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A Re-Examination of the Effect of Financial Integration on Financial Development in Sub-Saharan Africa

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Abstract: This paper aims to analyse the relationship between financial integration and financial development in Sub-Saharan Africa (SSA). To achieve this objective, we use a methodological approach based on panel data over the period 2000-2021 in 39 SSA countries. By estimating the panel threshold regression dynamic model (PTR Dynamic model) and using the Generalised method of moments (GMM), we show that there is a significant non-linear relationship between financial integration and financial development. This non-linear relationship refines existing evidence between financial integration and financial development. The optimal threshold of financial integration, defined as the level of financial integration that maximises financial development, is 69%. Therefore, the optimal level of financial integration is robust to sensitivity analysis, resulting in thresholds between 67% and 70%. The results show that financial integration has a differentiated effect on financial development depending on its sign. More specifically, below 69%, financial integration has a positive and significant effect on financial development; but above this 69% threshold, financial integration has a negative and significant effect on financial development. The public and monetary authorities must therefore take prudential measures into account in order to maintain the development of the financial system.

Keywords: Financial Integration, Financial Development, PTR Dynamic, GMM

1. Introduction

The process of international financial integration has accelerated in recent decades with the dismantling of exchange rate restrictions and restrictions on international financial transactions, the liberalization of domestic financial markets, and the implementation of a number of structural reforms to promote sustained growth [22].

According to Gourinchas, P. O. and al. [28], integration can be defined as a process of strengthening interactions between national financial systems, occurring at both the global and regional levels, creating larger financial spaces. It is the degree of financial openness of a country.

The concept of financial development is concerned with the access, depth, efficiency and stability of a country's financial institutions and market. It refers to the process of expanding a financial superstructure, that is, a comprehensive system of financial institutions, financial markets, and financial instruments. Financial integration is an aspect of advanced financial systems. In theory, liberalization of financial systems facilitates financial development by ensuring greater transparency and competition in the financial sector [54], allowing for efficient allocation of capital and resources [37], and encouraging the formation of better regulatory practices [37]. Thus, financial market liberalization helps to increase stock market liquidity,

improve the efficiency of the banking system [42], and reduce the cost of capital [70].

However, there is growing concern that too much integration could harm the development of financial systems. Greater financial openness could lead to excessive risk-taking [37], capital flight, vulnerability to self-fulfilling crises [21], and a higher risk of contamination between interconnected economies [37], ultimately imposing negative impacts on financial development in the long run [37]. Thus, it is possible that there is an association between financial systems development and integration, which may vary with levels of integration.

Analyses of the asymmetric relationship between financial integration, financial sector development, and macroeconomic and institutional indicators have been made by several economists [31]. Some studies show that financial integration has a positive and significant effect on financial development [35, 42, 47]. Others find that the effect of financial integration on financial development is negative [21]. Some works find a linear relationship between financial integration and financial development [7, 1]. While others show that this relationship is non-linear [51, 54, 71]. To this end, Asafo-Adjei, E. and al. [6] point out that the flow of information from global financial market stress to African stock markets depends on time scales, economic relationships and the state of global financial markets. In this context, financial integration is associated with a great deal of macroeconomic turbulence due to the volatility of cross-border capital movements and the overly unstable dynamics of institutions. Understanding these characteristics is essential for developing effective policies to preserve the stability of the international financial system [26].

The divergence of results leads us to ask what is the nature of the relationship between financial integration and financial development in Sub-Saharan Africa?

This paper therefore considers financial inclusion in improving financial development in SSA and makes two main contributions. First, it adds to the literature on financial development by showing the importance of financial integration. Indeed, integration allows for an optimal allocation of resources across the financial sector. Second, while most studies use linear modeling, this paper takes a nonlinear approach to the relationship between financial integration and financial development. Finally, the paper uses the Panel Smooth Threshold Regression (PSTR) method, which is a relatively efficient estimation technique compared to the usual panel data methods.

Given the challenges of financial development, the main objective of this paper is to assess the nature of the relationship between financial inclusion and financial development in SSA. To achieve this objective, the architecture of this paper is based on three sections. The first section reviews the theoretical and empirical links between financial integration and financial development. The second section presents the methodological approach and the third section is devoted to the interpretation of the results.

2. Financial Integration and Financial Development in the Economic Literature

The relationship between financial integration and financial development has been the subject of controversial analyses in the theoretical and empirical literature.

Theory shows that financial integration has an important impact on stimulating the growth of financial development. Thus, perhaps the most important channel through which financial integration affects financial development is through increasing the size of markets and the demand for financial services. As a result, international financial integration could increase liquidity and reduce the cost of capital, thereby promoting financial development. Rose, A. K. [64] suggests that financial integration improves the basic function of the financial system through two channels, the availability of funds and the improvement of the financial infrastructure needed to reduce information asymmetry, adverse selection and moral hazard. Levine, R. [41] shows that foreign banks play an important role in the development of domestic financial institutions by directly providing high quality banking services and indirectly by improving quality and reducing costs, and by strengthening legal, regulatory and supervisory systems. For Lucas, B. [45] capital should also flow from capital-rich to capital-poor countries because the marginal product of capital in capital-poor countries is lower than in capital-rich countries.

However, greater integration may lead to increased volatility resulting in a higher probability of financial crises [37]. International integration in the absence of appropriate macroprudential measures and financial stability safeguards, such as financial sector regulation/supervision, could lead to excessive risk taking and unsustainable credit/leverage expansions, with obvious negative consequences for long-term financial development. For Chinn, M. D. and Ito, H. [18], the countries that reap the benefits of greater integration in terms of financial development must have some level of legal and institutional "infrastructure. In the absence of such "institutional infrastructure," distortions in the domestic financial sector may be magnified by greater openness or, at best, the impact of greater integration on financial development would be mitigated by a lack of incentives.

Furthermore, Furstenberg, G. M. V. [25] suggested that financial integration also depends on the level of domestic financial development. A well-developed financial market helps attract foreign investors to diversify their portfolios and increase portfolio investment inflows. For Klein, M. W. and Olivei, G. P. [35], financial integration is an outcome in a world where the development of national financial markets is the only source of heterogeneity across countries.

Empirically, Iheanacho, E . and al. [32] examine the role of institutional structure on asymmetries, the dynamic impact of financial integration, capital market development on

economic performance on a panel of 16 countries in Sub-Saharan Africa from 1996-2019. The result is that a positive shock to the financial integration index leads to higher economic growth, while a negative shock to the financial integration index leads to lower economic growth. Both shocks (positive and negative) to financial market capitalisation reduce economic growth. However, the lack of consistency in the results between the models suggests that the interaction between these variables is still underdeveloped compared with other continents in the world, and that the benefits have yet to be adequately exploited.

García, E. D. [72] studies the impact of financial globalization on financial development in transition countries using a dynamic panel data model. He finds that financial globalization has a positive and significant relationship with the growth process of the financial system, but not with the development process, i. e., without better performance of basic financial functions.

Baltagi, B. H. and al. [9] using a large sample of countries, provide evidence that financial integration is an important catalyst for banking sector development. Similarly, Klein, M. W. and Olivei, G. P. [35] found that financial liberalization is associated with greater financial sector depth in a sample of advanced and developing economies. Levine, R. [42] provided evidence that liberalizing restrictions on international portfolio flows can improve stock market liquidity and that the efficiency of a banking system can be enhanced by a stronger presence of foreign banks in the domestic market.

However, other studies show weak or non-existent links between financial openness and financial development. David, A. C. and al. [21] analyze the links between international financial and trade integration and financial development in sub-Saharan African (SSA) countries based on a panel dataset using methods that deal with slope heterogeneity, cross-sectional dependence, and non-stationarity. They do not find a general direct robust link between financial integration and financial development in SSA due to distortions in domestic financial markets, relatively weak institutions, and/or poor financial sector supervision. Allegret, J. P. and Azzabi, S. [5] study the link between financial openness, financial development, and growth using the dynamic panel generalized method of moments on a sample of 112 emerging and developing countries between 1975 and 2007. Their estimates show significant negative effects of financial openness on financial intermediary activity and stock market development for emerging and developing countries. Thus, they unambiguously argue for no positive relationship between financial openness and financial development for the subgroup of emerging and frontier countries.

aghizadeh-Hesary and al. [67] assess the impact of financial integration on financial development and establish thresholds for the materialization of gains from financial advances from financial globalization by developing using threshold dynamics models for a panel of 34 countries in the East Asia and Pacific region. They find a significant robust inverted-U-shaped relationship between financial integration and financial development. Asongu, S. A. and De Moor, L. [7] study whether the financial development benefits of financial globalization are debatable until certain financial globalization thresholds are reached using the interactive generalized method of moments with forward orthogonal deviations on a sample of 53 African countries for the period 2000-2011. They find evidence of a positive threshold between financial integration and financial development. Indeed, while the initial effect of financial globalization on financial development is negative, there is a positive marginal effect, so that above a certain threshold, the overall effect of financial globalization on the given financial development dynamics becomes positive. It follows that financial globalization is both negative and positive for financial development, with a U-shaped relationship.

Ahmed, A. D. [1] analyzes considers the tripartite relationship between financial openness, financial market development, and economic growth using a dynamic system GMM model and panel data from 30 sub-Saharan African (SSA) countries from 1976 to 2010. It identifies a positive and significant association between international financial integration and financial development, supporting the indirect hypothesis that IFIs can positively influence economic growth by improving the depth of the domestic financial system. Ahmed, A. D. and Mmolainyane, K. K. [2] explore the impact of financial integration on economic growth in Botswana over the period 1974-2009. They show that financial integration is positively and significantly correlated with financial development in the Botswana economy. Sen, A. and Laha, A. [66] examine the state of financial development and financial integration in emerging Asia to determine whether the developed financial system promotes financial integration or whether financial integration induces the authorities to develop the financial system over the period 2001-2016. They support a significant positive association between financial development indicators and financial integration. Their results also indicate an empirical relationship between financial development and financial integration, and vice versa.

Kurantin, N., and Osei-Hwedie, B. Z. [38] investigate the increasing accessibility and the relationship between digital financial integration (e-economy) and poverty reduction since the era of structural adjustment programmes in sub-Saharan Africa. The ordinary least squares method for a macro data set relative to a regression model is found to provide empirical estimates of the increasing accessibility and the relationship between digital financial integration, investment, economic growth, development and poverty reduction.

Gourinchas, P. O. and al. [28] study the dynamic relationship between financial development, international financial integration, and institutional quality using panel cointegration tests for a panel of 18 emerging economies over the period 1985-2014 by controlling for cross-sectional dependence and structural breaks. They find that there is a long-run cointegrating relationship between financial

development, international financial integration, and institutional quality on the one hand, and a bidirectional causal relationship between financial development and international financial integration on the other. While Motelle, S. and Biekpe, N. [51], using feasible generalized least squares (FGLS), reveal a unidirectional causality from financial integration to banking sector development with adverse effects of financial integration on financial system development.

3. Methodology

3.1. Model Specification

In this article, we analyse the non-linear relationship between financial integration and financial development. To do this, we use a dynamic threshold panel model developed by [18] which, starting from a static threshold panel model developed [30], depends strongly on the value of a stationary exogenous variable so that the regression coefficients take a small number of different values. The Panel threshold regression model developed [31] was generalised by [27], who developed the Panel Smooth Threshold Regression (PSTR) model. However, these two models suffer from a problem of variable endogeneity. To remedy this, we will use the dynamic Panel threshold regression model developed [66] implemented in Stata [67]. This model can be applied to endogenous regressors as it is based on the threshold panel model which controls for endogeneity using GMM estimators [14]. Similarly, the dynamic PTR model has the particularity of allowing countries to make changes gradually over time. In this case, the dynamic PTR model takes into account the heterogeneity of the link between financial integration and financial development. It determines the lagged dependent variables and the endogenous covariances and takes into account the endogenous non-linearities that may highlight the minimum thresholds required of the countries concerned.

The study starts with the development of a static model without threshold in equation (1):

$$FD_{it} = \beta_i + \sum_{j=1}^{p} \alpha_i X_{it} + \varepsilon_{it} \quad (1)$$

Where *F*D represents the financial development indicator, the index *i* (*i* = 1… N) denotes the countries in our sample, and the index *t* (*t* = 1… T) denotes the dimension of the time series for each variable. X_{it} is a set of explanatory variables that include lagged values of the dependent variable and other endogenous variables, including the threshold variable, gross domestic product (GDP), $Trade$ is trade openness, Inf is inflation Pop is population growth. $I(.)$ is the indicator function specifying the regime, γ is the threshold parameter that divides the equation into two regimes: slope coefficients α_1 and α_2 , ν_i represents country-specific effects, η_t represents time-specific effects, ε_{it} is the independently and identically distributed error term. The panel threshold model was developed in equation (2).

$$FD_{it} = (\beta_1 FD_{it-1} + \alpha_{11} GDP_{it} + \alpha_{21} Trade_{it} + \alpha_{31} Infl_{it} + \alpha_{41} Pop_{it}) I(FI_{it} \leq \gamma) + (\beta_2 FD_{it-1} + \alpha_{21} GDP_{it} + \alpha_{22} Trade_{it} + \alpha_{32} Infl_{it} + \alpha_{42} Pop_{it}) I(FI_{it} > \gamma) + \nu_i + \eta_t + \varepsilon_{it} \quad (2)$$

3.2. Sources and Description of Data

Financial integration (FI) is measured by total assets and liabilities in portfolio investment and foreign direct investment as a percentage of GDP [37, 49]. Financial development is measured in this research by private credit, which is the value of bank credit to the private sector divided by GDP. The choice of this measure is justified by the fact that it is a catalyst variable for the financial system to predict the credit boom that would be induced by the sudden influx of foreign capital [17]. This research also uses other control variables that can potentially impact financial development. GDP measures economic growth. Trade openness is measured by the sum of imports and exports (as a percent of GDP). Inflation, measured by the annual percentage change in the consumer price index, is used as a proxy for macroeconomic stability.

The data used for 39 sub-Saharan African countries from 2000 to 2021 come from the World Bank's Word Development Indicator, the Financial Structure Development and UNCTAD databases. These are panel data that avoid the problem of unobservable heterogeneity and have the advantage of controlling for country-specific effects.

The summary of the descriptive statistics of the variables is reported in Table 1. In particular, the table shows that the value of financial integration is more dispersed than that of financial development. The financial development index in our model ranges from -0.45 to 10.86 with a mean value of 0.006 and a standard deviation of 0.822. Whereas, that of financial integration varies from 0.010 to 72.08 with a mean value of 1.512 and a standard deviation of 7.033.

Table 1. *Descriptive statistics.*

Variable	Obs	Mean	Standard deviation	Minimum	Maximum
FI	798	1.512	7.033	0.01	72.08
FD	798	0.006	0.822	-.45	10.86
GDP	798	1.456	4.965	-36.56	56.79
Pop	798	2.464	0.953	-2.63	5.6
Infl	798	8.495	26.998	-9.62	513.91
Trade	798	72.754	39.108	9.96	311.35

Examination of the correlation coefficients (Table 2) shows that they are generally low. Thus, the variables do not show a hint of multicollinearity. We note that financial development and financial integration are positively correlated.

Table 2. *Correlation of variables.*

	FD	FI	GDP	Pop	Infl	Trade
FD	1,0000					
FI	0,2275*** (0.0000)	1,0000				
GDP	-0,0541 (0.12560)	-0,0008 (0.9814)	1,0000			
Pop	-0,1249*** (0.0004)	-0,3410*** (0.0000)	0,0318 (0.3700)	1,0000		
Infl	-0,0345 (0.3299)	-0,0268 (0.4503)	-0,0881** (0.0128)	0,0368 (0.2994)	1,0000	
Trade	0,4470*** (0.0000)	0,1747*** (0.0000)	0,0737** (0.0374)	-0,2962*** (0.0000)	-0,0113 (0.7493)	1,0000***

Significance: ***; **; * indicate significance at the 1%, 5%, and 10% level, respectively.

3.3. Estimation Techniques

3.3.1. Results of the Cross-Sectional Dependence and Homogeneity Tests of the Slope Coefficients

When examining relationships in a panel data model, two possible problems must be considered. The first problem is cross-sectional dependence, which means that a shock affecting one country may also affect other countries in the model because of direct and indirect economic relationships between countries. Monte Carlo experiments by [59] show the substantial bias and size distortions if cross-sectional dependence is ignored. The second aspect to consider is the heterogeneity of slopes. The slope coefficients may not be homogeneous as countries differ in their stages of development and technology levels [44]. In general, the homogeneity assumption may mask country-specific characteristics [48]. Testing for cross-sectional dependence and slope homogeneity therefore seems to us an important step in a panel data model.

Regarding the first problem, the LM test (i. e., the Lagrange cross-sectional dependence multiplier) was developed by [14], subsequently [58] developed the LM CD cross-sectional dependence test. However, both of these tests can give biased results when the group mean is zero and the individual mean is non-zero. Pesaran, M. H. and al. [61] corrected for this bias by adding the variance and mean to the cross-sectional test statistics. Pesaran, M. H. and [61] thus developed the cross-sectional dependence test called the adjusted LM test. The null hypothesis indicates that there is cross-sectional independence between the series, while the alternative hypothesis shows cross-sectional dependence. On the second problem mentioned, Pesaran, M. H., and Yamagata, T. [60] proposed a test on the homogeneity or not of the slope coefficients: the Delta and adjusted Delta test statistics under the null hypothesis of homogeneity of the slope coefficients.

The results of the adjusted LM test of [61] and the adjusted Delta tilde test of [60] are shown in Table 3.

Table 2. *Cross-sectional dependence and homogeneity tests.*

Test	Statistics	P- value
Cross-sectional dependency tests		
LM (Breusch and Pagan, 1980)	1167	0.000
LM_{ADJ*} (Pesaran and al. 2008)	16.86	0.000
LM_{CD*} (Pesaran, 2004)	0.860	0.389
Homogeneity tests		
Delta tilde	5.367	0.000
Delta tilde adjusted	6.574	0.000

Sources: Calculations Authors

Table 3 shows that the null hypothesis of independence is rejected at the 1% threshold, as the probability values were found to be less than 1%. The series therefore exhibit cross-sectional dependence. Therefore, a shock occurring in one SSA country can be transmitted to the other countries in the zone. Moreover, the results of the adjusted Delta tilde test of [60] show that the null hypothesis of homogeneity of the slope coefficients is rejected. These results therefore support country-specific heterogeneity.

3.3.2. Cross-Sectional ADF Unit Root Test

Since there is cross-sectional dependence in the series used in the research, the average of the CADF (Cross-Sectional Augmented Dickey Fuller) test developed by [59], which is a second generation unit root test, is estimated in order to obtain more consistent and reliable results. CIPS (Cross-sectional augmented version of IPS) statistics were applied. The results of the unit root tests are reported in Table 4.

Table 4. *CIPS unit root test results.*

Variable	Level	First Difference	Conclusion
	Constant and trend	Constant and trend	
Financial Development Index	-1.338	-3.173***	I(1)
Financial integration	-2.300	-4.551***	I(1)
Gross Domestic Product	-4.221***		I(0)
Population growth	-1.869	-2.781***	I(1)
Inflation	-3.841***		I(0)
Trade	-2.780***		I(0)

Note: (***), (**), and (*) show stationarity at the 1%, 5%, and 10% significance level respectively. The critical values for the model with constant and trend for 10%, 5% and 1% are respectively: -2.54%, -2.61%, -2.73%.
Source: Authors' calculations

The CIPS tests show that the variables Financial Development Index, Financial Integration and Population Growth are stationary in first difference. On the other hand, the variables Gross Domestic Product, inflation and trade openness are stationary in level. Since, in the sample, the series do not have the same order of integration, in what follows the existence of a long-run relationship between the series is tested using cointegration tests.

3.3.3. Panel Cointegration Tests

Westerlund's ECM panel cointegration test is used for a more consistent analysis by accounting for horizontal cross-sectional dependence and heterogeneity between the data. Westerlund, J. [73] developed four panel cointegration tests based on the error correction model. Two of these tests are called group mean statistics and the other two are called panel statistics. The test is performed with a constant and a trend. To account for cross-sectional dependence, bootstrapping is introduced into the test to obtain the robust critical values.

Table 5 presents the results of the panel cointegration test. These results show that, according to the bootstrap method, the group mean statistics (Gt) and the panel statistics (Pt and Pa) are significant. Under the standard asymptotic distribution, the Gt and Ga and Pt and Pa statistics are also significant. Overall, the null hypothesis of no cointegration is rejected in both the standard asymptotic distribution and the bootstrap method. The results suggest that there is a cointegrating relationship between the series and that they should move together in the long run. In other words, tests with the original values will not include false regression.

Table 5. *Results of the cointegration test of Westerlund (2007).*

Statistics	Values	Z-value	P-value[a]	P-value robuste[b]
Gt	-3.957	-12.288	0.000***	0.000***
Ga	-20.788	-8.239	0.000***	0.110
Pt	-26.451	-15.639	0.000***	0.000***
Pa	-22.144	-13.612	0.000***	0.020**

Note: All tests are performed with a constant and a trend. a indicates tests where p-values are an asymptotic normal distribution. b indicates tests that have a p-value based on the bootstrap method. (***), (**), (*) indicate significance at the 1%, 5% and 10% level respectively. Null hypothesis: no cointegration.
Source: Author's calculations.

4. Estimation of the Dynamic Ptr Model

The analysis of asymmetric nonlinear dynamic modeling has recently come to the forefront. To achieve the objective of this study, we used the Generalized Moment Method in first difference based on the first difference transformation to eliminate unobserved individual effects.

Table 6. *Dynamic threshold panel regression estimation.*

Variables	Financial development index	Financial development index	Financial developement index
Estimated threshold 95% Confidence Interval	0.69 [0.40 0.94]	0.7 [0.41 0.94]	0.67 [0.41 0.94]
Impact of financial integration			
β_1	0.16***	0.133***	0.16***
	(0.00)	(0.00)	(0.00)
β_2	-0.16***	-0.13***	-0.29***
	(0.00)	(0.00	(0.00)
Effect of covariates			
Financial developement (-1)	.66***	0.73***	0.74***
	(0.00)	(0.00)	(0.00)
Gross Domestic Product	.00***	0.00***	0.00***
	(0.00)	(0.00)	(0.00)
Trade opening	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)
Population growth	-0.04***	-0.022***	-0.02***

Variables	Financial development index	Financial development index	Financial developement index
	(0.00)		0.16
Inflation	0.00****		-0.00***
	(0.00)		(0.39)
Financial development (-1)	0.20***	0.070***	0.039***
	(0.00)	(0.00)	(0.00)
Gross Domestic Product	-0. 00***	-5.59e-07	-2.72e-06***
	(0.00)	0.52	(0.02)
Trade opening	-0.00***	-0.00***	-0.00***
	(0.00)	(0.00)	(0.00)
Population growth	.12***	.086***	0.063***
	(0.00)	(0.00)	(0.00)
Inflation	-0.00***		-0.00***
	(0.00)		(0.027)
Constant	-.069***	-0.047***	0.157***
	(0.00)	(0.00)	(0.00)
Number of countries	39	39	37
Bootstrap p-value for linearity test	0.000	0.000	0.000

Notes: Values in parentheses are standard errors. (***), (**), (*) indicate significance of coefficients at the 1%, 5% and 10% thresholds, respectively.
Source: Authors' calculations.

The table summarizes the results of the dynamic threshold model estimation of financial development, economic growth, trade openness, population growth, inflation rate and financial integration. The results show that the threshold estimate of financial integration is 69.24% so that about 80% of the observations fall into the lower regime of financial integration. The coefficient on lagged financial development is significantly higher for countries with low levels of financial integration, suggesting that the financial development gas pedal effect is stronger for countries with financial development constraints.

Furthermore, the optimal level of financial integration is 69% below or below which financial development is affected. These results are in line with [7, 71] who found the existence of an inverted U-shaped relationship between financial integration and financial development with two phases that are the ascending and descending part. The first ascending phase shows that financial integration can ensure an optimal allocation of capital through financial sector development. Indeed, the easing of barriers to the entry of external capital in the form of Foreign Direct Investment and Portfolio Investment in Sub-Saharan Africa allows for an increase in bank lending.

Capital flows are necessary to promote or reduce financial development. This is what makes the analysis exclusively a bipolar debate. Indeed, financial integration can increase liquidity and improve the efficiency of the financial system. The financial system reduces savings and accumulates a large stock of net external liabilities in a long and gradual process.

The second part of the paper reveals the adverse effects of financial integration on financial sector development. Financial integration above or close to 80 percent stifles financial development. It shows that beyond the levels indicated, unregulated inflows of external capital can harm the local financial system. At this stage, financial integration encourages risk-taking, which can contribute to capital flight and increase financial vulnerabilities. Crises, because of the interconnectedness of economies, can arguably reduce the performance of economies and, in turn, have adverse effects on financial development. Indeed, the financial system may become more vulnerable to increased lending induced by unregulated inflows of external capital that accentuate maturity mismatches between bank assets and liabilities. This creates distortions and reduces the quality of bank lending. Thus, these credit distortions can exacerbate the negative impacts of capital flows on financial sectors, especially for developing economies with weak fundamentals.

Instability in financial development endogenously increases banks' exposure to sector-specific shocks. In this regard, if the sector in which a bank specializes suffers an adverse liquidity shock, that bank may not be able to raise the necessary liquidity in the integrated interbank market. The failure of a bank following a severe domestic shock is transmitted to other banks through an integrated interbank market and may ultimately destabilize financial development.

Uneven financial development can, in turn, increase the cost of financing business and household spending, thereby reducing economic performance. Such an increase in the cost of financing can cause firms and households to reduce spending and economic growth. Better monitoring and tracking of financial integration could help contain its negative effects on financial development.

We used other control variables such as investment, trade openness, inflation rate and population growth. These variables have an important role on the relationship between financial integration and financial development. Our results show that investment has a positive effect on financial development below a critical level of financial integration. This result is consistent with [67] view that wherever business leads, finance follows. To this end, investment benefits production by increasing employment, lifting people out of poverty, and improving economic performance and by extension financial development performance [33]

The results show that trade openness has a positive and significant effect on financial development. Indeed, Sub-Saharan African economies produce huge benefits in production and trade. This is what improves financial development [3]. However, once financial integration reaches a critical level, trade openness becomes zero and exports fail

to offset imports.

Inflation is used because of its significant effects in the economy. These effects are mixed and can be both positive and negative. Previous work has shown that there is a threshold below which inflation has a positive effect on financial development, but above which the effect becomes negative. Certainly, when inflation reaches a critical level, it contributes negatively to the performance of the financial sector through credit market frictions, leading to higher lending rates. In fact, the inflation rate influences stock market volatility and risk, which creates uncertainty and friction in the financial markets, and makes the financial system inefficient in allocating resources. It should also be noted that for developing countries with high levels of reserve requirements, high inflation rates can be a significant tax on banks. Thus, inflation negatively affects financial development in economies with high inflation rates. This result corroborates with those of [46].

Consistent with this reasoning, after controlling empirically for GDP per capita and inflation, population growth is significant and negative only at a low level. The reasoning is also consistent with observations about how developing countries lack skilled labor. In this case, population growth can have a negative impact on resource utilization [56], generating negative effects in the financial sector and reducing the performance of the financial system.

Robustness Test

For the robustness check, the static model in equation (2) is explicitly respecified according to a typical quadratic model specification to allow for testing the non-linear relationship between financial development and financial integration. This is shown in equation (3):

$$FD_{it} = \beta_1 FD_{it-1} + \alpha_1 Infl_{it} + \alpha_2 (Infl_{it})^2 + \alpha_3 GDP_{it} + \alpha_4 Trade_{it} + \alpha_5 Pop_{it} + \varepsilon_{it} \quad (3)$$

All variables in equation (4) are as defined above. The model in equation (4) is estimated using two-stage GMM system estimation to expose the threshold level of financial integration. The two-stage GMM system estimation is more robust and efficient in handling the endogeneity of the lagged dependent variable, heteroskedasticity, autocorrelation, and unobserved panel heterogeneity see [63]. From the estimation of equation (4), five scenarios could play out.

First, if $\alpha_1 < 0$ and $\alpha_2 > 0$, it indicates a U-shaped relationship between financial development and financial integration. Second, if $\alpha_1 > 0$ and $\alpha_2 < 0$, it supports an inverted U-shaped relationship between financial development and financial integration. Also, $\alpha_1 > 0$ and $\alpha_2 > 0$, it reveals a monotonically increasing (non)linear relationship. If $\alpha_1 < 0$ and $\alpha_2 < 0$, it indicates a monotonically decreasing (non)linear relationship. In the last two scenarios above, there may be an intrinsically hidden threshold level. However, in the fifth scenario, when, $\alpha_1 = 0$ and $\alpha_2 = 0$, there is a level relationship, indicating that no threshold level between financial development and financial integration. The results of the in-system GMM estimation are presented in Table 7.

Table 7. *Results of the estimation of the GMM in system.*

VARIABLES	Dependent variable
	Financial Development Index
Financial Development Index lagged one year	2.024***
	(0.238)
Financial integration	-0.403**
	(0.177)
Financial integration squared	0.304*
	(0.002)
Gross Domestic Product	0.001
	(0.008)
Population growth	-0.360***
	(0.038)
Inflation	-0.003**
	(0.001)
Trade opening	0.018***
	(0.002)
Observations	760
Number of id	38
AR(1)	z = -1.11 Pr > z = 0.269
AR(2)	z = -0.97 Pr > z = 0.330
Test de Hansen	0.228
Test de Sargan	0.997

Notes: Values in parentheses are standard errors. (***), (**), (*) indicate significance of coefficients at the 1%, 5% and 10% thresholds, respectively.
Source: Authors' calculations.

By canceling the first derivative of equation (4) with respect to $Infl_{it}$ it, we have:

$$\frac{\partial FD_{it}}{\partial Infl_{it}} = \alpha_1 + (2 * \alpha_2) Infl_{it} = 0 \quad (4)$$

For the optimal $Infl_{it}$, equation (5) is transformed to explain the threshold level of financial integration based on the system GMM in Table 7:

$$Infl_{it} = -0.5 \frac{\alpha_1}{\alpha_2} = -0.5 \left(\frac{-0.403}{0.004}\right) = 0.66 \quad (5)$$

This result confirms the dynamic threshold panel regression result by showing an inverted U-shaped relationship between financial integration and financial development.

Most of the control variables, with the exception of gross domestic product, have a significant impact on the dependent variable. A significant positive relationship with financial development is found in trade openness. Inflation and population growth have significant negative correlates with development. Indeed, increasing inflation and population growth resulted in a decrease in the financial development index.

5. Conclusion

The main objective of this research is to analyze the non-linear relationship between financial integration and financial development in 38 Sub-Saharan African countries from 2000 to 2020 by controlling for the effects of inflation, population growth, gross domestic product and trade openness.

Using dynamic threshold panel regression, the results of this research reveal an inverted U-shaped relationship between financial integration and financial development. Moreover, they reveal an optimal threshold of 69 percent at which financial integration is ambiguous. First, financial integration below a critical threshold positively affects financial development; but above 69 percent, it negatively affects financial development. These results are confirmed by the robustness tests conducted by the GMM in the system.

In the first phase of financial integration, the relaxation of barriers to external capital entry increases the level of bank lending. In the second phase of financial integration, unregulated external capital inflows negatively influence financial sector development. This is due to the maturity mismatch between bank assets and liabilities. This creates distortions, reduces the quality of bank loans and reduces the performance of the banking sector. In this case, it is noted that financial crises can occur as long as the integration of the financial system remains unregulated.

Therefore, it needs to be controlled by clear rules that prevent financial systems from collapsing through a disruption of one system to another. To do so, public and monetary authorities must take drastic measures to maintain prudential standards and allow regulators and supervisors in each financial system to determine where sources of potential financial instability are forming in the process of strengthening financial integration.

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