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Assessing the Role of Financial Development in Economic Sophistication: Evidence from a Dynamic Threshold Approach

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Abstract

This study examines the non-linear relationship between financial development and economic sophistication across 71 developing economies from 1995 to 2019. Using a dynamic panel threshold model, it investigates how varying levels of financial development affect economic sophistication—a metric reflecting a nation's production capacity and export of advanced goods. The findings reveal a threshold effect: financial development enhances economic sophistication only when it remains below a certain level. Beyond this threshold, further financial development diminishes economic sophistication. Across various indicators of financial development, including stock market turnover, domestic credit, private sector credit, and stock value traded, these results hold. The study shows the importance of balanced financial growth importance, which cautions that excessive financial system expansion causes inefficiency and counterproductive results. Policy recommendations encourage the developing world to prioritise the enhancement of the financial intermediation quality rather than only increasing the financial sector. More research should study the effect of equity markets and test the everlasting consequences of financial progress on the progress of economic complexities.

Keywords: *Economic Sophistication, Financial Development, Private Credit Sector, Threshold, GMM.*

Introduction

In traditional economic evaluations, GDP witnesses a common use as an initial indicator of a country's standing in the global economy. Yet, according to Hidalgo and Hausmann (2009), GDP operates as a static snapshot of a nation's current position which fails to capture the

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fundamental processes and abilities contributing to its status. The GDP limitations and advancements in data availability have spurred the development of alternative measures, such as the Economic Complexity Index (ECI) has gained importance to offer a deeper insight into the structural transformations driving growth and progress. Hidalgo and Hausmann (2009) invented ECI based on the idea that a nation's productive abilities shape its comparative advantages. Nations making sophisticated, diverse ranges tend to experience sustained economic growth, which underscores the importance of economic complexity in fostering long-term prosperity (Balland et al., 2020; Gala et al., 2018; Hausmann & Hidalgo, 2010).

Economic complexity is the knowledge intensity distribution and the production of structural composition in an economy, which establishes a fundamental connection to economic growth and environmental sustainability (Felipe et al., 2012; Mealy & Teytelboym, 2022). According to some scholars, a nation's economy is closely linked to production complexity, with countries which specialise in high-complexity goods and experience quicker growth. Hausmann et al. (2007) offer a compelling clarification of the "rich-product" versus "poor-product" strategy and argue that the nature of a nation's economic outputs greatly affects its likelihood of achieving sustained wealth, in contrast to stagnation. As a result, advancing a country's economic complexity has become a critical aim for researchers and policymakers who want to promote sustainable economic growth.

An understanding of economic complexity is important to grasp the intricate connections between a nation’s productive abilities and the broader social and economic dynamics. Resilience, cost-effectiveness, inequality, and sustained progress are well-documented features of highly complex economies (Hartmann et al., 2017). On the contrary, countries heavily depend on exporting raw materials, usually exhibiting relatively simplistic economic structures, development of lower levels of, and heightened vulnerability to market disturbances (Ndoya et al., 2024). These vulnerabilities have increased due to the recent global disruptions- the COVID-19 and the Russia-Ukraine war. Since the pandemic began, fiscal deficits have increased, and current account balances have worsened, in particular in developing nations (World Bank, 2022). Most low-income countries now suffer the risks of debt crises, intensified by global food crises driven by disruptions to agricultural exports from Ukraine and Russia, the main providers of wheat, barley, and maize (Sokhanvar & Bouri, 2023), underscoring the susceptibility of less complex economies to both demand- and supply-side shocks which highlight the economic complexity critical role in fostering economic resilience and stability.

There are some identified factors as critical drivers of economic complexity, such as innovation (Safi et al., 2023), internet access (Khan and Ximei, 2022), remittances (Liu et al., 2023; Ajide and Osinubi, 2024), human capital development (Rivera et al., 2023), foreign direct investment (Osinubi and Ajide, 2022), and financial openness (Andrew et al., 2024). Although the literature on these determinants grew rapidly, financial development in shaping economic complexity is still overlooked. Only a few (Arooj and Sajid, 2022; Karasoy, 2022; Nguyen and Su, 2021) have clearly studied and investigated how financial development makes it easy for countries to transition towards more advanced and sophisticated economic structures.

The second category is a financial system, which comprises institutions like commercial banks and financial markets- stocks and bonds driving growth by efficiently allocating resources to their most productive uses. A well-functioning credit system increases savings and investment, which accelerates the physically accumulating the capital. Channelling funds to high-tech and knowledge-driven sectors make financial development foster economic complexity. It makes

efficient capital distribution, which promotes innovation and diversifies an economy's productive base (Sahay et al., 2015; Abubakar et al., 2021). Financial progress affects economic sophistication differently. Firstly, it increases firms' access to capital, which encourages investment in high-tech and innovative industries. Advanced systems in developed economies often specialise in external finance-dependent sectors (Beck et al., 2018; Olaniyan et al., 2022). Secondly, liquidity constraints are reduced, which boosts firms' production capacities and diversification of exports, further increasing economic complexity. Yet, some heterodox theories indicate that financial liberalisation may distort technological progress, causing exhaustion of technology and diversification and sophistication of reduced exports (Ebireri, 2014).

Kletzer and Bardhan (1987) and Baldwin (1989) showed that financial institutions are pivotal in shaping a nation's comparative advantages. Advanced financial systems lower transaction costs, increase risk-sharing mechanisms and decrease the costs of investment-related information, so they encourage investment in more complex industries and foster economic diversification. Nations implementing financial reforms usually see improved economic complexity as firms have improved access to financial resources (Ebireri, 2014). Yet, recent studies show that while financial development at the begining improves economic sophistication, its impacts may become negative beyond a certain threshold. Over-financialisation and resource misallocation may cause inefficiencies and speculative behaviours which undermines the economic complexity and sustainable growth. According to Njangang et al. (2021), excessive financial development in African nations turns their resources into less productive activities with less economic sophistication. Similarly, Yan and Chen (2023) observed a U-shaped pattern, where the positive influence of financial development diminishes after reaching an optimal level, particularly in the context of industrial upgrading.

Utilising Kremer et al.'s (2013) dynamic panel threshold model, the research investigates the non-linear interaction between economic sophistication and the development of financial institutions and markets across 71 countries from 1995 to 2019. Recognising the inherently dynamic nature of economic sophistication, the study adopts a dynamic panel approach, which is more suitable than static threshold models, as argued by Hansen (1999). The findings reveal threshold effects, illustrating how financial development influences economic sophistication differently at various stages of financial system development. This approach mitigates multicollinearity and allows for an analysis of heterogeneity across country groups, highlighting that the impact of financial development varies—and can even reverse—depending on a nation's level of development and financialisation.

Using cross-country panel data, this study makes three key contributions to the academic discourse: (i) it is the first to examine the heterogeneous dynamic threshold effects of financial development on economic sophistication; (ii) it illustrates how these relationships differ across income and financial stability groups; and (iii) it offers policy recommendations aimed at enhancing economic sophistication through targeted financial system reforms. This research significantly contributes to ongoing debates on pathways to sustainable economic development by disentangling the complex relationships between financial development and economic sophistication and emphasising the mediating role of financial institutions. The remainder of the paper is organised as follows: Section 2 reviews the existing literature on financial development and economic sophistication, Section 3 describes the data and empirical methodology, Section 4 presents the empirical findings, and Section 5 discusses the policy implications.

Literature Review

Various theoretical frameworks have been employed to explore the relationship between finance and economic development, providing distinct perspectives on the finance-growth nexus. Some scholars contend that finance follows economic development, suggesting that financial systems react to, rather than drive, changes in the real economy. Robinson (1952) argued that demand in the real sector precedes finance, a view echoed by Lucas (1988), who expressed scepticism about the role of finance in development. However, many economists assert that financial systems enable economic growth. In this regard, Levine (2005) posited that well-developed financial markets alleviate financing constraints, providing firms with access to external capital and fostering dynamic economic growth. Schumpeter (1911) laid the foundation for this perspective, arguing that financial institutions, particularly banks, are crucial in directing resources towards productive investments and innovation, which can reduce asymmetries and enhance a country's economic complexity through advancements in high-tech sectors.

Empirical studies on the economic complexity determinants have identified factors which influence a nation's capacity to diversify its economy and produce sophisticated goods, with institutional quality often regarded as one of the most significant. Still, Hoang and Chu (2022) stated while institutional quality helps in economic sophistication, various institutional dimensions affect complexity in distinct methods. They agree with Vu (2022), who stressed the significance of fostering an environment conducive to growth and complexity through strong, reliable institutions that enable countries to break free from cycles of underdevelopment.

Also, globalisation is crucial in shaping economic complexity through the integration of economies into global markets, which provides access to new technologies and ideas, enhancing economic sophistication. Nguea et al. (2022) stated that policies that promote global integration, such as trade openness and financial globalisation, encourage greater product variety and sophistication in developing economies, with benefits in African nations. They also showed the positive effect of social, political, and economic globalisation on economic complexity. Baliamoune-Lutz (2019) emphasised the significance of foreign markets in boosting the sophistication of exporting countries, in particular to developed economies. Although these benefits are clear in lower-income nations, they diminish over time. Foreign direct investment (FDI) is a key driver of globalisation contributing to economic complexity, in particular in emerging economies (Osinubi & Ajide, 2022). According to Zhang, Chen, and Economy (2020), outward FDI had little impact on China’s export sophistication, with a clearer effect in coastal regions in which industrial diversification is bigger.

In contrast, nations rich in natural resources tend to exhibit lower economic complexity. Avom et al. (2022) found that these nations often struggle to develop complex economies, as their reliance on raw material exports inhibits diversification into more knowledge-driven industries. Zhu and Li (2017) emphasised the crucial role of human capital in enhancing economic complexity, noting that higher levels of educational attainment, particularly in secondary education, significantly contribute to complexity and long-term growth. As countries' comparative advantages evolve, the relationship between human capital and complexity strengthens, highlighting the importance of investing in education for successful industrial upgrading. The rise of digital technologies, particularly the internet, has also emerged as a key driver of economic complexity. According to Lapatinas (2019), broadening access to knowledge and innovation makes digital advancements foster greater economic sophistication. Yet, some argue that economic complexity is path-dependent, which suggests that when countries reach a

certain complexity level, they become more resilient to complexity even during crises (Kočenda & Poghosyan, 2018).

Financial development and economic complexity literature show many perspectives. Financial openness is usually seen as a factor promoting complexity by making technology transfer easy, enhancing production capabilities, and attracting FDI. According to Manova (2008), those industries that require substantial external capital or lack collateral benefit significantly from financial development, alleviating financing constraints. As a result, deeper financial openness encourages these industries and fosters economic sophistication by enabling the production of high-value, differentiated goods. According to Hsu, Tian, and Xu (2014), financial development is an advantage to industries which heavily depend on external capital and drive innovation and economic complexity. In addition, financial openness stimulates entrepreneurship, increases productivity, and boosts R&D investments, contributing to greater economic sophistication (Bayar, Gavriletea, & Ucar, 2018; Milani & Neumann, 2018). Still, not all research shows a positive relationship between financial openness and complexity. Institutional investors usually favour firms with strong corporate governance, possibly limiting access to capital for newer, innovative firms (Ferreira & Matos, 2008).

According to Zhu et al. (2020), while financial development encourages innovation, its benefits reduce as systems are overly developed, with capital usually flowing to established sectors rather than newer, innovative industries. In addition, Agosin, Alvarez, and Bravo-Ortega (2012) examined the role of financial openness in fostering complexity, which notes that the choice of proxies for measuring openness influences the results, offsetting positive and negative effects. Ofa et al. (2012) showed that FDI in these nations is usually concentrated in marginal sectors with limited linkages to other industries, which hinders export diversification. In the same way, according to Njangang et al. (2021), high levels of financial development reduce economic sophistication by the direction of the resources towards less productive sectors. Yan and Chen (2023) showed an inverted U-shape relationship, in which the positive effect of financial development reduces beyond a certain threshold, in particular in industrial advancement.

Model Specification

Building on prior research, the empirical framework investigates the relationship between financial systems and economic sophistication, adapting its core components to align with financial development. Using a dynamic panel approach, the base model examines the association between financial development and the level of economic sophistication in a country's economy. Although similar to models in previous studies on finance, this model specifically focuses on economic sophistication as the primary dependent variable. The general model is formulated as follows:

$$ES_{i,t} = \beta_1 FD_{i,t} + \gamma Z_{i,t} + \varepsilon_{i,t} \qquad (1)$$

In the equation 1, $ES_{i,t}$ is Economic sophistication for country *i* at time *t*. $FD_{i,t}$ evaluate financial development and $Z_{i,t}$ is a vector of control variables influencing economic sophistication (GDP per capita, human capital, population growth, and investments). Finally, the maximum level of random variation, $\varepsilon_{i,t}$, where *i* is the country effect and *t* is the time effect. By applying a threshold value to the financial development variable, the sample is divided into distinct regimes,

allowing for an analysis of whether the impacts of financial development vary when a country exceeds or remains below this threshold. The threshold model can be expressed as:

$$ES_{i,t} = \mu_i + \beta_1 FD_{i,t} I(FD_{it} \leq \lambda) + \delta I(FD_{it} \leq \lambda) + \beta_2 FD_{it} I(FD_{it} > \lambda) + \gamma Z_{i,t} + \theta_t + \varepsilon_{i,t} (2)$$

In this formulation 2, μ_i are country-specific fixed effects, β_1 and β_2 are the coefficients of the financial development (the threshold variable) in each regime and λ represents the unknown threshold separating the two regimes. An indicator functions I (1) for the case when the condition is satisfied, else 0. $\delta 1$ represents the intercept for the regime where $FD_{it} \leq \lambda$. $Z_{i,t}$ while the control variables (GDP per capita, human capital, population growth, and investments) θ_t is time effects and $\varepsilon_{i,t}$ is the error term. The threshold model examines the contribution of financial development to economic sophistication in two distinct regimes: above and below a threshold of financial development. By employing this methodology, the study aims to highlight the non-linear effects of financial development on the transformation of economies over time. For its part, the model includes control variables $Z_{i,t}$ for GDP per capita, human capital, population growth, and investment since these are widely accepted as affecting economic complexity. The model specifications are adjusted to control for the potential endogeneity nature of some variables and thus include lagged values of some control variables and separate endogenous and exogenous variables for additional robustness. $Z1_{i,t}$ and $Z2_{i,t}$ are exogenous and endogenous variables that may be endogenous to the model and are properly addressed through the model.

Methodology & Data

This study uses a dynamic panel threshold model to examine the non-linear link between financial development and economic sophistication. The methodology incorporates the forward orthogonal deviations technique introduced by Arellano and Bover (1995) to address country-specific fixed effects in panel data. This transformation eliminates fixed influences while keeping the uncorrelated nature of the errors, so the avoidance of the issues of endogeneity. This is in particular suited to this study analysis, as standard methods- in transformation and first-differencing violate the main assumptions of dynamic panel models (Hansen, 1999; Caner & Hansen, 2004). To ensure accuracy and robustness, the estimation undergoes many steps. Firstly, a reduced-form regression is performed on endogenous variables by suitable instruments. The anticipated values from this regression are thus used to ensure the threshold parameter λ by the minimisation of the sum of squared residuals over a spectrum of threshold values. The last threshold estimate is the value reducing the residual sum, which provides the optimal financial development partition.

After identifying the threshold value, the model estimates slope coefficients by the Generalized Method of Moments (GMM). To solve the endogeneity concerns, the model depends on lags of the dependent variable as instrumental variables (Arellano & Bover, 1995; Kremer et al., 2013). Yet, the application of GMM to small-sample panel data can cause issues such as skewed standard errors and weakened over-identification tests (Windmeijer, 2005; Bowsher, 2002). To overcome these challenges, Roodman's (2009) guidance is followed for limiting the number of instruments utilised. The truncation of the instrument count to a single lag aims to reduce overfitting and improve the reliability and stability of the coefficient estimates. Therefore, it minimises estimation bias.

The sample chosen for data reliability is 71 countries from 1995 to 2019. The Economic Complexity Index (ECI), the dependent variable, is a comprehensive measure of economic

sophistication. Yearly published by the Economic Complexity Observatory, the ECI shows a country's ability to manufacture and exporting products relying on skills and knowledge. Hidalgo and Hausmann (2009) developed the ECI captures a nation's comparative advantage by the complexity and diversity of its exports. It shows a holistic economic sophistication view showing the production complexity of an economy. Countries exporting high-tech, high-value goods, machinery, electronics, and chemicals have a higher ECI, while those exporting lower-complexity goods score lower. According to Hausmann and Hidalgo (2011), the ECI does not only measure export diversity but also provides insights into the quality of national institutions, the education system, and general competitive advantages.

This research investigates the correlation between economic sophistication and the advancement of the financial sector using four principal indicators: private sector credit (PVC), domestic credit (DC), stock market turnover (SMT), and stock value traded (SVT). PVC and DC represent financial resources and credit allocation, while SMT and SVT reflect market liquidity and activity. These indicators are crucial for developing countries, where bank credit is the primary financing source. Data are sourced from the World Bank and World Development Indicators. The analysis follows established approaches by Levine and Zervos (1998), Law and Sing (2014), Beck and Levine (2004), and Chu (2020), with GDP per capita, population growth, human capital, investment, government consumption, trade openness, and inflation as control variables. Descriptive statistics and correlations are shown in Tables 1a and 1b.

Variable	Obs	Mean	Std. Dev.	Min	Max
ES	1824	0.365	0.943	-3.555	2.492
PCS	1762	3.944	0.8	0.236	5.476
DC	1716	3.876	0.846	-1.681	6.262
SMT	1407	6.255	2.942	-8.36	14.9
SVT	1850	3.529	0.316	2.735	4.239
GDPc	1846	2.292	3.809	-3.562	4.032
HC	1850	4.512	0.069	4.419	4.627
POP	1629	-0.022	1.047	-6.445	2.897
INV	1776	1.34	1.024	-3.03	2.464
GCE	1763	2.742	0.343	0.847	3.472
TOP	1797	4.288	.621	-3.863	6.094
INF	1850	6.946	5.887	2.535	25.387

Table 1a: Descriptive Statistics

Variables	ES	PCS	DC	SMT	SVT	GDPC	HC	POP	INV	GCE	TOP	INF
ES	1.000											
PCS	0.472	1.000										
DC	0.340	0.621	1.000									

SMT	0.352	0.262	0.095	1.000							
SVT	0.281	0.539	0.322	0.348	1.000						
GDPc	0.645	0.592	0.387	0.269	0.359	1.0000					
HC	0.538	0.403	0.298	0.139	0.135	0.576	1.000				
POP	0.124	0.309	0.234	-0.002	0.623	0.209	0.026	1.000			
INV	-0.033	0.054	0.059	0.026	0.005	-0.052	-0.079	0.038	1.000		
GCE	0.459	0.205	0.257	0.156	-0.101	0.366	0.574	-0.270	-0.218	1.000	
TOP	0.228	0.319	0.279	-0.114	0.517	0.220	0.117	0.759	0.067	-0.102	1.000
INF	-0.325	-0.350	-0.272	0.060	-0.116	-0.296	-0.323	-0.076	-0.048	-0.243	-0.147	1.000

Tabe 1b: Correlation Matrix

Results

Table 2 shows the threshold model results for four financial development indicators: private sector credit, domestic credit, stock market turnover, and stock value traded. In Model 1(a), which assesses private sector credit as a proxy for financial development, the estimated threshold value is 4.8, with a 95% confidence interval ranging from 4.76 to 4.84. Below this threshold, financial development positively influences economic sophistication, with a coefficient (β_1) of 0.055, though this effect is not statistically significant. However, beyond the threshold, private sector credit negatively impacts economic sophistication, as indicated by a β_2 coefficient of -0.012**. These findings suggest that while financial development fosters economic complexity up to a certain point, excessive private-sector credit may have adverse effects, potentially due to inefficiencies in credit allocation as financial systems mature.

In Model 2(a), domestic credit is used as an alternative measure of financial development, with a threshold value of 4.7. Consistent with the findings in Model 1, economic sophistication is positively impacted by financial development below the threshold. In Model 2(a), when domestic credit exceeds the threshold of 4.7, its effect on economic sophistication becomes negative and statistically significant (β_2 = -0.091). This suggests that while domestic credit initially promotes economic sophistication, the inclusion of public sector credit may lead to inefficiencies that impede complexity when financial systems become overly developed.

Model 3(a) examines financial development through the stock market turnover ratio, with an estimated threshold value of 2.5, accompanied by a wider confidence interval (2.14 – 4.37).

Below the threshold, stock market turnover positively influences economic complexity, but the effect is not statistically significant (β_1 = 0.036). Beyond the threshold, however, the impact becomes negative and highly significant (β_2 = -0.036). This suggests that excessively high turnover ratios may be indicative of short-term trading behaviours that do not contribute to long-term investments necessary for enhancing economic sophistication. Finally, Model 4(a) employs stock value traded as a measure of financial development, with a threshold value of 3.0. Below the threshold, financial development positively and significantly impacts economic sophistication. However, once the threshold is exceeded, the relationship turns negative and significant (β_2 = -0.016). These findings imply that while stock market activity can support economic complexity up to a certain point, excessive trading may not facilitate the structural changes required for advanced economic production.

The control variables in this analysis offer important insights into the factors influencing economic sophistication. Human capital, measured through secondary education, generally exhibits a positive effect, underscoring the importance of education in driving complexity when combined with other growth factors. Population size also contributes positively, suggesting that larger populations foster the development of more complex industries. Investment is another positive factor in some models, emphasising the significance of efficient capital allocation. In contrast, GDP and government expenditure show mixed results, indicating that while larger economies and increased government spending can promote complexity, inefficiencies—particularly in state-owned enterprises—may hinder growth. These findings highlight the complementary roles of investment, population growth, and human capital in enhancing economic sophistication, while cautioning against the risks of inefficient government spending and excessively large financial systems. Bootstrap testing, using the SupWstar statistic, was employed to test for a threshold value in the models (Table 2). The SupWstar statistic was significant for models 1, 2, 3, and 4, with p-values allowing rejection of the null hypothesis at the 1% significance level. This confirms the presence of a threshold effect in these models.

	Model (1a)	Model (2a)	Model (3a)	Model (4a)
VARIABLES	FD=(Private Credit)	FD=(Domestic Credit)	FD=(Stock Market Turnover)	FD=(Stock Value Traded)
Threshold Estimate $\hat{\lambda}$	4.8	4.7	2.5	3.0
95% Confidence Interval	[4.76 4.84]	[4.75 4.84]	[2.14 4.37]	[-.40 4.57]
Impact of FD_{it}				
β_1	0.055	0.011	0.036	0.015**
	(0.551)	(0.056)	(0.172)	(0.007)
β_2	-0.012**	-0.091*	-0.036***	-0.016**
	(0.004)	(0.049)	(0.014)	(0.006)
Impacts of Covariates ES_{it}	0.657***	0.588***	0.586***	0.743***
	(0.032)	(0.034)	(0.031)	(0.023)
Ln GDP_{it}	-0.0174	0.008	0.002	0.028**
	(0.024)	(0.022)	(0.220)	(0.012)

Ln HC_{it}	-0.046***	0.003***	0.024***	0.143**
	(0.017)	(0.093)	(0.008)	(0.060)
Ln POP_{it}	0.021***	0.023	0.019	0.013**
	(0.006)	(0.016)	(0.012)	(0.005)
Ln INV_{it}	0.042	-0.026	0.012**	-0.013
	(0.028)	(0.034)	(0.005)	(0.016)
Ln GOV_{it}	0.053***	-0.789**	0.117	0.083**
	(0.008)	(0.355)	(0.195)	(0.034)
Constant	-0.047	2.022**	-0.638	-0.649**
	(0.145)	(0.984)	(0.615)	(0.280)
SupWstar	4.020***	2.163***	4.956***	7.348***
	(1.344)	(0.468)	(1.623)	(2.272)
Observations	1,400	1,390	1,363	1,402
Number of ID	71	71	71	71

Table 2: Dynamic Panel Threshold Model Results

Note: Standard errors are presented in parentheses. Economic sophistication is the dependent variable. Significance at the 1%, 5%, 10% level is denoted by '***' "**' '*'

The results across all four models consistently indicate an inverse-U-shaped relationship between financial development and economic sophistication. Financial development appears to foster sophistication up to a specific threshold, after which the relationship turns negative. Among the four financial development indicators, private domestic credit exhibits the most significant positive effects below the threshold level (Arcand et al., 2015; Chu, 2020; Law & Singh, 2014). Although the stock market turnover ratio and stock value traded initially show a positive effect (Chu, 2020), their influence becomes the most negative once a certain threshold is surpassed (Zhu et al., 2020).

Although the study does not delve into the exact reasons for the non-linear relationship between financial development and economic sophistication, several explanations are proposed, informed by recent literature. Initially, financial development boosts sophistication by improving access to capital, financial services, and innovation. However, beyond a certain threshold, these benefits may diminish or reverse. First, over-expansion of the financial sector can lead to resource misallocation, with speculative activities and inefficiencies crowding out productive investments (Njangang et al., 2021). Second, while early financial development fosters innovation, further complexity may not lead to real growth or sophistication (Yan & Chen, 2023). Third, at high levels of development, weak institutions and regulatory frameworks can exacerbate financial crises, hindering economic progress (Beck & Levine, 2000). Fourth, as financial systems grow, resources may shift towards less productive sectors, reducing sophistication (Njangang et al., 2021). Fifth, overreliance on external capital, such as FDI, can reduce resilience and sophistication, exposing the economy to external shocks (Anetor, 2020).

Robustness Check

To validate the results, a series of robustness checks were performed, incorporating additional determinants of economic sophistication, alternative methodologies, income group sample splits, and various estimation strategies. The first set of checks included variables such as

inflation and trade openness. The findings, based on private sector credit as the financial development measure, largely corroborated those in Table 2, with the threshold estimate for private sector credit remaining at 4.7. Both the financial development coefficient (β_2) and threshold value were statistically significant. Below the threshold, private sector credit positively influenced economic sophistication, whereas, beyond the threshold, its effect became negative and significant. Additionally, Table 3 shows that inflation and trade openness, included in the robustness checks, are significant determinants of economic sophistication, with trade openness positively correlating with sophistication and inflation negatively affecting it. These findings align with theoretical expectations, indicating that greater global integration enhances production complexity, while macroeconomic instability hinders advanced production.

VARIABLES	Model1(b)	Model 2(b)
Threshold Estimate $\hat{\lambda}$	4.7	4.7
95% Confidence Interval	[4.73 4.81]	[4.69 4.83]
Impact of FD_{it}		
β_1	0.105	0.040
	(0.072)	(0.065)
β_2	-0.015**	-0.011*
	(0.006)	(0.005)
Impacts of Covariates ES_{it}	0.500***	0.598***
	(0.035)	(0.031)
Ln GDP_{it}	-0.063**	0.020
	(0.030)	(0.030)
Ln HC_{it}	0.027	0.020
	(0.202)	(0.017)
Ln POP_{it}	0.037*	0.037**
	(0.022)	(0.017)
Ln INV_{it}	0.016	-0.055
	(0.034)	(0.040)
Ln INF_{it}	-0.024***	
	(0.008)	
Ln TOP_{it}		0.036**
		(0.014)
Constant	0.132	-0.456*
	(0.203)	(0.244)
SupWstar	20.052	14.400
	(4.670)	(4.725)
Observations	1,452	1,598
Number of ID	71	71

Table 3: Dynamic Panel Threshold Model Results with Additional Variable

Note: Standard errors are presented in parentheses. Economic sophistication is the dependent variable. Significance at the 1%, 5%, 10% level is denoted by '***' "**' '*'

Additionally, estimates from a dynamic system GMM estimator (Blundell & Bond, 1998) are employed for further robustness checks. By incorporating the squared terms of financial development variables, these models assess the non-linear relationship between economic sophistication and financial development. The inclusion of squared terms highlights the inverted U-shaped association identified in prior studies. Table 4 reveals that the coefficients of financial development variables and their squared terms are statistically significant for all four models. The positive linear terms and negative squared terms confirm the inverted U-shaped relationship between financial development and economic sophistication. These findings align with those from the dynamic panel threshold analysis in Table 2, indicating that while financial development initially boosts economic sophistication, excessive development diminishes its positive effects. Diagnostic tests in Table 4, including the Sargan test and AR1 and AR2 serial correlation tests, indicate appropriate model specifications. In GMM models, the Sargan test ensures instrument validity, while the AR2 test confirms the absence of second-order serial correlation, supporting the robustness of the estimates.

To further investigate the threshold effect, we computed the partial derivatives of economic sophistication with respect to financial development variables and assessed the significance of marginal effects. Following the methodology of Austin et al. (2005), we estimated standard errors and examined financial development indicators at their minimum, average, and maximum values to evaluate the significance of the marginal effects. All marginal effects were statistically significant at the minimum and mean levels, except for the marginal effects in Models 1c and 4c (estimates based on Models 2a, 2b, 3a, 3b, 5a, and 5b). For instance, the case of private sector credit shows that the marginal effect at the minimum level (0.062) suggests that a 1% increase in credit contributes to a 0.062% improvement in economic sophistication. At the maximum credit level, however, the marginal effect becomes negative (−0.053%), indicating that excessive credit starts to hinder economic sophistication. This pattern is consistent across other financial development measures, including domestic credit, stock market turnover ratio, and stock value traded. In each case, financial development initially fosters economic sophistication, but beyond a certain point, it becomes negatively correlated. This inverted U-shaped relationship suggests that financial systems are crucial for economic complexity in the early stages of growth. Still, if financial systems become disproportionately large relative to the economy's capacity to absorb capital, they may become inefficient or harmful to growth.

VARIABLES	Model 1(c)	Model 2(c)	Model 3(c)	Model 4(c)
$L.ES_{it}$	0.925***	0.909***	0.920***	0.904***
	(0.005)	(0.007)	(0.013)	(0.006)
Ln PRI_{it}	0.067***			
	(0.021)			
Ln PRI_{it}^2	-0.011***			
	(0.003)			
Ln DC_{it}		0.041**		
		(0.017)		
Ln DC_{it}^2		-0.016**		

		(0.007)		
SMT_{it}			0.0655***	
			(0.006)	
SMT_{it}^2			-0.027***	
			(0.007)	
SVT_{it}				0.011***
				(0.002)
SVT_{it}^2				-0.095***
				(0.022)
Ln GDP_{it}	0.042***	0.046***	0.0192***	0.017***
	(0.003)	(0.008)	(0.00373)	(0.002)
Ln HC_{it}	0.016***	0.015***	0.0944***	0.014***
	(0.002)	(0.002)	(0.0270)	(0.002)
Ln POP_{it}	0.0556***	0.074***	0.0825***	0.052***
	(0.020)	(0.020)	(0. 021)	(0.006)
Ln INV_{it}	0.023	0.077**	-0.0834***	0.039***
	(0.035)	(0.036)	(0.0171)	(0.012)
Ln GOV_{it}	-0.033***	-0.065	-0.0114***	-0.013***
	(0.011)	(0.099)	(0.00176)	(0.002)
Constant	-0.285***	-0.159***	0.115***	-0.135***
	(0.060)	(0.029)	(0.0419)	(0.020)
Sargan	63.490	63.495	56.834	59.356
	(1.000)	(1.000)	(1.000)	(1.000)
AR1	-5.299	-5.373	-5.035	-5.212
	(0.000)	(0.000)	(0.000)	(0.000)
AR2	0.5413	1.101	0.00303	0.253
	(0.588)	(0.270)	(0.997)	(0.799)
Marginal Effect				
Minimum	0.0620***	0.0401**	0.0414***	0.022***
Mean	0.01975	0.0378**	0.0356***	0.021
Maximum	-0.0532***	0.0236*	-0.0159***	-0.010***
Observations	1,237	1,191	982	1,070
Number of ID	70	70	63	66

Table 4: Dynamic Panel S-GMM Estimation Results

Note: Standard errors are presented in parentheses. Economic sophistication is the dependent variable. Significance at the 1%, 5%, 10% level is denoted by '***' "**' '*'

The final robustness checks, shown in Table 5, group the sample into low-income and high-income countries. The results confirm that the non-linear relationship between financial development and economic sophistication holds for both groups, though threshold values and effect sizes vary. The marginal effect of private sector credit in high-income countries starts

positive but turns negative at higher levels of financial development, aligning with the overall results. The results underscore the crucial role of financial development in facilitating structural transformation and economic complexity. However, they also highlight the need for careful management. If financial systems expand beyond a certain threshold, they may hinder rather than enhance economic sophistication, particularly in countries with less developed financial infrastructure.

	High Income	Low Income
VARIABLES	Model 1	Model 2
$L.ES_{it}$	0.865***	0.763***
	(0.017)	(0.032)
FD_{it}	0.625*	0.051***
	(0.365)	(0.016)
FD_{it}^2	-0.029**	-0.210***
	(0.011)	(0.043)
Ln GDP_{it}	0.090	-0.038**
	(0.074)	(0.018)
Ln HC_{it}	0.021***	0.096*
	(0.002)	(0.055)
Ln POP_{it}	0.058**	0.036
	(0.028)	(0.052)
Ln INV_{it}	0.086***	0.031***
	(0.012)	(0.002)
Ln GOV_{it}	0.077	-0.074***
	(0.219)	(0.021)
Constant	1.900***	1.304***
	(0.732)	(0.280)
Sargan	30.509	29.789
	(1.000)	(1.000)
AR1	-2.473	-2.255
	(0.013)	(0.024)
AR2	1.889	0.339
	(0.058)	(0.734)
Marginal Effect		
Minimum	0.510	0.019***
Mean	-0.441	-0.034***
Maximum	-0.257***	-0.025***
Observations	674	554
Number of ID	37	34

Table 5: Dynamic Panel S-GMM Estimation Results (Income Wise Countries).

Note: Standard errors are presented in parentheses. Economic sophistication is the dependent variable. Significance at the 1%, 5%, 10% level is denoted by '***' "**' '*

Conclusion

Based on data from 71 developing countries (1995–2019), this study explores the non-linear relationship between financial development and economic sophistication using a dynamic panel threshold model. The findings show a threshold effect: financial development positively influences economic sophistication below the threshold but becomes counterproductive once it surpasses this point. Beyond the threshold, further financial growth hinders economic sophistication, likely due to inefficiencies, credit mismanagement, and resource diversion. These results are robust across various financial development indicators and alternative analyses. The study suggests that policymakers should focus on improving the quality of financial intermediation rather than expanding the financial sector. In developing countries, where the threshold is lower, attention should be given to ensuring effective financial systems that support the transition to more sophisticated economic structures rather than aggressively increasing financial sector size. This study focused on banking sector development indicators, but future research could examine the role of equity markets and other forms of financial development in economic sophistication. Another potential avenue for research is investigating the sustainability and duration of financial development's impact on economic sophistication. Understanding whether these effects are short-lived or long-lasting could further illuminate the dynamic relationship between finance and economic development. In conclusion, while financial development is crucial for driving economic sophistication, its expansion must be carefully managed. Once financial systems become too large, they may hinder the progress they aim to support, underscoring the need for balanced, efficient financial sector growth strategies.

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