional on the proxy of finance employed. As a result, it is critical for Ghana to establish its own distinct financial development threshold and work within the optimal level for economic growth promotion and sustainability. This study adds to the body of knowledge by establishing a financial development threshold, which provides policymakers in Ghana with a clear direction for pursuing economic growth and financial development.

Keywords: Financial development; threshold; economic growth, Ghana

Jel Classification: E02; G10; 011

1. Introduction

Schumpeter's (1911) seminal work demonstrates that advances in the financial sector are crucial for economic growth. He asserted that a developed and efficient financial sector could provide efficient financial intermediary services, allocating capital to the most innovative entrepreneurs. This was reinforced by Shaw (1973) and McKinnon (1973), who asserted that financial sector improvement benefits growth. Since then, the relationship between financial development and growth has garnered considerable attention in both empirical and theoretical research in developed and developing countries (Asteriou & Spanos, 2019). Nonetheless, the debate over the connection between financial development (i.e., market-based and bank-based) and growth continues without resolution (Nyasha & Odhiambo, 2018; Uddin et al., 2013). Ugwuanyi *et al.* (2015) define financial development as advances in quantity, quality, and efficiency of financial intermediations. This process encompasses the interplay of various activities and institutions and has been linked with economic growth. Also, Uddin *et al.* (2013) describe financial development as institutions, strategies, factors and policies that contribute to the efficient intermediation of capital and

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the functioning of financial markets. Feldman *et al*. (2016) stated that economic growth is well-grounded in theory and easily quantifiable as an increase in aggregate output. Solow (Solow, 1956) conceptualised an economy as a machine that generates economic output in response to labour, land, and equipment inputs. Increased output can occur through additional inputs or by using technology and innovation to improve the efficiency with which inputs are transformed into outputs. Growth occurs as a result of increased output.

Previous empirical research has demonstrated that the relationship between financial development and economic growth is extremely complex (Rousseau & Wachtel, 2011). Thus, empirical research indicates that whether finance stimulates or retards growth is conditional on attaining a certain level of financial development. (Arcand et al., 2012; Ibrahim & Alagidede, 2018). According to some studies, the finance-growth nexus is intrinsically inverted U-shaped. (Cecchetti & Kharroubi, 2012; Samargandi et al., 2013). This implies that finance boosts growth to a point beyond which it slows. For example, in Ghana, Anokye and Frimpong (2010) uncovered a significant positive link between growth and finance, with causality flowing in both directions using Granger causality estimations.

Beyond the linear relationships, Ibrahim and Alagidede (2018) argue that finance facilitates growth. However, finance was insensitive to growth below the estimated thresholds while significantly impacting economic activities in countries above the estimated thresholds. Cecchetti and Kharroubi (2012) found a nonlinear association between productivity growth and trade indicators, robust to model specification errors and model specification. The findings appear to explain empirical literature on threshold effects. However, the literature is deficient in addressing the mediating role of critical variables affecting the finance-growth link. Ibrahim and Alagidede (2018) observe that the real impact of finance on growth is conditional on per capita income and human capital levels. Samargandi *et al.* (2015) argue that excess finance negatively impacts total output in middle-income nations.

Interestingly, the existing literature is devoid of discussion of the mediating role of key variables in evaluating the finance-growth link in Africa, specifically Ghana. Undoubtedly, the inconsistencies in this relationship can be attributed to the underdeveloped financial sector in the country. Despite the favourable evidence indicating the importance of financial development, empirical studies have been insufficient in examining these effects. Even those studies that attempted to investigate the threshold impacts suffer from critical flaws. To begin, prior research has heavily relied on basic estimation techniques to establish the presence of nonlinearity in the finance-growth link via the imposition of exogenous limits. This was accomplished by including quadratic terms in the equation. However, this approach does not show the confidence intervals within which the threshold variables lie. Second, most of these previous empirical studies cannot meticulously assess whether the level of financial development mediates these nonlinearities in the finance-growth link. Against this backdrop, the current study aims to explore the existence of threshold effects in the finance-growth nexus in Ghana using various measures of financial development as the threshold variables. In addition, we investigate how financial development influences economic growth below and above the threshold.

The remainder of the study is structured as follows: The second section summarises the literature on the finance-growth nexus, while the third section describes the empirical model specification, estimation technique, and data sources. Finally, in section four, we discuss the main results, and section five concludes.

2. Literature Review

The notion that an efficient financial sector enhances economic growth is traced back to Bagehot (1873). However, recent studies prove a positive association between growth and finance (Goldsmith, 1969). He was the first scholar to establish a positive association between

finance and growth. However, he contended that the positive association is not about the volume of investment but rather a result of financial intermediation improving the efficiency in allotting savings to productive assets. Goldsmith (1969), however, failed to establish the direction of causality. Initiated by Robinson (1952), Musamali et al. (2014), Cheng (2019) and Nwakobi et al. (2019) argue that improvements in financial intermediary services are a consequence of the general economic growth process. Guru and Yadav (2019) however, maintained that there is a causal link between finance and economic growth. Patrick (1966) elaborates on financial development's demand-following and supply-leading aspects. In addition, some authors highlighted the relationship between a nation's financial structure and development (Goldsmith, 1969; McKinnon, 1973; Shaw, 1973). While the focus of Goldsmith (1969) was on how a nation's financial structure promotes growth and the extent to which economic performance can be linked to allocating funds to viable investments. Shaw (1973) and McKinnon (1973) argue that governments impede financial development by imposing financial limitations such as targeted credit programmes, reserve requirements that are excessive and interest rate capping. The endogenous growth models support this argument, and the definition of economic growth and financial development was explicit in these models (Durlauf et al., 2005; Khan et al., 2006; Levine, 2005).

Consistent with the works of Levine and Renelt (1992) and Barro (1991), recent studies focusing on growth include generally accepted and robust determinants of growth as regressors in the growth equation. King and Levine (1993) extended this approach by incorporating proxies of financial development. Current studies on the finance-growth nexus are shifting toward threshold analysis to account for potential nonlinearities in these growth equations. The authors classified countries based on their financial development status, which they ranked as high, intermediate, or low financial development (Rioja & Valev, 2004; Rousseau & Yilmazkuday, 2009) or divergence from optimum financial development (Graff & Karmann, 2006), as well as their inflation rates, which they classified as below and above the optimal threshold inflation (Bruno & Easterly, 1998; Fischer, 1993; Khan et al., 2006; Khan & Senhadji, 2001; Rousseau & Wachtel, 2002, 2011; Rousseau & Yilmazkuday, 2009; Yang, 2019).

Rousseau and Wachtel (2002) discovered that the threshold for inflation for the finance-growth nexus falls between 13 and 25%, and finance no longer promotes economic growth once inflation exceeds the maximum point. Additionally, they discovered a deleterious link between financial depth and inflation in low-inflation economies, and disinflation is associated with the growth-enhancing effect of finance. Using a threshold autoregressive (TAR) model, Chien-Chiang and Wong (2005) examine the inflation threshold effect in the finance-growth link for Japan and Taiwan from 1965 to 2002. They concluded that finance stimulates economic growth when inflation is low to moderate. Iyke and Odhiambo (2017) discovered comparable evidence using a similar technique and data from Ghana and Nigeria spanning 1961–2011. They found that financial development fosters economic growth in moderate and low inflationary environments and negatively affects economic growth in high inflationary environments. Graff and Karmann (2006) found that gains from financial development diminish when a country falls short of or exceeds what would be considered balanced growth, supporting the "balanced" financial development hypothesis. Eggoh (2012) used panel smooth threshold regression to analyse the effect of inflation on a finance-growth link. The findings indicate that when inflation exceeds 20%, finance is not or is inversely linked to economic growth, but the relationship is significantly positive when inflation is less than 10%.

Deidda and Fattouh (2002) assessed the association between finance and growth between 1960 and 1989, using the threshold regression technique and a sample of 119 countries. Their analysis revealed that while the relationship between finance and growth is positive in high-income economies, it is non-existent in low-income economies. Law *et al*. (2013) examined the

finance-growth relationship in 212 countries between 1996 and 2008, using institutional quality as a threshold variable. As the panel threshold analysis reveals, finance contributes to growth only after a certain threshold is crossed. Finance does not affect economic growth until that time. Deltuvaitė and Sinevičienė (2014) established a statistically significant positive monotonic connection between growth and finance. Also, a host Nation's high level of financial development discourages FDI, as foreign investors may prefer portfolio investments (Tsaurai & Makina, 2018).

Using panel threshold techniques, Masten (2008) examined 628 country-industry units from 1995 to 2005. The findings indicate that nonlinear effects are significant and that under-developed European nations benefit most from a developed financial sector. In comparison, the benefits of financial development become apparent at advanced stages. To bolster these findings, Cecchetti and Kharroubi (2012)concluded that financial sector advancements are promising up to a point where they obstruct economic growth and that a rapidly expanding financial sector is detrimental to total productivity growth in developed economies. According to Arcand *et al.* (2012), finance harms growth when credit exceeds 100% of GDP. These findings corroborate the financial development's diminishing impact. Law *et al.* (2014) use a panel of 87 countries and an innovative, dynamic panel threshold technique to examine whether excess finance is detrimental to growth. They succeeded in establishing an optimal level of finance conducive to growth. The implication is that finance promotes growth up to a point; past that point, additional finance tends to impede growth.

Adeniyi *et al.* (2015) used the ARDL and Johansen cointegration tests to revisit the finance-growth link in Nigeria from 1960 to 2010. They discovered that excess finance has a detrimental effect on growth, but a sign reversal enabled them to account for threshold effects. This demonstrates that the finance–growth relationship has some inflexion points. Estimating a threshold model, Samargandi *et al.* (2015) established that finance has a non-monotonic effect on growth. The study found that an excess of finance had a long-run detrimental effect on economic growth in middle-income nations. The relationship, however, is insignificant in the short run. Alaabed and Masih (2016) discovered that further developments in the financial sector harm economic growth beyond the threshold (i.e., when domestic credit exceeds 24.5% of GDP). However, at the lower level, finance spurs economic growth. Hou and Cheng (2017) concluded that while capital market development promotes growth in low-GNI economies, private credit harms growth in low and high GNI and high-FD economies, based on data from 31 countries from 1981 to 2008.

Shahbaz *et al.* (2017) used quarterly data from 1960 to 2015 to study the asymmetric cointegration between India's finance and growth. The study concluded that only adverse shocks to financial development affect the economy's growth. Ruiz-Vergara (2017) examined more countries (116 from 1991 to 2014) and used the dynamic panel threshold regression technique to analyse the data. He suggested that countries with a low finance threshold grow slowly while those with a high finance threshold grow rapidly. Chow *et al.* (2018) discovered that the threshold approach is superior to traditional linear methods for assessing the finance-growth association. According to Smolo's (2018) panel data analysis, bank concentration inhibits economic growth, and the relationship is nonlinear. While he discovered an inverse relationship between finance and growth, the coefficients were insufficiently large to be economically significant.

Ibrahim and Alagidede (2018) used threshold estimation to scrutinise the nonlinearities in the finance-growth link for 29 countries in Sub-Saharan Africa from 1980 to 2014. They concluded that a higher level of financial development is a prerequisite for long-run economic growth. Botev *et al.* (2019) could not confirm the "too much finance" hypothesis. Their study

could not pinpoint a tipping point at which financial development becomes detrimental to economic growth.

Asimakopoulos *et al.* (2019) recently used dynamic panel threshold methods to empirically evaluate the influence of nonlinearities in the finance-growth nexus using data for 50 countries spanning the period 1990–2016. They discovered that when private sector credit exceeds 60% of GDP, innovation has little impact on output growth. According to Benczúr *et al*. (Benczúr et al., 2019), total bank credit has a more pronounced nonlinear effect on growth than the sum of stock market financing, bank credit, debt securities or household credit. In the Ghanaian context, Peprah *et al.* (2019) found that economic growth becomes negative when financial development exceeds 70% of GDP.

Indeed, prior research on the finance-growth connection has been inconsistent in examining the nonlinear relationship. The majority of studies ignored finance's mediating role as a threshold variable in determining how finance affects growth. For instance, the impact of finance on growth may be determined by a country's financial sector's level of development. Despite favourable evidence indicating the critical role of domestic financial development in Ghana and the African continent over the last years, empirical efforts (Adu et al., 2013; Adusei, 2018; Demirguc-Kunt & Levine, 1999; King & Levine, 1993; Levine, 1997) have not conducted an in-depth examination of these effects. While financial development theoretically boosts growth, empirical evidence is mixed, with most studies overlooking possible nonlinearities in the nexus. Even the scanty empirical studies that have been conducted have a critical flaw. Most of these study uses conventional threshold estimation techniques, such as including an exogenous quadratic term in the growth equation, to ascertain the presence of nonlinearity in the nexus. However, these methods are not instructive because they conceal several distinctions in the threshold effect of finance. This paper aims to close this critical gap in the empirical literature by thoroughly avoiding these issues by examining the nonlinearities in the nexus between financial development and economic growth using Hansen's (Hansen, 1999, 2000) threshold estimation and sample splitting approach. This technique incorporates asymptotic theory, allowing statistical significance, thresholds, and confidence intervals to be evaluated. Additionally, this technique elucidates the effect on the finance-growth nexus both above and below the estimated threshold, which is impossible with conventional approaches.

3. Data and Model Specification

3.1 Data sources

Yearly data from 1960 to 2019 are used in this study. The data were gleaned from World Bank databases (namely, GFDD and WDI) and the PWT9.0. We proxy Economic growth by GDP (constant 2010 US$), and financial development was measured by domestic credit, private credit, broad money and liquid liabilities, all as a percentage of GDP. The control variables are Trade (% of GDP) and the Human Capital index. Table 1 summarises the data employed used and their source.

Table 1: Summary of Data Sources and Measurement of Variables

Variable	Description	Source
GDP	GDP (constant 2010 US$)	WDI
DCPBS	Domestic credit provided by financial intermediaries	WDI
DCPS	Domestic credit to private sector	WDI
LL	Liquid Liabilities	GFDD
BM	Broad Money	WDI
TOP	Trade	WDI
HC	Human capital index	PWT9.0

Note: The World Bank publishes Global Financial Development Database (GFDD) and World Development Indicators (WDI); Penn World Tables 9[i] (PWT9.0).

3.2 Empirical Model Specification

This paper examines the possibility of nonlinearities in the finance-growth nexus. The origins of threshold regression analysis can be traced back to the seminal work of Tong (1978). The conventional technique to examine finance's threshold effect on growth incorporates a quadratic term for financial development and some controls in the equation (Adeniyi et al., 2015; Benczúr et al., 2019; Smolo, 2018). More precisely, such techniques estimate the following regression model:

$$EG_t = \beta_0 + \beta_1 FD_t + \beta_2 FD_t^2 + \beta_3 X_t + \varepsilon_t \quad (1)$$

$t = 1, 2, \ldots, T$

Where EG, FD^2, and FD represent economic growth, quadratic term of financial development and financial development. The quadratic term of financial development is used to measure the nonlinearity of the finance growth nexus; X_t denotes the control variables, t is the time index, and ε_t is the error term. This technique imposes exogenous nonlinearities and does not account for the possibility that the impact of financial development on economic growth could be contingent on a critical factor, such as the country's level of financial sector development (Ibrahim & Alagidede, 2018). For example, a country's financial sector may be extremely underdeveloped to significantly influence economic growth even when there is a percentage gain in financial development. Thus, this research departs from previous approaches by adopting Hansen's (Hansen, 2000) sample-splitting approach, which is based on an asymptotic theory for threshold estimation. Numerous authors have used this approach to assess the finance-growth link (Alaabed & Masih, 2016; Botev et al., 2019; Chien-Chiang & Wong, 2005; Law et al., 2013; Meniago & Asongu, 2018). The Hansen (Hansen, 2000) sample splitting approach evaluates the regression parameters using the OLS technique, which uncovers the precise nature of the threshold and unearths the significance level of all the thresholds estimated. Hansen (Hansen, 2000) proposed evaluating the threshold model using a two-stage OLS regression method. The model is as follows:

$$y_i = \begin{cases} \theta_1' x_i + e_i, & q_i \leq \gamma, \\ \theta_2' x_i + e_i, & q_i > \gamma, \end{cases} \quad (2)$$

Where the threshold variable is represented by q is used to divide the sample into two clusters called a class or regime, depending on the context. y is the outcome variable; x is an m-vector of independent variables, and the error term is represented by e. To carry out this procedure, we modify equation (2) so that the level of finance moderates the exact impact of finance on growth. We argue that whether financial development spurs or hinders growth is conditioned on the proxy of finance and how developed or underdeveloped the domestic financial sector is. As a result, equation (2) is estimated by treating the threshold values as a continuous probability distribution. Following that, we will assess a two-regime threshold model using the following equation:

$$EG_t = \begin{cases} (\beta_{11} + \beta_{21}FD_t + \beta_{31}TOP_t + \beta_{41}HC_t + \varepsilon_t) & \text{for } d_t\{q_t \leq \gamma\} \\ (\beta_{12} + \beta_{22}FD_t + \beta_{32}TOP_t + \beta_{42}HC_t + \varepsilon_t) & \text{for } d_t\{q_t > \gamma\} \end{cases} \quad (3)$$

Where *EG* denotes growth, proxied by *GDP*; *FD* denotes financial development as measured by *DCPS, DCPBS, BM, and LL*; *d(.)* is a dummy variable if the condition is satisfied, then *d(.)* = 1 and *d(.)*= 0 if the condition is not satisfied; q denotes the threshold variable, and γ is the threshold value. *t* represents the time index.

This modelling technique enables the influence of finance to vary according to whether the proxy for financial development is greater than or less than an unidentified threshold value of γ. Thus, in equation (3), the level of financial development serves as a sample splitting variable. At this juncture, finance effect on economic growth is estimated by β_{21} and β_{22} for Ghana, both above and below the financial development threshold. At the outset, the sum of square errors (SSE) for a given threshold is calculated. The next stage entails estimating $\hat{\gamma}$ by minimising the sum of the squares. We then use the *F*-test to check for the presence or otherwise a threshold effect and to evaluate H_0 as follows:

$$F_\gamma = \frac{SSE_0 - SSE_1(\hat{\gamma})/1}{SSE_1(\hat{\gamma})/n(T-1)} = \frac{SSE_0 - SSE_1(\hat{\gamma})}{\hat{\varphi}^2}$$

The null hypothesis's rejection establishes the existence of a threshold. However, noises result in a non-standard distribution for the *F*-test statistic. As a result, Hansen (1999) proposed a "bootstrap" technique for determining the asymptotic distribution of the test statistics when performing a likelihood ratio test to determine the threshold effect's significance. As a result, the *p*-values generated are asymptotically valid since the bootstrap method generates a first-order asymptotic distribution. Also, Hansen (1999) stated that the best method for constructing the confidence interval is to use the likelihood ratio statistic to develop a 'no-rejection region' for the test. As a result, the hypothesis is tested in the following these steps:

$$\begin{cases} H_0: \gamma = \gamma_0 \\ H_1: \gamma \neq \gamma_0 \end{cases}$$

We calculate the following test statistic

$$LR_n(\hat{\gamma}) = \frac{SSE_1(\gamma) - SSE_1(\hat{\gamma})}{\hat{\varphi}^2}$$

Again, we reject the null hypothesis (H_0) for large values of $LR_n(\hat{\gamma})$. Implying the presence of a threshold.

4. Results and Discussion

4.1 Descriptive statistics and correlation matrix

Table 2: Descriptive Statistics and Correlation Coefficients

	LGDP	LDCPBS	LDCPS	LBM	LLL	LTOP	HC
Mean	23.380	1.936	1.946	3.079	2.701	0.299	1.773
Max	24.648	2.762	2.765	3.530	3.468	0.974	2.465
Min	22.670	0.433	0.433	2.425	1.847	0.029	1.100
SD	0.576	0.638	0.648	0.262	0.433	0.272	0.429
Obs	58	58	58	58	58	58	58
Correlations							
LGDP	1.000						
LDCPBS	0.674[a]	1.000					
LDCPS	0.689[a]	0.999[a]	1.000				
LBM	0.574[a]	0.769[a]	0.769[a]	1.000			
LLL	0.588[a]	0.788[a]	0.794[a]	0.722[a]	1.000		
LTOP	0.932[a]	0.713[a]	0.723[a]	0.523[a]	0.539[a]	1.000	
HC	0.914[a]	0.468[a]	0.480[a]	0.409[a]	0.268[a]	0.887[a]	1.000

Note: a, b and c represent significance at 1%, 5% and 10%, respectively; L = Natural logarithm; GDP= Gross domestic productDCPBS=Domestic credit(% of GDP; BM=Broad Money (% of GDP); DCPS=Private credit (% of GDP); LL=Liquid Liabilities (% of GDP); Trade (% of GDP); HC = Human capital index; SD = Standard deviation; Obs= Observations; Max= Maximum; Min= Minimum.

Table 2 contains descriptive statistics. Furthermore, it displays the correlation coefficients between the dependent (LGDP) and the regressor (LDCPBS, LDCPS, LBM, LLL, LTOP, and HC) variables. The closer the correlation coefficient (R) is to -1 or 1, the stronger the association (Gujarati, 2004). It is critical to note that while the correlation matrix may indicate the direction and strength of association between the dependent and independent variables, this does not always imply causation (Gujarati, 2004). All the estimated correlation coefficients are significant at a 1% level, as shown in Table 2. The strength of the relationships in most cases is quite strong. The result of the correlation matrix also justifies why only one measure of financial development is included in each model at a time to prevent the problem of multicollinearity. The estimated correlation matrix indicates that all the regressors are significantly associated

with the gross domestic product (LGDP) at a 1% significant level. Apriori, all the coefficients in the relationship have the expected sign.

Figure 1 illustrates plots of economic growth (LGDP) and measures of financial development. We can see from the graphs that most observations are clustered around a low level of finance. Also, lower economic growth was experienced in some years on the back of higher-level financial development.

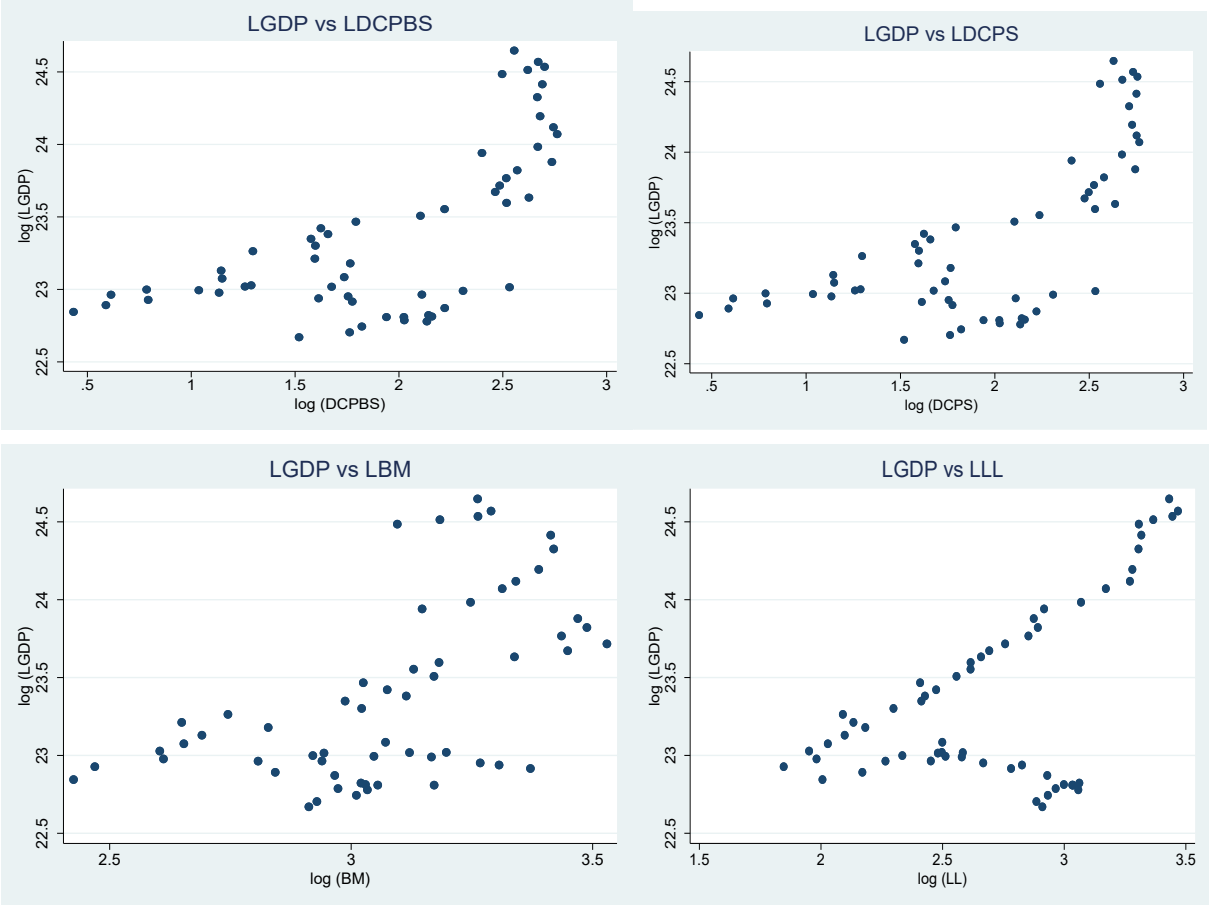

Figure 1: Charts depicting financial development indicators and economic growth

Apart from the scatter plot illustrating the finance-growth relationship, the following section discusses the empirical findings.

4.2 Unit Root Test

The stationarity tests were based on the DF-GLS test proposed by Elliot *et al.* (1996) because it performs better when dealing with small samples than the conventional ADF test and has a substantially improved predictive power when there is an unknown mean or trend. Additionally, the DF-GLS test allows for the inclusion of both constant (intercept) and trend variables at the logarithmic unit root level and differences between variables with no trend. The null hypothesis of non-stationarity was compared to the alternative hypothesis of stationary series. Table 3 summarises the results of the stationarity tests conducted on all the series. The stationarity test results indicate that after first differencing the series, all of them were stationary, meaning they are all integrated at the same order of difference (i.e., $I(1)$). The results of the unit root test have statistical and economic implications. The economic significance of a non-stationary series is

that any shock(s) to the variable would have an infinite effect, indicating the absence of mean reversion. The statistical implication is that even in particular situations, when the variables are cointegrated, and the explanatory variables are purely exogenous, the ordinary least squares (OLS) technique can generate spurious results. It is challenging to meet the strict exogeneity constraint; thus, an estimating approach that permits the model to select the threshold variable(s) and regime(s) endogenously is suitable (Papageorgiou, 2006). This influenced our choice of Hansen's (Hansen, 2000) estimation technique.

Table 3: Stationarity Test

	Variables at levels		Variables at 1st difference	
Variable	Without Trend	With Trend	Without Trend	With Trend
LGDP	2.199[b]	-0.662	-4.912[a]	-5.536[a]
LDCPBS	-0.981	-1.462	-5.924[a]	-6.567[a]
LDCPS	-0.916	-1.442	-5.919[a]	-6.565[a]
LBM	-1.713	-2.110	-8.005[a]	-8.012[a]
LLL	-0.492	-0.751	-6.126[a]	-6.608[a]
LTOP	0.031	-1.677	-6.286[a]	-6.408[a]
HC	-0.498	-3.140	-7.155[a]	-7.173[a]

Note: a, b and c represent significance at 1%, 5% and 10%, respectively

The threshold tests reported in Table 4 indicate that the finance-growth link is nonlinear. For example, given that we failed to accept the null hypothesis, the relationship between DCPBS and GDP demonstrates a threshold effect. At conventional levels, the presence of a threshold is significant for all proxies of financial development (i.e., DCPBS, DCPS, BM and LL). At the 1% significance level, the p-values for the threshold models were statistically significant at the conventional levels. This indicates that the sample could be classified into two distinct regimes based on proxies of finance, with the level of finance moderating the overall effect of finance on growth in Ghana. The test is graphically illustrated in Figure 2. The presence of a threshold effect is reinforced further by the plots in which the threshold variables (i.e., DCPBS, DCPS, BM, and LL) exceed the 95 % critical value line. As a result, DCPBS, DCPS, BM, and LL as measures of financial development in Ghana have a nonlinear effect on gross domestic product.

Table 4: Results of Test for Existence of Threshold

	Dependent variable: LGDP	
Threshold variable	LM–test for no threshold	Bootstrap p-value
LDCPBS	27.539	0.000[a]
LDCPS	28.300	0.000[a]
LBM	22.304	0.000[a]
LLL	29.666	0.000[a]

Note: a, b and c denote significance at 1%, 5% and 10%, respectively

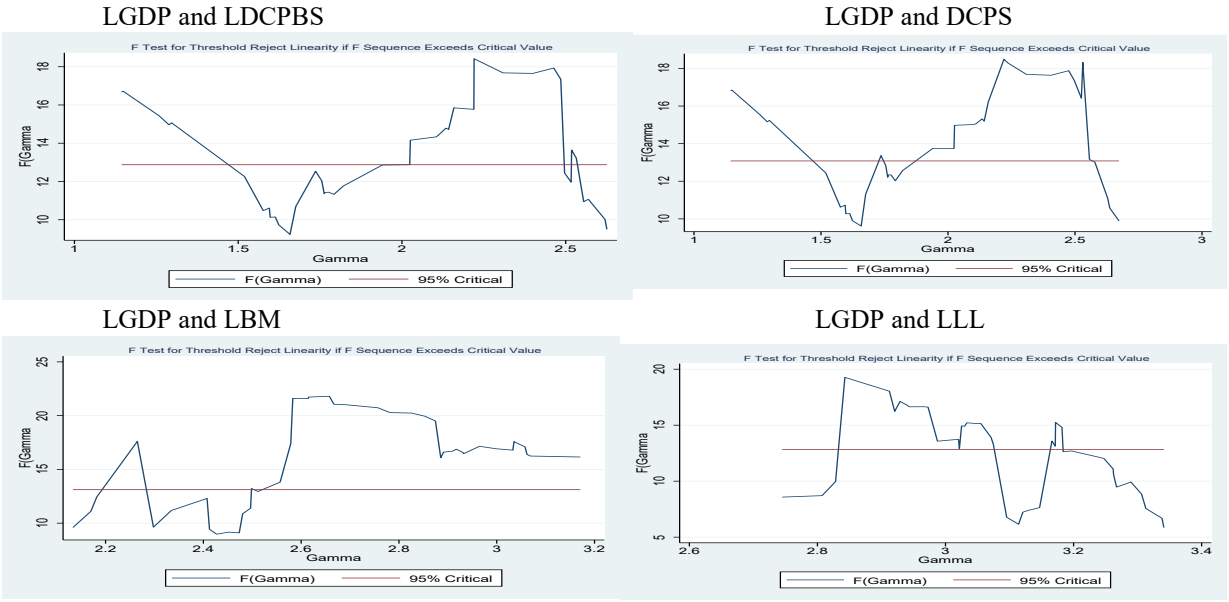

Figure 2: F-Test for Threshold

The results of threshold regression for each finance proxy using GDP as the dependent[ii] variable are summarised in Table 5. We discover a significant positive effect of finance on economic growth. Without threshold effects, a 1% increase in DCPBS, DCPS, BM, and LL increases GDP by 0.196 %, 0.207 %, 0.338 %, and 0.460 %, respectively. Because the data support a threshold model, it generates a point estimate of 10.0 % for DCPBS, 12.58 % for DCPS, 24.09 % for BM, and 13.67 % for LL, with corresponding confidence intervals of [8.52 %,12.00 %], [12.58 %,12.58 %], [20.50 %,24.09 %], and [13.24 %,15.75 %]. It is worth noting that the DCPS confidence interval is identical to the threshold value, indicating that the threshold value is exact. Confidence intervals for threshold effects are shown in Figure 3.

Focusing on regime 1, where DCPBS is lower than the threshold, a change in DCPBS promotes GDP. A percentage increase in DCPBS increases GDP by 0.159%, which is statistically significant at 1%. However, in regime 2, where DCPBS is above the threshold, a change in DCPBS has no effect on GDP, albeit the negative coefficients. Concerning DCPS–GDP nexus, the impact is significantly positive in Regime 1. When DCPS is below its threshold, a 1% rise in DCPS increases GDP by 0.199%, but above the threshold drags growth by 0.145%. Turning to BM-GDP nexus, the study reveals that financial development promotes economic growth in regime 1 whilst adversely affecting growth above the threshold (regime 2). In regime 1, a 1% increase in BM is linked to a 0.453% rise in GDP, which is significant at 1%. However, in regime 2, financial development measured by BM, a 1% rise in BM dampens GDP by 0.919%, which is significant at 1%. Concerning LL, the estimation gives evidence that LL, regardless of the regime, positively and significantly affects GDP. However, when LL is lower than the threshold value, a 1% gain in finance significantly increases GDP by 0.411% but increases GDP by 0.634% when finance is above the threshold value.

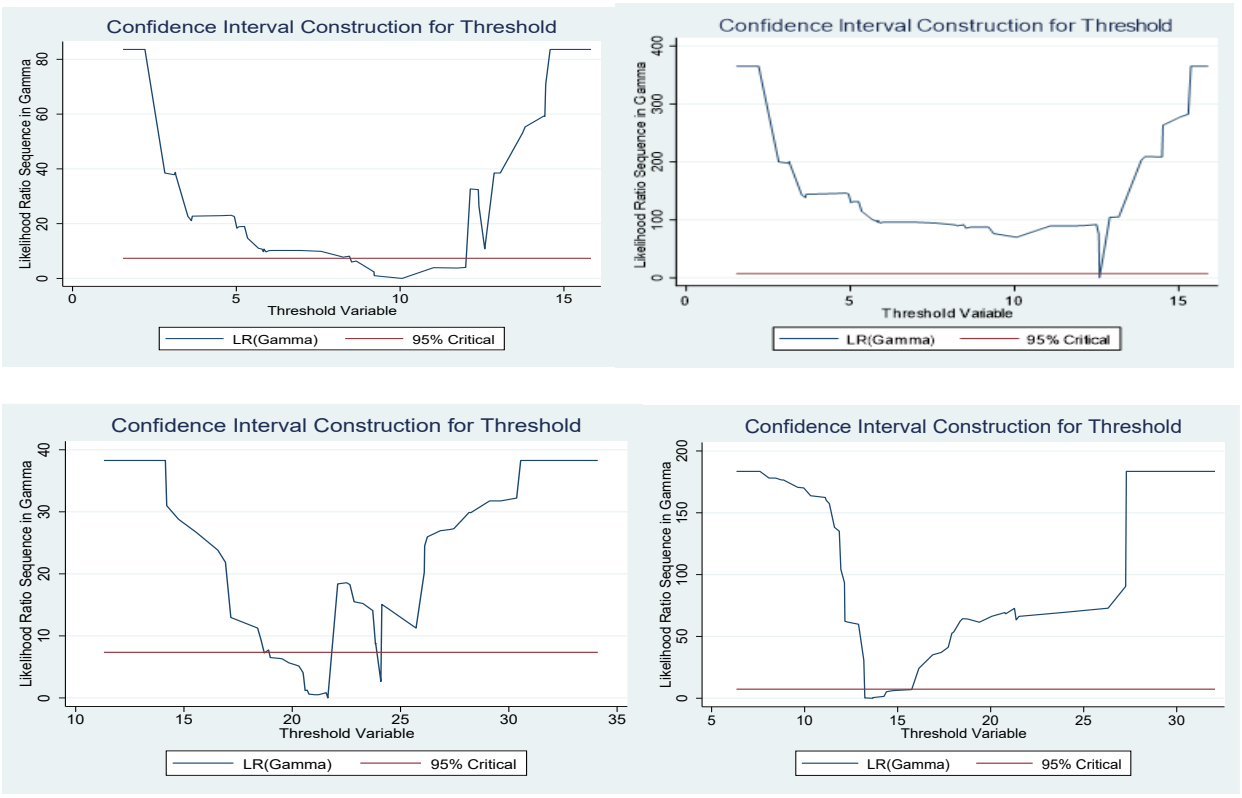

Figure 3: Plots of confidence intervals for threshold effects

Table 5: Threshold estimation effects in Ghana

	Dependent Variable: LPGDP											
	Linear model	Threshold Model: Threshold Variable: DCPBS		Linear model	Threshold Model: Threshold Variable: DCPS		Linear model	Threshold Model: Threshold Variable: BM		Linear model	Threshold Model: Threshold Variable: LL	
	Global OLS without threshold	Regime 1 [q≤ μ]	Regime 2 [q>μ]	Global OLS without threshold	Regime 1 [q≤ μ]	Regime 2 [q>μ]	Global OLS without threshold	Regime 1 [q≤ μ]	Regime 2 [q>μ]	Global OLS without threshold	Regime 1 [q≤ μ]	Regime 2 [q>μ]
LDCPBS	0.153[a]	0.152[a]	-0.127									
	(0.039)	(0.025)	(0.096)									
LDCPS				0.163[a]	0.157[a]	-0.201[b]						
				(0.038)	(0.020)	(0.084)						
LBM							0.251[a]	0.377[a]	-0.854[a]			
							(0.072)	(0.059)	(0.198)			
LLL										0.377[a]	0.375[a]	0.560[a]
										(0.034)	(0.027)	(0.072)
LTOP	0.189[a]	0.092	0.200[b]	0.169[b]	-0.035	0.218[a]	0.277[a]	0.166[a]	0.242[a]	0.077[b]	0.108[a]	0.135[a]
	(0.068)	(0.060)	(0.096)	(0.067)	(0.028)	(0.033)	(0.055)	(0.054)	(0.078)	(0.030)	(0.015)	(0.047)
HC	-0.236[b]	-0.235[a]	1.276[a]	-0.225[b]	-0.214[a]	1.273[a]	-0.373[a]	-0.347[a]	-0.024	-0.037	-0.385[a]	-0.106
	(0.106)	(0.060)	(0.117)	(0.105)	(0.041)	(0.121)	(0.089)	(0.050)	(0.181)	(0.062)	(0.039)	(0.074)
Threshold Value (μ)		12.58%			12.58%			24.09%			14.26%	
95% confidence interval		[12.58%,12.58%]			[12.58%,12.58%]			[20.60%,24.09%]			[13.24%,15.75%]	
Mean of finance		8.250			8.387			16.293			22.440	
Observations	58	45	13	58	44	14	58	38	20	58	28	30
Joint *R*-squared	0.853			0.936			0.812			0.950		
R-squared		0.611	0.982		0.764	0.981		0.658	0.830		0.933	0.910
Heteroskedasticity test (p-value)		0.810			0.285			0.224			0.517	

Note: a, b and c represent significance at 1%, 5% and 10%, respectively; values in (#) represent standard errors

Concerning the control variables, the findings indicate that when the level of DCPBS acts as a mediator between finance and growth, TOP positively influences GDP when no threshold exists. Although TOP hurts GDP below the threshold value, the relationship is insignificant. When DCPBS exceeds the threshold, this effect reverses and is significant. When DCPS is used as the threshold variable in the TOP-GDP relationship, our findings indicate that TOP does not affect GDP below the threshold. Above the threshold, however, TOP promotes economic growth. The results suggest that TOP stimulates GDP in both regimes when BM and LL are used as threshold variables. Finally, the findings indicate that trade openness has a beneficial effect on economic growth. While the theory is conclusive on the impact of trade on economic growth, the contribution of trade openness to economic growth remains ambiguous.

Regarding human capital (labour)-economic growth nexus, the results indicate that human capital (HC) significantly promotes economic growth, regardless of the threshold and indicator of financial development used. However, except for DCPBS, the growth-enhancing impact of HC is consistently large when the thresholds are exceeded. The estimated R-squares are slightly larger in regime 2, implying that our regressors account for at least 89.1% of the variation in economic growth.

Thus, we discover that in Ghana, the finance-growth link exhibits threshold effects and asymmetries that call into question widely held beliefs about finance and growth. Specifically, when the DCPCS, DCPS, and BM levels correspond to 10.06%, 12.58%, and 24.09% of GDP or greater seem to divert economic resources away from productive investments (Tobin, 1984). Moreover, the findings lend credence to developing empirical evidence of finance's nonlinear association with economic growth (Adeniyi et al., 2015; Alaabed & Masih, 2016; Arcand et al., 2012; Asimakopoulos et al., 2019; Beck et al., 2014; Deidda & Fattouh, 2002; Nyasha & Odhiambo, 2018; Peprah et al., 2019). Most estimated threshold values in the finance-growth link range between 24.45% and 100%. For instance, Masten *et al.* (2008) between 53% and 70%, Arcand *et al.* (2012) estimate a threshold of around 100%, Cecchetti and Kharroubi (2012) and Law *et al.* (2014) at 88%, Alaabed and Masih (2016) at 24%, Peprah *et al.* (2019) and Samargandi *et al*. (2015) at 91%.

This study, however, does not investigate the reasons for the nonlinear connection between finance and growth, but we discuss various potential hypotheses advanced in the current literature. First, one possible explanation is the relative size of the various kinds of credit/loans supplied by the financial system. According to Hung (2009), financial development enables growth-promoting investment, while non-productive consumer loans hinder growth. He replicates the nonlinear connection between finance and growth by combining consumption and investment loans in a typical asymmetric information model. Additionally, Beck *et al.* (2014) suggest that business and household credit are critical in defining the finance-growth nexus. They showed that industry rather than consumer lending drives financial development's growth effect. Their results give credibility to the notion that financial development fosters economic growth by easing businesses' funding restrictions and help explain why high-income countries lack a robust finance-growth nexus

The inflexion points in our study are estimated to be between 10% and 24%. While these values are lower than the lower end of the range reported in the previous studies, we argue that this is due to the econometric technique used and the possible influence of financial integration in Africa and the rest of the world rather than sample selection. Asimakopoulos *et al.* (2019) obtained comparable results and used the quadratic regression technique to incorporate the square term of the financial development measures for comparison purposes. As a result, high threshold values were

determined, consistent with previous research. According to the evidence presented, the high threshold values reported in earlier studies could result from selection bias. The disparity may also be partly explained by earlier studies using a cross-country setting (panel techniques). In comparison, our study used a single-country (time series) approach, even though regional characteristics and economic environments for which bank loans are allocated are significantly different. The findings, however, are consistent with that of Ruiz-Vergara (2017), who concluded that threshold values in developed countries are consistently higher than in developing countries.

Additionally, the results indicate that the means for DCPBS, DCPS, and BM are less than their respective threshold values, whereas the mean for LL is greater than the threshold value. This indicates that Ghana is operating at a relatively higher level than the estimated threshold when LL is the finance measure, with the mean of finance exceeding it. The inverted U-shaped association between financial development indicators and economic growth observed in this study supports the argument made by Soedarmono *et al.* (2017) and Arcand *et al.* (2012) that *"too much finance"* dampens economic growth. While the *"too much"* effect occurs with DCPBS, DCPS, and BM, it does not occur with LL. Regarding the control variables' impact on total output, trade openness (TOP) and human capital (HC) have an ambiguous effect.

5. Conclusion and Policy Implication

The finance-growth link has attracted extensive interest in empirical and theoretical literature over the last few decades. Indeed, existing theoretical work establishes a positive connection between total output and financial development at the firm and industry levels. However, empirical findings are inconclusive. Additionally, the nonlinearities in the finance-growth link have not been rigorously investigated, and the conclusions of such studies are not instructive. As a result, this paper reassessed the threshold effect of finance on economic growth, hypothesising that whether finance spurs or retards growth is contingent on the level of domestic financial development. Accordingly, we re-examined finance's threshold effect on growth using annual time series data from 1960 to 2019 and a sample splitting threshold estimation technique.

The study establishes a threshold effect in Ghana, indicating that the precise impact of financial sector development on economic growth in Ghana is threshold-dependent in light of the various finance measures. The major finding is that whether finance stimulates or retards economic growth is contingent upon the optimal level of finance, which varies according to specific measures of financial development (i.e., DCPBS, DCPS and BM). Finance stimulates economic growth in underdeveloped financial sectors where financial development on the domestic front is less than the threshold and stifles economic growth in developed financial sectors with a higher level of domestic financial development above the threshold. As measured by LL, financial development promotes economic growth in both underdeveloped and developed financial sectors. The small confidence interval for the threshold estimation indicates that the threshold is quite exact. When examined more closely, it becomes clear that increasing financial development can help boost economic growth. However, once a certain level of financial development has been achieved, regardless of the proxy for finance, increased finance levels can also drag on economic growth. These findings reaffirm the notion that excessive reliance on finance is harmful to economic growth. Our interpretation of this finding is that because the financial sector competes for scarce resources with other sectors of the economy, financial booms do not generally boost growth.

As a result, nonlinearities in the finance-growth link are critical for Ghana's economic growth. A possible explanation for the country's low economic growth rate is the domestic financial

sector's overall weakness. This study has important policy ramifications for Ghana and other developing economies to optimise the financial deepening necessary to ensure that the banking sector generates the maximum economic gain possible. The highest possible growth rate should be attributed to an optimal level of financial development, to be precise. Thus, promoting financial development for the sake of financial development may be counterproductive. Rather than expanding the financial sector in general, policymakers and stakeholders should focus on strengthening the types and quality of financial intermediation and services appropriate for them. Once the necessary financing is in place, they can focus on other growth-enhancing policies. This finding is consistent with the argument advanced by Cetorelli and Peretto (2012) that the connection between financial deepening and physical capital accumulation is somewhat vague. Whereas increased bank competition leads to increased credit supply for businesses, banks offer fewer additional services to businesses, thereby increasing the chance of the investment failing (Bezemer et al., 2014; Law et al., 2014). Intuitively, the productive sectors of the economy benefit from a well-developed financial sector and increased credit availability due to this development. However, excessive finance does not always result in economic growth. While increased financial development due to increased investment in productive sectors has been linked to economic growth, increased credit due to luxury goods consumption has the potential to dampen economic growth.

To summarise, the study argues that the finance-growth nexus may be more complex and nuanced than the relationships suggest and that whether finance promotes or inhibits growth is highly dependent on attaining a specific indicator-specific threshold. As a result, it is critical for Ghana to establish its own distinct financial development threshold and work within the optimal level to promote economic growth and sustainability.

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Notes

[i] For more information kindly visit https://www.rug.nl/ggdc/productivity/pwt/?lang=en

[ii] To check the robustness of the model, we varied the dependent variable by employing GDP Per Capita as the dependent variable. Similar results were obtained and the results would be made available upon request.