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Exploring the impacts of financial development on economic growth through financial openness in three urban agglomeration regions of China

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Abstract

This study explores the nonlinear relationship between financial development (FD), financial openness (FO), and economic growth across China's three key urban agglomerations: Jing-Jin-Ji, Yangtze River Delta, and Pearl River Delta. Using panel data from 10 provinces, municipalities, and Special Administrative Regions over the period 1995–2021, the study applies a panel threshold regression model to examine how the growth-enhancing effects of FD vary across different levels of FO. The results reveal that when FO is low (FO < 0.4253), FD has a strong positive impact on economic growth, indicating that domestic financial systems play a pivotal role in less open economies. In moderately open regimes (0.4253 ≤ FO ≤ 0.43720), the positive effect of FD weakens, possibly due to transitional inefficiencies or policy misalignments. Interestingly, in highly open regimes (FO > 0.43720), the impact of FD strengthens again, though not to the level observed in closed financial environments. Among the control variables, government expenditure, trade openness, and higher education enrollment negatively influence economic growth, while inflation is positively associated. These findings offer important policy insights, emphasizing the need for region-specific financial liberalization strategies and reinforcing the importance of domestic financial system development to effectively harness the benefits of global financial integration.

Keywords: Agglomeration regions of China, Economic growth, Financial development, Financial openness, Threshold regression.
JEL Classification: E1; E6; F31; G2.

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Contents

Contribution of this paper to the literature

This study examines the complex relationship between financial development and economic growth through financial openness by employing a threshold regression model across three urban agglomeration regions in China, which have been infrequently studied previously. The primary contribution of this research is its finding that the impact of financial development on economic growth varies across different regimes of financial openness.

1. Introduction

Economic growth involves a continuous increase in a nation's ability to provide a wider range of goods over time, driven by technological progress and institutional changes (Kuznets, 1963). Regarding the definition of financial openness, so far the academic community has not provided a unified concept. Scholars often associate it with broader themes such as financial integration, globalization, capital account liberalization, and cross-border capital mobility (Abiad, Detragiache, & Tressel, 2004; Bekaert, Harvey, & Lundblad, 2005; Bussière & Fratzscher, 2008; Huang, 2006; Islamaj, 2012; Ito, 2011; Kose, Prasad, & Terrones, 2009; Nasreen, Shah, & Ahmed, 2020; Obstfeld, 2009; Quinn & Inclan, 2009; Wooldridge, 2007). Others frame it as a component of economic openness, emphasizing reduced barriers to foreign investment and deeper linkages with global financial systems. This study also agrees with the view of previous studies Jia (2005) and Xie and Pan (2018) that financial openness involves receiving foreign capital freely and tends to embrace foreign capital, intertwining with global financial networks. The World Bank highlights that strengthening the financial sector requires addressing costs related to information, contract enforcement, and transactions, thereby enhancing the sector's resilience and efficiency (The World Bank, 2025). Consequently, this study defines financial development as a transformative process that enhances a financial system's capacity to overcome structural barriers and support sustainable economic growth.

In 2006, the 11th Five-Year Plan of China introduced the idea of "urban agglomeration as the key way to grow urban areas," marking the initial exploration of the new regional governance model termed "group." Although the significance of urban agglomeration for regional coordination was repeatedly underscored in central government documents and reports from 2007 to 2016, there was no explicit intention to deepen its promotion during that period. In 2014, President Xi Jinping suggested a plan to make Beijing the main city of the Beijing-Tianjin-Hebei region (Jing-Jin-Ji). The term "city cluster" gained official recognition in government documents following Xi's endorsement, sparking increased interest in regional governance.

In 2017, the report presented at the 19th Congress of China's Communist Party articulated the goal of establishing a pattern of working together to grow big, medium, and small cities and towns, with a focus mainly on urban agglomerations. This marked the first clear acknowledgment that urban agglomerations were to be the main drivers of coordinated development among cities of varying sizes, outlining the strategic direction for building and growing urban agglomerations (Wu, 2021).

The combined GDP of the Yangtze River Delta, Pearl River Delta, and Beijing-Tianjin-Hebei urban agglomeration exceeds 40% of the country's total, playing a crucial role in the nation's economic stability, serving as a source of high-quality development, and acting as a testing ground for reforms. According to Zhang (2022), these three regions demonstrate economies of scale, a rapid accumulation of innovation elements, a concentration of high-level talents, and stand at the forefront of connecting with other countries, making them the main drivers of China's technological innovation and pioneers in institutional opening up.

Financial development defined as the evolution and increased complexity of a country's financial markets and institutions plays a key role in stimulating economic growth. It involves the progress of banks, markets, and financial instruments that help mobilize savings, direct investments efficiently, and manage risks. An advanced financial system not only channels savings into productive ventures but also enhances resource allocation by offering improved investment information and supports technological innovation through funding projects with higher risk and return. Moreover, by reducing information gaps, lowering transaction costs, and facilitating both trade and foreign investment, a robust financial system becomes a cornerstone for long-term economic prosperity. This phenomenon is particularly evident in China's urban clusters, where financial advancements have significantly contributed to rapid economic growth.

On the other hand, financial openness refers to the extent to which a country's financial institutions and markets are integrated with those worldwide, and it is widely regarded as a key factor in driving economic growth. By attracting foreign capital, intensifying competition, and streamlining resource allocation, this openness helps improve economic performance (Klein & Olivei, 2008). It also provides access to global savings, enables investment diversification, and helps mitigate risks, thereby strengthening economic resilience (Henry, 2007). In China's urban clusters, for example, financial openness has been crucial for growth by linking these regions to international markets, drawing in foreign investments, and spurring technological innovation (Bekaert, Harvey, & Lundblad, 2011). While it brings notable benefits, financial openness can also increase exposure to market volatility and crises (Stiglitz, 2002). Overall, when managed properly, it is seen as a significant contributor to sustained economic growth (Klein, 2005).

Urban agglomerations in China have become pivotal engines of economic growth, yet the intricate interplay between financial development and financial openness within these regions remains underexplored. Despite a growing body of literature underscoring the importance of both domestic financial sophistication and international financial integration in fostering economic performance, there is a notable gap in understanding how these two forces interact in urban contexts where rapid economic transformation is underway. This paper addresses the problem by investigating how financial development characterized by the evolution of financial markets, institutions, and instruments translates into economic growth when coupled with financial openness, which integrates these domestic mechanisms into global financial networks. Focusing on three major urban agglomerations in China, the study seeks to clarify whether and how financial openness amplifies or moderates the impact of financial development on economic growth. This research is crucial not only for advancing academic discourse but also for informing policy decisions aimed at enhancing economic resilience and sustainable development in urban settings facing both domestic and global financial challenges.

The significance of this study lies in its potential to bridge a critical gap in existing research by integrating two well-documented yet often separately examined dimensions financial development and financial openness—within the unique context of China's urban agglomerations. Previous studies have robustly documented the role of financial development in promoting economic growth by enhancing the mobilization of savings, improving resource allocation, and supporting innovation (King & Levine, 1993; Levine, 2005). Similarly, research on financial openness has demonstrated its ability to attract foreign capital, increase competition, diversify investments, and bolster economic resilience (Henry, 2007; Klein & Olivei, 2008).

However, while the individual impacts of these factors are well-established, there remains a noticeable gap in understanding how financial development and financial openness interact, particularly at the urban level, to affect their economic performance. Urban agglomerations in China are dynamic economic engines; yet, few studies have specifically examined how their financial systems, when integrated with global markets, affect local economic growth. By focusing on three key urban regions, our research aims to provide a nuanced analysis of this interplay.

This will not only enrich the academic literature by addressing the conditional effects of financial openness on the benefits of domestic financial development but also offer valuable insights for policymakers seeking to harness these synergies to drive sustainable urban growth.

This study advances the literature by integrating financial development and financial openness within a unified framework that explicitly considers their nonlinear interplay. By employing a threshold regression approach, this research refines traditional growth models to examine how varying degrees of financial openness may amplify or moderate the benefits of domestic financial development. Importantly, this method helps capture heterogeneity across China's urban agglomerations and mitigates potential endogeneity concerns that typically complicate the analysis of financial variables. As such, our theoretical framework offers a more nuanced understanding of the conditional mechanisms through which global financial integration influences local economic performance.
Empirically, the study makes a significant contribution by applying a robust panel threshold regression method to data from three major urban agglomerations in China, considering financial openness as a moderating variable.

This technique enables us to identify distinct regimes in the relationship between financial development, financial openness, and economic growth, revealing nonlinear effects that traditional linear models might overlook. The threshold regression approach can address heterogeneity across regions, ensuring that the estimates are both reliable and insightful. Consequently, the findings provide clear empirical evidence on the conditional impact of financial openness, offering policymakers tailored insights to harness the synergistic benefits of domestic and international financial integration for sustainable urban growth.

2. Literature Review

2.1. Theoretical Review

Economic theories have long recognized the pivotal role of financial development in driving economic growth. Seminal works by King and Levine (1993) and Levine (2005) emphasize that robust financial institutions and markets are fundamental for mobilizing savings, channeling investments, and improving resource allocation, thereby fostering capital accumulation and innovation. These perspectives are integral to both classical finance-growth models and modern endogenous growth theories, which collectively argue that a well-functioning financial system is essential for sustainable economic progress. Complementing this view, theories on financial openness highlight the advantages of integrating domestic financial systems with global markets. For instance, Klein and Olivei (2008) demonstrate that financial openness attracts foreign capital and intensifies competition, while Henry (2007) shows that it facilitates diversification of investment portfolios and risk mitigation, further strengthening domestic financial structures in supporting economic growth.

Building on these complementary strands of thought, our study explores the interplay between financial development and financial openness within China's urban agglomerations. Recognizing that the impact of financial development may vary with different levels of global financial integration, we employ a threshold regression approach to capture potential nonlinearities and regional heterogeneity. This methodology allows us to identify distinct regimes where the influence of financial development on economic growth is either amplified or moderated by varying degrees of financial openness. By synthesizing established economic theories with advanced empirical techniques, our research not only clarifies the individual contributions of financial development and openness but also uncovers their conditional interplay, offering valuable insights for policymakers seeking to harness these dynamics in rapidly evolving urban economies.

2.2. Empirical Review

The link between financial development and economic growth is a central topic in economics, with various methods and interpretations highlighting how financial systems impact economic activity. Here, it summarizes important studies that have shaped our understanding of this connection.

Regarding the role of financial markets and institutions: Arestis, Demetriades, and Luintel (2001) and Levine and Zervos (1996) provided comprehensive analyses on how stock markets contribute to economic growth. They concluded that stock markets enhance growth through improving liquidity and facilitating investment diversification, which in turn lowers the cost of capital and supports corporate investments.

Shen and Wei (2021) examined panel data from 31 provinces in China covering 2007 to 2019. Their research measured financial openness and financial risk at the regional level, analyzing how regional financial openness dynamically affects financial risk. The results showed that the level of financial openness and financial risk varies greatly among provinces in China, and there is heterogeneity in the effect of financial openness on financial risk among provinces. In regions with weak economic foundations and a low level of financial development, financial openness can reduce regional financial risk. In regions with a better economic foundation and higher financial development levels, the improvement of the regional financial openness level brings relatively large financial risks.

Njindan Iyke and Odhiambo (2017) investigated how inflationary thresholds affect the relationship between finance and economic growth in Ghana and Nigeria. Their study identified inflationary thresholds for both countries: 10.73%–29.83% for Ghana and 10.07%–19.25% for Nigeria. The findings revealed that financial development

promotes economic growth during periods of low to moderate inflation but has little to no effect during high inflation periods.

However, Using a balanced panel dataset covering 30 Chinese provinces from 1987 to 2017, Li and Wei (2021) analyzed how carbon emissions influenced economic growth. They explored the relationship between economic growth and factors such as financial development (such as deposits and loans per capita), innovation, economic openness (imports and exports per capita), capital stock, and carbon emissions (CO2 emissions in million tonnes with a one-period lag). Their findings indicate two main conclusions: i) There are complex nonlinear connections between carbon emissions, financial development, economic openness, innovation, and economic growth; and ii) carbon emissions reduce the positive effects of financial development and innovation on economic growth.

Meanwhile, scholars also examined the nonlinear relationship existing between financial development, financial openness, and economic growth. Guo and Peng (2016) conducted an analysis using data from 87 countries and delved deeper into the provinces in China, precisely 31 of them, including municipalities and autonomous regions. This involved computing individual threshold values for capital account openness in each province and assessing how varying openness levels impacted the economy across these regions. Their findings revealed three key points: firstly, a threshold effect exists in how capital account openness influences economic growth, signaling China is positioned within a range capable of reaping benefits from an open capital account. Secondly, the relationship between economic promotion from capital account openness and the extent of global openness isn't straightforward. Lastly, there are noteworthy differences in how capital account openness impacts economic growth across various Chinese regions. To optimize the advantages of an open capital account, China needs heightened global openness overall. Additionally, specific regions may need to focus on increasing per capita income, while others could benefit from restructuring industries to reduce reliance on foreign trade. Similarly, Guo and Peng (2016) examining both national and provincial levels in China, the study found a notable threshold effect of financial openness on economic growth. The same perspectives can also be found in the studies of Liang (2020), Karim, Chowdhury, and Uddin (2021), and Nam (2024).

2.3. Research Gap and Contribution of the Study

Despite extensive research on the individual effects of financial development and financial openness on economic growth, significant gaps remain in understanding their interactive dynamics, especially within the context of China's urban agglomerations. Previous studies, such as those by King and Levine (1993) and Levine (2005), have underscored the importance of financial development for mobilizing savings and allocating investments efficiently, while research by Klein and Olivei (2008) and Henry (2007) has highlighted how financial openness can attract foreign capital and diversify risks. However, these works typically treat the two dimensions as separate influences and assume linear relationships, thereby overlooking the potential nonlinear and conditional effects that may emerge when financial openness reaches certain thresholds. Although Rajan and Zingales (1996) and Stiglitz (2002) offer valuable insights into the risks and benefits associated with financial systems and global integration, they do not specifically address how the interplay between domestic financial development and international financial integration affects economic outcomes in rapidly urbanizing regions. Consequently, our study seeks to bridge this gap by employing a threshold regression approach to capture these nonlinear interactions and provide a more nuanced understanding of how financial openness moderates the impact of financial development on economic growth in three key urban agglomerations in China.

3. Methodology

3.1. Data Source, Study Period and Sample Regions

The study has compiled panel data for three urban agglomeration regions, namely the Yangtze River Delta, the Pearl River Delta, and Jing-Jin-Ji, consisting of 10 provinces, municipalities, and Special Administrative Regions, covering 1995–2021. The dataset is sourced from the China City Statistical Yearbook, China Financial Yearbook, Provincial Statistical Yearbook, and Hong Kong and Macao SAR Yearbook, as well as data provided by the China Economic Network and the National Bureau of Statistics. The choice of sample, study period, model, and variables is based on the availability of data, theoretical foundations, and existing literature.

3.2. Model Specification and Variables

The data is first checked through descriptive statistics to assess the normality of data, and then the coefficient of correlation is estimated to examine the association and multicollinearity between the variables. Subsequently, the Variance Inflation Factor (VIF) is applied to further evaluate multicollinearity. Additionally, unit root tests are conducted to determine the order of integration, along with the application of Kao cointegration tests. Later, the coefficients are estimated using the threshold regression model developed by Hansen (1999). The models to be estimated is given in equation 1 to 3.

$$PGDP_{it} = \alpha_0 + \beta_1 FD_{it} + \beta_2 GovExp_{it} + \beta_3 TEI_{it} + \beta_4 ERHE_{it} + \beta_5 IR_{it} + \beta_6 lnFAI + \varepsilon_{it} \quad (1)$$

Where i signifies various provinces or municipalities included in the data set, t represents the time-series dimension for each observation (t = 1,...,T), $FO_{it}$is financial openness, $GOVEXP_{it}$is government expenditure, TEI_{it} is total exports and imports, $ERHE_{it}$ is the gross enrollment of higher education, FAI_{it} is fixed assets investment and IR_{it} is Inflation rate. The term α_0 represents a distinct fixed effect, while ε_{it} follows an independent and identical distribution with a mean of zero and variance σ^2. Details of the variables, their notations and sources are given in Table 1.

To examine the non-linear connection between financial development and economic growth, and how financial openness influences this relationship, Equation 2 is applied. This equation incorporates a squared term of financial development, multiplied by financial openness, together with control variables. If the square term of financial development multiplied by financial openness's coefficient is significant, it means financial openness has a threshold effect, indicating that the impact of financial development on economic growth is not linear.

$$PGDP_{it} = \alpha_0 + \beta_1 FD_{it}{}^2 FO_{it} + \beta_2 lnGovExp_{it} + \beta_{3ln} TEI_{it} + \beta_4 lnERHE_{it} + \beta_5\, lnIR_{it} + \beta_6 lnFAI + \varepsilon_{it} \quad (2)$$

Considering FO as a threshold variable, the static threshold regression model with a single threshold adopted in this research is:

$$PGDP_{it} = \alpha_0 + \beta_1 FD_{it} \cdot I(FO_{it} \le \gamma) + \beta_2 FD_{it} \cdot I(FO_{it} > \gamma) + \beta_3 GovExp_{it} + \beta_4 TEI_{it} + \beta_5 ERHE_{it} + \beta_6 IR_{it} + \beta_7 lnFAI\varepsilon_{it} \quad (3)$$

By performing formulas (1) and (3), this study will assess the influence of financial development (FD) on economic growth through the moderation of financial openness across the three major urban regions of China.

Table 1. Details of variables, notation and data source.

Variable	Notation	Description	Source
Financial development	FD	Index developed through entropy evaluation by using LFIN: The total loans in the financial system. SFM: Securities fund management GP: Gross premiums	China city statistical yearbook
Financial openness	FO	Proxy by foreign direct investment logarithmic transformed	China financial yearbook
Economic growth	PGDP	Per capita GDP	Provincial statistical yearbook
Government expenditure	GOVEXP	Logarithmic transformation of Government Expenditures	China city statistical yearbook, the China financial yearbook, the provincial statistical yearbook
Trade volume	TEI	Sum of exports and imports logarithmic transformation	China city statistical yearbook, the China financial yearbook, the provincial statistical yearbook
Human capital	ERHE	Enrollment ratio in Higher Education, Logarithmic transformation	China city statistical yearbook, the China financial yearbook, the provincial statistical yearbook
Inflation	IR	Inflation rate Logarithmic transformation	China city statistical yearbook, the China financial yearbook, the provincial statistical yearbook
Physical capital	FAI	Fixed assets investment logarithmic transformation	China city statistical yearbook, the China financial yearbook, the provincial statistical yearbook

3.3. Conceptual Framework

The conceptual Framework of the research is given in Figure 1. It shows that the dependent variable is economic growth, while the main variable of interest is financial development. However, the threshold variable here is financial openness. The control variables include trade openness, government expenditures, inflation rate, fixed assets investment, and enrollment ratio in higher education. Financial development is expected to have a nonlinear influence via financial openness on economic growth. The trade volume, government expenditures, fixed assets investment, and gross enrollment ratio are expected to have positive effects on economic growth. However, the inflation rate is expected to have negative impacts on economic growth.

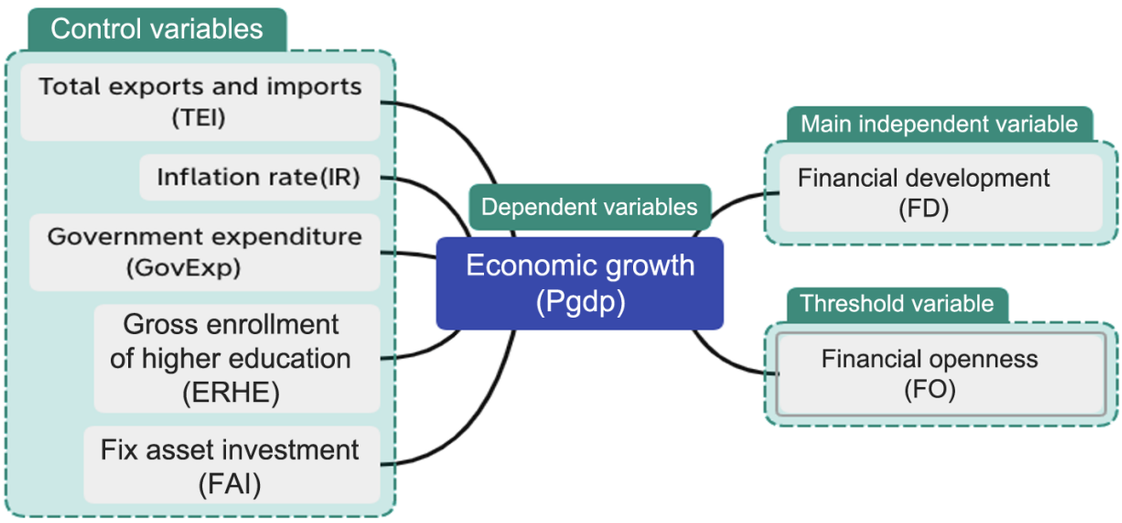

Figure 1. Conceptual framework.

3.4. Hypothesis

1. *Financial development and economic growth have a nonlinear relationship.*
2. *Financial openness moderates the intricate relationship between financial development and economic growth.*
3. *The impacts of financial development on economic growth vary at different levels of financial openness.*

4. Results Discussion

4.1. Descriptive Statistics

The Table 2 presents descriptive statistics for eight variables across 270 observations, offering insights into their central tendencies and dispersion. The log of per capita GDP (LMGDP) has a mean of 8.777 and ranges from 5.935 to 11.888, showing a slightly left-skewed distribution (skew = −0.152) and a kurtosis of 2.221, indicating a relatively flat curve. Financial openness (FO) averages 4.409, but with a standard deviation of 2.170 and values stretching from

−4.841 to 9.592, it displays pronounced variability and negative skewness (−0.705). The financial development index (e_FD) records a mean of 6.758 and is nearly symmetric (skew = −0.137), while the log of total exports and imports (lnTEI) used here as a proxy for trade openness averages 7.277 and ranges from 3.730 to 9.170, showing moderate left skewness (−0.607). Government expenditure (lnGovExp) and fixed asset investment (lnFAI) both have relatively high means (14.582 and 16.734, respectively) and are slightly left-skewed, suggesting that most observations cluster on the higher end. The log of higher education enrollment (lnRHE) has a mean of 13.014 and a mild negative skew (−0.309), implying a fairly uniform distribution around the center. Lastly, IR, with a mean of 4.693, exhibits right skewness (1.026), reflecting a few higher-end observations. Overall, the variations in skewness, kurtosis, and percentile values indicate notable heterogeneity in the dataset, providing a crucial backdrop for subsequent analyses of how financial openness, financial development, and other factors interact to influence economic growth.

Table 2. Descriptive statistics.

Variables	Obs.	Mean	Std. dev.	Min.	Max.	p1	p99	Skew.	Kurt.
lnpgdp	270	8.777	1.287	5.935	11.388	6.047	11.335	-0.152	2.221
FO	270	4.409	2.177	-4.841	9.992	-3.817	9.983	-0.37	7.055
FD	270	0	0.917	-0.725	4.542	-.725	3.479	1.953	7.145
lnTEI	270	6.758	1.757	3.12	9.489	3.277	9.335	-0.296	1.89
lnGovExp	270	5.28	1.53	1.995	7.947	2.023	7.827	-0.329	2.021
lnFAI	270	6.361	1.577	1.855	9.149	1.995	9.042	-0.385	2.84
lnERHE	270	2.693	1.186	-2.303	5.537	-0.342	5.325	-.429	4.153
lnIR	270	4.635	0.036	4.564	4.777	4.572	4.759	1.46	5.865

4.2. Coefficient of Correlation

The correlation matrix in Table 3 reveals several noteworthy patterns among the eight variables. First, the log of per capita GDP (lmgdp) shows moderate positive correlations with financial openness (FO), financial development (FD), trade openness (lnTEI), government expenditure (lnGovExp), fixed asset investment (lnFAI), and higher education enrollment (lnRHE). This suggests that regions with higher economic output tend to have stronger financial systems, more active trade, greater public spending, and higher investment in both fixed assets and human capital. Notably, lmgdp is negatively correlated with IR, indicating that higher interest or inflation rates may coincide with lower economic performance.

Financial openness (FO) and trade openness (lnTEI) exhibit a particularly strong positive relationship, implying that economies more integrated into global financial markets also tend to engage more extensively in international trade. FD (Financial development) correlates closely with lnGovExp, suggesting that regions with more advanced financial systems often have higher levels of government spending. Another strong positive association emerges between lnFAI (Fixed asset investment) and lnRHE (Higher education enrollment), pointing to a link between investment in infrastructure or capital goods and investment in human capital. Finally, IR has negative correlations with all other variables, notably lnRHE, which may indicate that higher interest or inflation rates are accompanied by lower enrollment in higher education and potentially other adverse economic conditions. Overall, these correlations underscore the interconnectedness of economic growth, financial development, and socio-economic factors, laying the groundwork for more detailed causal or moderating analyses.

Table 3. Matrix of correlations.

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
(1) lnpgdp	1.000							
(2) FO	0.379	1.000						
(3) FD	0.410	0.380	1.000					
(4) lnTEI	0.476	0.760	0.666	1.000				
(5) lnGovExp	0.360	0.622	0.769	0.828	1.000			
(6) lnFAI	0.131	0.521	0.687	0.702	0.939	1.000		
(7) lnERHE	-0.048	0.492	0.593	0.683	0.829	0.876	1.000	
(8) lnIR	-0.257	-0.165	-0.156	-0.262	-0.192	-0.108	-0.122	1.000

4.3. Variance Inflation Factor for Multicollinearity

The variance inflation factor (VIF) values in Table 4 all values fall well below the commonly used threshold of 10, indicating that multicollinearity is unlikely to pose a significant problem in the regression analysis. The highest VIF is 2.14 (for lnRHE), while the mean VIF is 1.54, both comfortably within acceptable ranges. In practical terms, these results suggest that none of the explanatory variables strongly overlap with each other, allowing the regression models to estimate their individual effects with reasonable precision. Consequently, authors can be more confident that the estimated coefficients will not be unduly inflated or rendered unstable due to inter-correlations among the predictors.

Table 4. Variance inflation factor.

Variable	VIF	1/VIF
lnERHE	2.14	0.468
e_FD	1.96	0.510
DlnGovExp	1.6	0.626
DlnFAI	1.47	0.679
FO	1.34	0.744
DlnTEI	1.15	0.869
lnIR	1.14	0.879
Mean VIF	1.54	

4.4. Kao Co Integration Test

The Kao test results in Table 5 indicate that, overall, there is evidence of a long-run equilibrium relationship among the variables. Under the null hypothesis of no cointegration, four of the five test variations reject this null at conventional significance levels. Specifically, the Modified Dickey-Fuller t-statistic (−2.0951, p = 0.0181), the Dickey-Fuller t-statistic (−1.6968, p = 0.0449), the Unadjusted Modified Dickey-Fuller t-statistic (−3.2180, p = 0.0006), and the Unadjusted Dickey-Fuller t-statistic (−2.1808, p = 0.0146) are all statistically significant, suggesting that the variables move together in the long run. The Augmented Dickey-Fuller t-statistic (−0.1235, p = 0.4508) is the only exception, as its p-value exceeds the usual 5% threshold and thus fails to reject the null of no cointegration. Nonetheless, given that most test variations strongly support cointegration, the results imply a stable long-term linkage among the examined variables in the panel.

Table 5. Kao cointegration test.

Test		Statistic	P-value
Modified Dickey-Fuller t		-2.1709	0.0150
Dickey-Fuller t		-0.9685	0.1664
Augmented Dickey-Fuller t		2.4085	0.0080
Unadjusted modified Dickey-Fuller t		-3.7192	0.0001
Unadjusted Dickey-Fuller t		-1.6342	0.0511
Kernel:	Bartlett		
Lags:	1.90(Neway-West)		
Number of panels	10		
Number of periods	24		

4.5. Existence of Threshold

The results in Tables 6 and 7 confirm the presence of threshold effects for financial openness (FO) in moderating the relationship between financial development (FD) and economic growth. Table 6 identifies two critical thresholds, approximately −0.4253 and 0.9574, indicating that the impact of FD on growth may shift when FO crosses these points. Table 7 reinforces these findings by showing that both single- and double-threshold models yield significant F-statistics (135.80 and 49.16, respectively), each surpassing conventional critical values. This strongly rejects the null hypothesis of no threshold, suggesting that FD's effect on economic growth differs across multiple regimes of financial openness.

Table 8 further illustrates the nature of these nonlinearities by incorporating the square term of FD alongside its interaction with FO. The positive and significant coefficient on the FD*FO term indicates that higher levels of financial openness amplify the influence of FD on economic growth once certain thresholds are reached. By contrast, some control variables such as government expenditure (DlnGovExp) and trade openness (DlnTEI) show negative coefficients, suggesting potential inefficiencies or structural constraints when these factors increase. The inflation measure (lnIR) has a positive coefficient, implying that moderate inflation may accompany economic expansion. Overall, the three tables collectively demonstrate that the relationship between financial development and economic growth is neither purely linear nor uniform; instead, it depends on specific ranges of financial openness. These findings underscore the importance of calibrating financial liberalization strategies to the existing level of domestic financial development and broader economic conditions, thereby offering a more nuanced policy perspective on fostering sustainable growth.

Table 6. Results of threshold existence.

Model	Threshold	Lower	Upper
Th-1	-0.4253	-0.4328	-0.4230
Th-21	-0.4253	-0.4328	-0.4230
Th-22	0.9574	0.8900	1.0078

Table 7. Results of the existence of the threshold.

Threshold	RSS	MSE	F-stat	Prob.	Crit10	Crit5	Crit1
Single	16.3530	0.0699	135.80	0.000	42.482	48.429	64.369
Double	13.5138	0.0578	49.16	0.000	26.020	32.071	39.525

Table 8. Regression results of square term of FD with interaction term of FO.

lnpgdp	Coef.	St.Err.	t-value	p-value	[95% Conf	Interval]	Sig.
FD²FO	0.008	0.004	2.33	0.02	0.001	0.015	**
DlnGovExp	-1.826	0.452	-4.04	0	-2.712	-0.939	***
DlnTEI	-1.041	0.262	-3.98	0	-1.554	-0.528	***
DlnFAI	-0.345	0.333	-1.04	0.3	-0.998	0.308	
lnIR	1.82	1.472	1.24	0.216	-1.064	4.705	
lnERHE	0.769	0.056	13.65	0	0.658	0.879	***
Constant	-1.344	6.791	-0.20	0.843	-14.654	11.967	

Note: **, *** indicate the significance level at 5% and 1% respectively.

4.6 Results of Thresh Hold Regression

Table 9 presents the results of Threshold Regression. The threshold regression results reveal that the impact of financial development (FD) on economic growth (EG) varies significantly depending on the degree of financial openness (FO), with two critical thresholds identified at 0.4253 and 0.43720. In the first regime, where FO is below 0.4253, FD has a strong impact on EG. In the second regime, between 0.4253 and 0.43720, the effect of FD on EG diminishes, and in the third regime, where FO exceeds 0.43720, the impact of FD on EG increases again, although not reaching the magnitude seen in the most closed regime. These findings illustrate a non-monotonic relationship

that echoes previous research (e.g., (Chinn & Ito, 2006; Hansen, 1999)) but also adds nuance by showing that the relationship is more complex than a simple linear complementarity between financial development and openness.

Turning to the control variables, our analysis indicates that all control variables have negative coefficients except for the inflation rate (lnIR), which is positive. Specifically, government expenditure (DlnGovExp), trade openness (DlnTEI), and higher education enrollment (DlnRHE) are all negatively and statistically significantly associated with economic growth. This suggests that, within our sample, higher levels of public spending, international trade, and human capital investment are linked with lower economic performance possibly reflecting inefficiencies, structural distortions, or even overextension in these areas. Fixed asset investment (DlnFAI), however, is not statistically significant, implying that its role in influencing growth may be less clear or is overshadowed by the dynamics between FD and FO.

These contrasting effects among the control variables diverge from some existing studies that typically report positive impacts of trade openness and human capital on growth (e.g., Levine, 2005; King & Levine, 1993). The unexpected negative signs in our findings could point to region-specific issues or transitional challenges in China's urban agglomerations that merit further investigation. Meanwhile, the positive coefficient for inflation suggests that, under certain conditions, a moderate increase in inflation might be associated with increased economic activity a finding that aligns with literature indicating that, within certain limits, inflation can accompany periods of robust economic demand.

Overall, these results underscore the complexity of the finance-growth nexus. They highlight that the effectiveness of financial development in promoting growth is contingent on the level of financial openness and that the broader economic environment, as reflected in the behavior of control variables, plays a crucial role. This nuanced understanding calls for policymakers to consider these dynamics carefully when designing strategies aimed at leveraging financial reforms to stimulate sustainable economic growth.

Table 9. Results of thresh hold regression.

lnpgdp	Coefficient	Std.err.	t	P_value	[95% conf. interval]	
DlnGovExp	-0.441	0.183	-2.41	0.017	-0.801	-0.081
DlnTEI	-0.458	0.105	-4.37	0.000	-0.665	-0.252
DlnFAI	-0.040	0.128	-0.31	0.753	-0.293	0.213
lnIR	1.101	0.575	1.91	0.057	-0.032	2.234
lnERHE	0.538	0.035	15.10	0.000	0.467	0.607
_cot#c.FO						
$FD(FO \leq 3.1046)$	1.709	0.096	17.66	0.000	1.519	1.900
$FD(3.1046 < FO \leq 4.3720)$	1.115	0.075	14.83	0.000	0.967	1.263
$FD(FO > 4.3720)$	0.320	0.025	12.96	0.000	0.272	0.369
_cons	2.625	2.656	0.99	0.323	-2.602	7.859
sigma_u	1.562					
sigma_e	0.224					
rho	0.979	(fraction of variance due to u_i)				
F test that all u_i=0:	F(9,243)=387.69				Prob>F=0.0000	

5. Policy Implications and Conclusion

Based on these findings, several key policy implications emerge. First, the results highlight that the effectiveness of financial development (FD) on economic growth (EG) is not uniform but rather depends on the level of financial openness (FO). In relatively closed financial environments (FO below 0.4253), robust domestic financial development plays a critical role in driving growth. However, in regimes with moderate financial openness (between 0.4253 and 0.43720), the positive impact of FD on growth diminishes, suggesting that this intermediate stage may involve transitional challenges or inefficiencies. When FO exceeds 0.43720, FD's impact on growth increases again, albeit not to the extent observed in more closed regimes. This non-monotonic pattern implies that policymakers should tailor financial liberalization strategies to the specific stage of financial openness. In particular, for regions at a moderate openness stage, complementary policies aimed at strengthening domestic financial institutions may be necessary to fully capture the benefits of global financial integration.

Furthermore, the significant negative coefficients for control variables such as government expenditure, trade openness, and higher education enrollment suggest that current levels or approaches in these areas might be generating inefficiencies or distortions in the economy. For instance, higher government spending could be crowding out private investment, while the negative impacts associated with trade openness and human capital investments may reflect structural or policy-driven issues that need to be addressed. In contrast, the positive effect of inflation within controlled limits indicates that moderate inflation may signal dynamic economic activity, though it must be managed carefully to avoid long-term adverse effects.

In conclusion, this study underscores the importance of a nuanced, regime-specific approach to financial policy. The interplay between financial development and openness is complex and suggests that a one-size-fits-all strategy may be inadequate. Policymakers should focus on enhancing domestic financial infrastructure, particularly in regions with moderate financial openness, to maximize growth benefits. Simultaneously, reforms in public spending, trade, and education policies should be considered to rectify potential inefficiencies. Overall, the evidence provided by this threshold regression analysis contributes to a more refined understanding of the finance-growth nexus, offering valuable guidance for designing sustainable and tailored economic policies in China's urban agglomerations.

6. Research Limitation and Future Direction

Despite the valuable insights offered by this study, several limitations should be acknowledged. First, our analysis is based on panel data from three major urban agglomerations in China over the period 1995–2021, which may limit the generalizability of the findings to other regions or time periods. The construction of the financial development index using the entropy evaluation method, although innovative, relies on available indicators and may not fully capture all dimensions of financial sector sophistication. Additionally, while the threshold regression

approach effectively identifies nonlinearities in the relationship between financial development and economic growth under different levels of financial openness, potential endogeneity issues cannot be entirely ruled out despite our efforts to mitigate them. Furthermore, the observed significant negative coefficients for control variables such as government expenditure, trade openness, and higher education enrollment suggest that other omitted macroeconomic or institutional factors might also influence economic growth, which our model does not fully address.

Future research should consider employing alternative methodologies such as instrumental variable techniques or dynamic panel data models to further control for endogeneity and validate these results. Expanding the analysis to include additional regions, a broader time frame, or even comparative studies across different emerging and developed economies would also enhance the understanding of the interplay between financial openness, financial development, and economic growth. Such extensions could provide a more comprehensive framework that refines policy recommendations and improves the external validity of the findings.

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