The Impact of Financial Openness on Economic Growth - A Case Study of China's Beijing-Tianjin-Hebei Region

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Abstracts
This paper first uses a Principal Component Analysis (PCA) to determine both the comprehensive index of financial openness and financial development in the Beijing-Tianjin-Hebei(BTH) region, then discusses the impact of financial openness and financial development on economic growth with a threshold regression model from a regional perspective with a data from 2000-2020. The results indicate that the financial market scale in Beijing from 2000-2014 and in Tianjin from 2000-2001 is not sufficient to support the financial openness, so the financial openness in this period hurts the development of the region's economy; the financial market scale in Tianjin from 2008-2020 and in Hebei from 2000-2020 too inflated compared to the lower level of financial openness, which is also unfavorable to economic growth in this region. On the another hand, with the level of financial openness in Beijing from 2006-2018 and in Tianjin from 2013-2020, the development of transaction volume in the financial market has reached an optimal level to promote the economic development of the region.
Keywords: Financial Openness, Economic Growth, Financial Development, BTH

Introduction
China's president Xi Jinping called for a regional strategy to build Beijing as the capital of the Beijing-Tianjin-Hebei area (BTH) in 2014. The development goal of the BTH region is to become the main platform for China's strong competitiveness in the international economic system. Meanwhile, China's financial industry began to open to the outside world in a planned and step-by-step manner since China's accession to the WTO in 2001. The Regulations on the Administration of Foreign Banks, as well as the precise rules for their implementation, were passed at the end of 2006, removing limits on foreign banks' territory and clients to do RENMINBI operations. For the first time, international banks' assets in China exceeded one trillion yuan in 2007. China's financial Openness has advanced in recent years, with significant changes to financial policy and faster banking sector reform.

Since the 1970s, academics, and policymakers, in general, have believed that financial deregulation will boost economic growth. However, after more than 30 years of financial

globalization, cross-border capital flows have increased rapidly and the role of financial openness in driving economic growth is controversial(Obstfeld, 2009).

Against this background, studying the impact of Beijing-Tianjin-Hebei's financial openness on economic growth will provide an important reference for the formulation and implementation of financial opening-up policies in other economic regions of China or China as a whole.

The remainder of this study is organized as follows. Section 2 provides a review of the literature. The methodology and data are described in Section 3 and Section 4, respectively, followed by a thorough analysis of the empirical results in Section 5. Section 6 provides conclusions and recommendations.

Literature review
The positive effect of financial openness on economic growth
As for the research on the effect of financial openness on economic growth, with the continued advancement of global financial integration, many academics have concluded that financial openness contributes to economic growth. Global financial integration, according to Edison et al (2002) promotes economic growth primarily through three channels.

Financial openness encourages the entry of more efficient foreign banks, which may lead to the import of risk management technologies and new financial instruments and services, thereby improving the domestic financial system and the efficiency of a country's financial institutions, and thus indirectly raising investment returns and economic growth rates (Jimei et al., 2020).

Tao Xionghua et al (2017) investigated the financial openness level and spatial correlation of 31 provinces in China from 2004 to 2014. Their findings are as follows: first, the overall level of financial openness in China's provinces is not high, and relevant national policies play an important role in promoting financial openness; Second, there is a strong spatial connection between the level of provincial financial openness in China. Third, the economic growth effect of financial openness and its spatial spillover effect is quite significant, indicating that the economic growth of each province is not only related to the financial openness level of its province but also affected by the financial openness status of neighboring provinces (Tao Xionghua & Xie Shoutao, 2017).

The Negative Effect of Financial Openness on Economic Growth
Xie Shouqiong (2017) argued there exists a strong spatial and temporal relationship of China's provincial level of financial openness, which is increased gradually with the growing effects of the economic relationship between the provinces; the third, regional distribution of the level of financial openness is uneven and has obvious regional agglomeration characteristics.

Karim et al (2021) used the method of a dynamic panel threshold and found a threshold effect in the financial inclusiveness-growth nexus.

Obstfeld (2009) found financial openness is not a panacea—and it could be poison. The empirical record suggests that its benefits are most likely to be realized when implemented in a phased manner, when external balances and reserve positions are strong, and when complementing a range of domestic policies and reforms to enhance stability and growth.

The non-linear relationship between financial openness and economic growth
Some scholars have studied the effects of financial openness on economic growth as non-linear. For example, Jimei (2020) applied Hansen's non-dynamic panel threshold model from

a country perspective and used five indicators from three dimensions of financial development as threshold variables to examine the heterogeneity of financial development level in different dimensions of economic growth. The study shows that financial openness has different effects on economic growth at different levels of financial development (Jimei et al., 2020).

Drawing on balanced panel data of 30 Chinese provinces in 1987–2017, Guangchen Li & Wei (2021) examined the impact of carbon emissions on economic growth through the panel smooth transition regression model. one of their results revealed that noticeable non-linear relationships do exist among carbon emissions, financial development, openness, innovation, and economic growth (Li & Wei, 2021).

Based on the panel data of 31 provinces in China from 2007 to 2019, Shengtao, and Wei Yaqian (2021) measured the level of regional financial openness and regional financial risk and empirically studied the dynamic impact of regional financial openness on regional financial risk by using a state-space model. 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 (Shen Tao & Wei Yaqian, 2021).

Upon the above literature review, we propose our hypothesis here: There is at least one threshold of FO(Financial Openness), and before and after this threshold, the impact of financial development on economic growth can change.

Methodology
Model Construction

This paper firstly estimates the Financial Development indicator and Financial Openness indicator using Factor analysis and Principal Component Analysis, then put the Financial Development indicator, Financial Openness indicator, and other control variables into an endogenous economic growth model, apply a dynamic panel threshold model to test whether there are one or more thresholds of financial openness in the financial development process that promote economic growth.

Our model is originally derived from the Cobb-Douglas production function to measure economic growth and borrows the classical analytical framework of the production function of the neoclassical economic school, according to Solomon Oluwaseun Okunade(Okunade, 2022), Therefore, the equation can be decomposed to:

$$Y = f(FD, FO, K, L)\ldots\ldots\ldots\ldots\ldots\ldots(3.6)$$

Furthermore, referring to Siong Hook Law el al. 's (Law & Singh, 2014) empirical model, we can write the above equation in this way:

$$PGDP_{it} = \alpha_0 + \beta_1 FO_{it} + \theta\chi_{it} + \varepsilon_{it}\ldots\ldots\ldots\ldots\ldots\ldots\ldots(3.7)$$

Where $PGDP$ refers GDP per capita, FO refers Financial Openness, and i represents different provinces or municipalities within the scope of the cross-section (i = 1, …, N), t indicates the time-series dimension for each unit (t = 1,…, T), χ_{it} indicates an m-dimensional vector of explanatory regressors that include the threshold variable and other control variables. α_0 is the specific fixed effect, $\varepsilon_{it} \approx (0, \sigma2)$ is the independently and identically distributed error term.

According to the non-dynamic panel threshold regression model proposed by Hansen(Hansen, 1999), the single threshold model should be:

$$PGDP_{it} = \alpha_0 + \beta_1' FO_{it} \cdot I(FD_{it} \leq \gamma) + \beta_2' FO_{it} \cdot I(FD_{it} > \gamma) + \theta\chi_{it} + \varepsilon_{it}\ldots\ldots\ldots\ldots\ldots\ldots(3.2)$$

where γ is the unknown threshold parameter, when $FD_{it} \leq \gamma$, the coefficient of FO_{it} is β_1', when $FD_{it} > \gamma$, the coefficient of FO_{it} is β_2', The threshold model holds only when the time comes $\beta_1' \neq \beta_2'$. Therefore, it can be reflected in the threshold variable when FD_{it} is in different ranges, the impact of financial opening up on economic growth will be different, and then expand equation (3.2) to a double threshold model, as shown in equation (3.3):

$$PGDP_{it} = \mu_i + \beta_1'FO_{it} \cdot I(FD_{it} \leq \gamma_1) + \beta_2'FO_{it} \cdot I(\gamma_1 < FD_{it} \leq \gamma_2) + \beta_3' \cdot FO_{it} \cdot I(FD_{it} > \gamma_1) + \theta\chi_{it} + \varepsilon_{it} \dots\dots\dots\dots\dots(3.3)$$

Similarly, if we take FO (financial openness) as a threshold to test whether financial development has a threshold effect on economic growth, the equation can be expressed as follows:

$$PGDP_{it} = \mu_i + \beta_1'FD_{it} \cdot I(FO_{it} \leq \gamma_1) + \beta_2'FD_{it} \cdot I(\gamma_1 < FO_{it} \leq \gamma_2) + \beta_3' \cdot FD_{it} \cdot I(FO_{it} > \gamma_1) + \theta\chi_{it} + \varepsilon_{it} \dots\dots\dots\dots\dots(3.4)$$

Variable Selection

(1) The explained and main explanatory variables

The explained variable is GDP per capita(PGDP). For the core explanatory variables of Financial Openness and Financial Development, many researchers use only one indicator or two from either the banking market or capital market to represent the level of Financial Openness or Financial Development, which is not comprehensive enough to describe the whole picture of the Financial Openness or Financial Development in a certain area. In this paper, we adopt the method of Ozkok (2015); Xiaobo (2012); Tingting & Gaobo (2020), and choose indicators from the banking market, stock market, bond market, and insurance market and extract a comprehensive index by using principal component analysis (PCA). The description of FD and FO variables is illustrated below

Table 1

Description of financial development variables

Name of Variables	Description
Banking Market	the total loans in the financial system/GDP
	total deposits in the financial system/ GDP
	total household savings deposited in the financial system/GDP
	Deposit money banks' assets to GDP
	Number of institutions in the banking system
Stock Market（Including B shares, H shares, and futures）	Companies Listed by Year-end(unit)
Bond market	Securities fund management
Insurance market	Gross premiums /GDP
	Number of insurance system organizations

Table 2
Description of financial openness variables

Name of Variables	Description
Capital account opening	Foreign direct investment/GDP
Financial market opening	Number of H share, and oversea share listed companies
	Foreign exchange transaction & Cross-border RMB settlement volume
	Foreign banks among total banks

(2) Control variables

The control variables cover the ratio of exports to imports versus GDP (EI), inflation rate (INF), natural population growth rate(NPG), government expenditure rate(GE), average investment rate(AIR), the gross enrollment rate of higher education(HEE). The definition and description of the control variables are presented in Table 3.

Table 3
Description of control variables

Control variable	Description
EI	The ratio of exports to imports versus GDP
INF	Inflation rate
GE	Government expenditure rate
AIR	Average investment rate
HEE	The gross enrollment rate of higher education

Data

This paper examines the annual data of Beijing, Tianjin, and Hebei provinces from 2000 to 2020. The data are obtained from the China Financial Statistical Yearbook, the China City Statistical Yearbook for various years, the statistical yearbooks of each province, the database of the China Economic Network and the National Bureau of Statistics, the official website of the People's Bank of China, and the State Administration of Foreign Exchange. Some variables have missing values in individual years. We used Stata to fill in the missing values. The variables except for inflation rate (IR) are logarithmized. IR is calculated as the previous year=100. Table 4 shows the descriptive statistics for all variables.

Table 4
Descriptive Statistics for Variables

variable	min	p25	p50	p75	max
lnpgdp	8.849	10.139	10.688	11.237	12.013
lndfin	7.745	9.284	10.206	10.932	12.113
lnlfin	7.540	8.889	9.803	10.465	11.311
lnhousedep	6.690	7.980	8.920	9.445	10.666
lnba	8.006	9.231	10.621	11.212	12.564
lnnob	4.663	5.595	7.879	8.053	8.367
lnnumlc	2.773	3.555	3.912	4.419	5.943
lnsfm	3.096	7.073	9.265	10.182	11.235
lngp	3.449	5.168	6.211	6.837	7.742
lnnoi	4.625	5.956	6.405	7.480	8.574
lnfdi	11.191	12.639	13.271	13.800	14.705
nholc	1.000	14.000	23.000	62.000	773.000
lnfecbsv	1.639	5.083	6.981	8.323	12.690
fbtb	1.000	2.000	19.000	99.000	161.000
lntie	3.958	6.041	6.470	7.200	8.366
ir	98.200	101.400	102.000	103.100	106.200
lngovexp	5.231	6.600	7.749	8.337	9.108
lnfai	6.390	7.830	8.837	9.361	10.565
lnerhe	1.515	2.589	2.746	3.220	3.963

Empirical results analysis
Principal component analysis (PCA)
Principal Component Analysis of Financial Development
First, we need to perform the SMC test on the variables for principal component analysis.

Table 5
The result of the SMC Test

Variable	SMC
lndfin	0.9925
lnlfin	0.9840
lnhousedep	0.9936
lnba	0.9269
lnnob	0.9444
lnnumlc	0.9433
lnsfm	0.7889
lngp	0.9802
lnnoi	0.6521

The results of the SMC test show that the SMC value of most variables is above 0.7, so the principal component analysis can be performed. Stata is used to perform principal component analysis of the correlation coefficient matrix of the relevant variables representing financial development. According to the extraction condition that the eigenvalue is greater than 1, two principal components can be extracted.

Table 6
The result of PCA of FD

Variable	Comp1	Comp2	Unexplained
lndfin	0.4027	0.0010	.02525
lnlfin	0.4014	0.0263	.03015
lnhousedep	0.3987	-0.1344	.01083
lnba	0.3917	0.0201	.07719
lnnob	0.1293	-0.6264	.1721
lnnumlc	0.3430	-0.2554	.1718
lnsfm	0.2591	0.2610	.4702
lngp	0.3881	0.1643	.04451
lnnoi	0.1100	0.6544	.1335

Based on the information content of the individual variables carried by the extracted principal components, it can be seen that the two proposed principal components are the financial market transaction volume component (FD_1) and the financial market scale component (FD_2).

Principal Component Analysis of Financial Openness

Principal component factor analysis is performed for the relevant variables representing financial openness, and a principal component（FO） with an eigenvalue greater than 1 can be identified.

Table 7
The result of PCA of FO

Variable	Factor1	Uniqueness
lnfdi	0.7364	0.4576
nholc	0.8878	0.2118
lnfecbsv	0.9562	0.0856
fbtb	0.8642	0.2531

The Result of Linear Regression
Table 8
The Result of Linear Regression

	lnpgdp
FD_1	0.171**
	[0.020]
FD_2	-0.078**
	[0.017]
FO	0.016
	[0.745]
lntie	0.277***
	[0.000]
ir	0.006
	[0.611]
lngovexp	-0.314
	[0.204]
lnfai	0.580***

	[0.000]
lnerhe	-0.763***
	[0.000]
_cons	7.650***
	[0.000]
N	63
adj. R-sq	0.970

Note: p-values in brackets
* $p<0.1$, ** $p<0.05$, *** $p<0.01$

FD_1 and FD_2 are the two principal components to represent Financial Development Index. FO is the principal component to represent Financial Openness Index.

Tables 9 and Figure1 present the descriptive statistics and the scatterplots of the pairwise correlation matrix of the variables employed in the analysis, respectively. From Figure1, It can be seen that all other variables are significantly correlated with lnpgdp, indicating that it is feasible to use them to explain lnpgdp.
As shown in the following table

Table 9
Descriptive Statistics

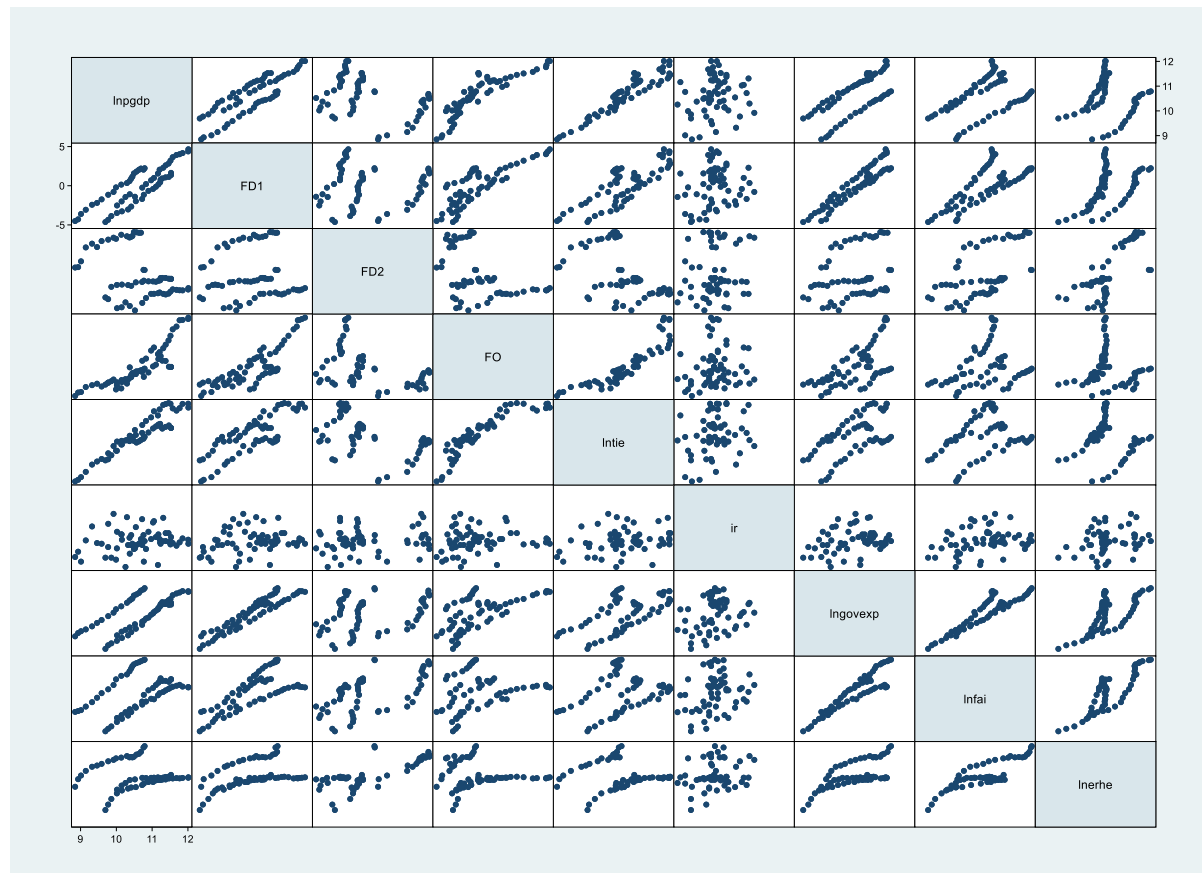| variables	min	p25	p50	p75	max
lnpgdp	8.849	10.139	10.688	11.237	12.013
FD_1	-4.632	-1.975	0.217	1.811	4.659
FD_2	-2.042	-1.017	-0.383	1.562	2.436
FO	-2.573	-1.352	-0.415	0.820	4.304
lntie	3.958	6.041	6.470	7.200	8.366
ir	98.200	101.400	102.000	103.100	106.200
lngovexp	5.231	6.600	7.749	8.337	9.108
lnfai	6.390	7.830	8.837	9.361	10.565
lnerhe	1.515	2.589	2.746	3.220	3.963

Source: STATA Version 15 output

Figure1 : The Scatterplots of Pairwise Correlation Matrix

Results of threshold regression model analysis

FD_1 as a Threshold

Using equation (3.3) and taking FD_1 (the financial market transaction volume component) as a threshold to test whether the threshold effect of financial openness on economic growth is affected by the transaction volume of the different financial markets.
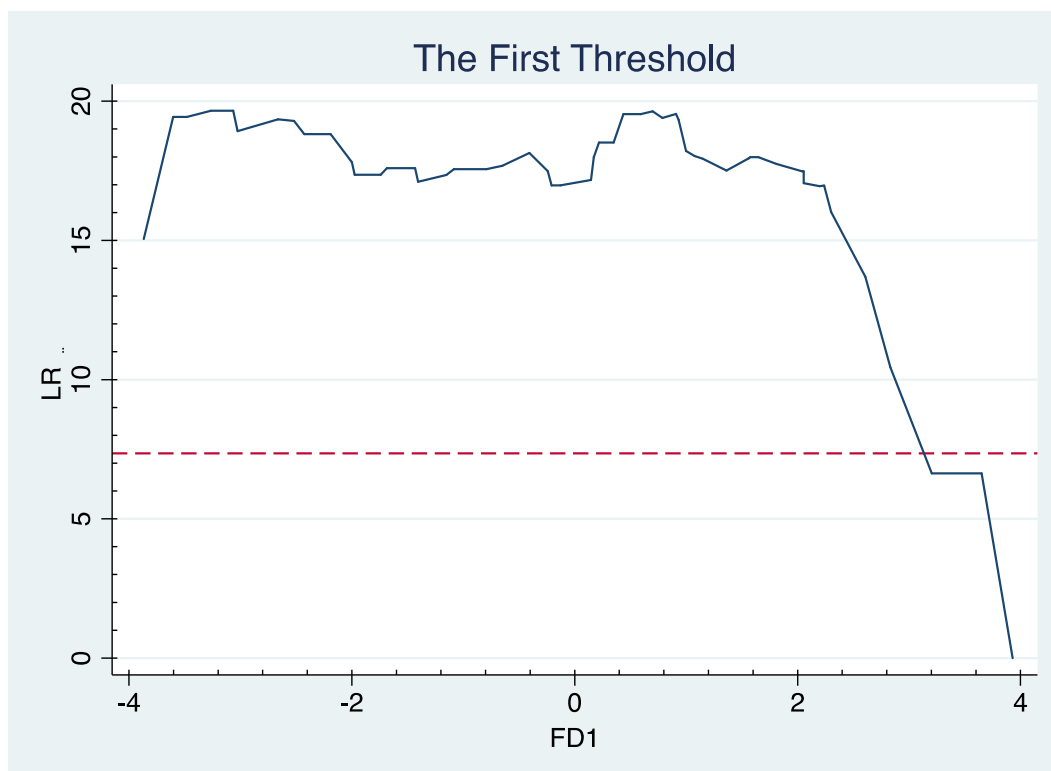
Figure 2: the first threshold

Table10
Threshold Estimates and Confidence Intervals

	Threshold Estimates	[95%Conf. Interval]
Single Threshold	3.930	[3.204 , 3.930]
Double threshold		
Ito1	-3.868	[-3.868 , 2.238]
Ito2	4.171	[3.930 , 4.171]
Triple Threshold	2.832	[-3.025 , 2.832]

Table 11
Threshold Effect Self-Sampling Test

Model	F-statistic	P-values	BS times	Critical Value		
				1%	5%	10%
Single Threshold	21.538	0.388	500	64.796	64.796	35.052
Double threshold	11.120	0.184	500	33.966	20.160	18.815
Triple Threshold	6.729**	0.048	500	8.833	6.729	4.104

The result shows there should be no thresholds.

FD₂ as a Threshold
Using equation (3.3) and taking FD_2 (the financial market scale component) as a threshold to test whether the threshold effect of financial openness on economic growth is influenced by the different financial market scales.
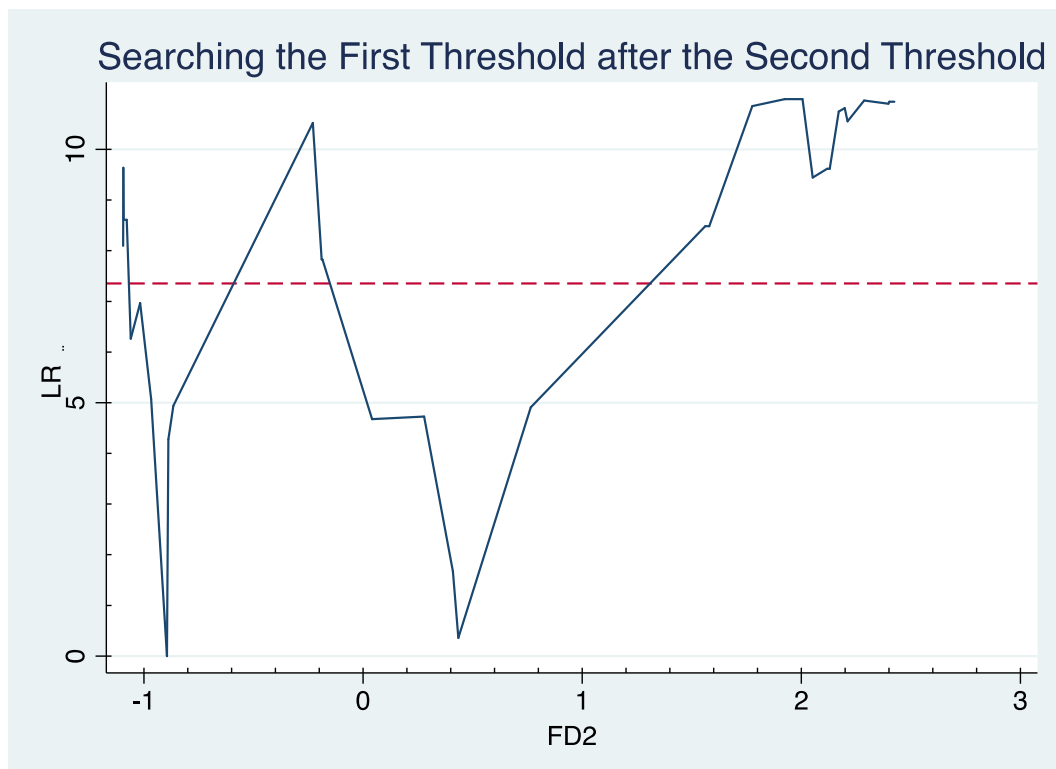
Figure3: Two thresholds of FD2

Table 12
Threshold Estimates and Confidence Intervals

	Threshold Estimates	[95%Conf. Interval]
Single Threshold	-0.895	[-1.095 , 2.118]
Double threshold		
Ito1	-0.436	[-0.583 , 2.424]
Ito2	-0.895	[-1.061 , 0.765]
Triple Threshold	0.765	[0.434 , 1.562]

Table 13
Threshold Effect Self-Sampling Test

Model	F-statistic	P-values	BS times	Critical Value 1%	5%	10%
Single Threshold	3.584	0.202	500	7.704	6.884	3.995
Double threshold	4.939***	0.000	500	4.939	4.674	3.466
Triple Threshold	9.986	0.268	500	25.785	25.785	24.792

The result shows there should be two thresholds.

Table 14
The Result of Double Threshold Regression Model

R-sq: within = 0.9937   Obs per group: min =21
   between=0.1282   avg =21.0
   overall=0.6408   max =21
F(9,51) = 890.12
corr(u_i, Xb)=-0.1111   Prob > F= 0.0000

lnpgdp	Coef.	Std. Err.	t	P>|t|	[95%Conf. Interval]
FD1	.1320028	.0297862	4.43	0.000	[.0722045, .191801]
lntie	.1172635	.03973	2.95	0.005	[.0375021, .1970249]
ir	-.0015535	.0051207	-0.30	0.763	[-.0118336, .0087267]
lngovexp	.2615184	.0996588	2.62	0.011	[.0614451, .4615917]
lnfai	-.0529934	.0644586	-0.82	0.415	[-.1823993, .0764126]
lnerhe	.169403	.0656571	2.58	0.013	[.0375908, .3012153]
FO_1	-.0167032	.0218537	-0.76	0.448	[-.0605764, .0271699]
FO_2	.0088535	.0198901	0.45	0.658	[-.0310776, .0487845]
FO_3	-.0291338	.0243444	-1.20	0.237	[-.0780073, .0197396]
cons	8.016452	.5808119	13.80	0.000	[6.850423, 9.18248]
sigma_u	.56952688				
sigma_e	.05372053				
rho	.99118129	(fraction of variance due to u_i)			

F test that all u_i=0: F(2, 51) = 143.18   Prob > F = 0.0000

Robustness test
Table 15
The Result of Robustness Test

	fe1	fe_robust1
FD1	0.134***	0.134
	(4.70)	(2.38)
lntie	0.140***	0.140***
	(3.47)	(14.11)
ir	-0.00263	-0.00263
	(-0.53)	(-0.55)
lngovexp	0.227**	0.227
	(2.37)	(2.35)
lnfai	-0.0356	-0.0356
	(-0.58)	(-0.68)
lnerhe	0.170**	0.170
	(2.67)	(1.18)
$\beta'_1 - FO(FD2 \leq \gamma_1)$	-0.0390***	-0.0390**
	(-2.98)	(-4.33)
$\beta'_2 - FO$	0.00949	0.00949
	(0.49)	(0.24)
$\beta'_3 - FO(FD2 > \gamma_2)$	-0.0426**	-0.0426
	(-2.30)	(-1.85)
_cons	8.084***	8.084***
	(14.40)	(12.98)

r2	0.994	0.994
r2_w	0.994	0.994
N	63	63
F	950.9	.

t-statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

The results of the robustness test, with individual effects and heteroscedasticity removed, show: When FD2 is smaller than -0.895, the impact of FO (financial openness) on economic growth is significantly negative, whether heteroscedasticity is taken into account or not. While FD2 is larger than -0.436, it has a significantly negative effect when the individual effect is removed without considering heteroscedasticity, and the negative impact tends to increase. When FD2 lies between the two values, the relationship between financial openness and economic growth is positive but not significant, i.e. changes in financial openness do not have a statistically significant impact on economic growth.

FO as a Threshold
Using equation (3.4) and FO (financial openness component) as a threshold, we test whether the threshold effect of financial market transaction volume(FD1) on economic growth is affected by different levels of financial openness. The analysis results show that there are two thresholds.
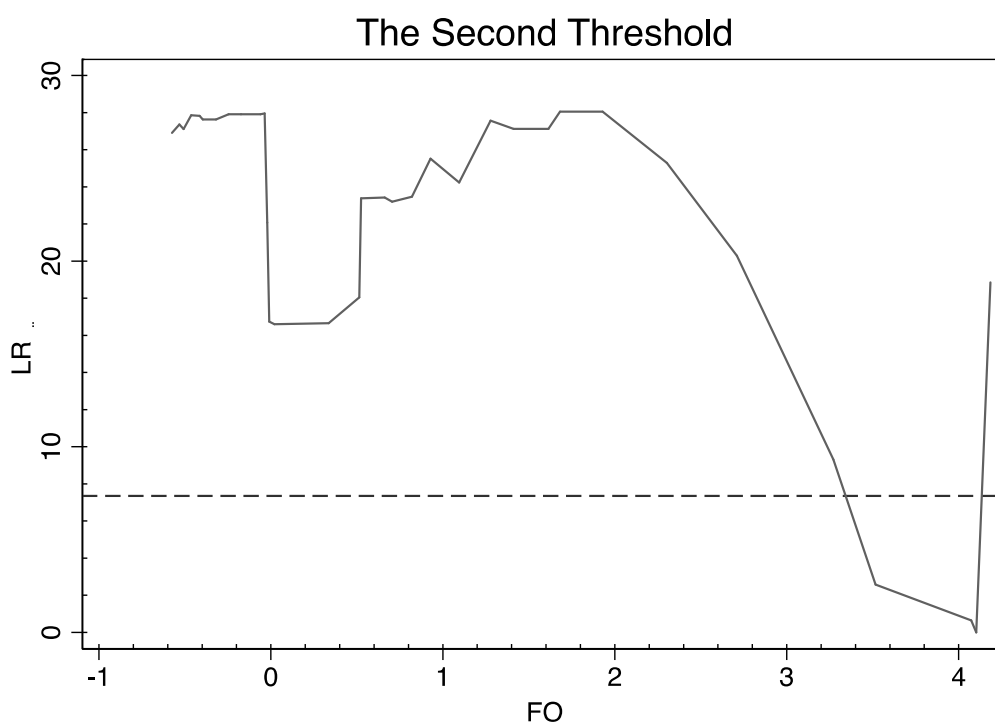

Figure 3: the Second threshold

Table 16
Threshold Estimates and Confidence Intervals

	Threshold Estimates	[95%Conf. Interval]
Single Threshold	-1.134	[-1.181 , 0.929]
Double threshold		
lto1	4.102	[3.517 , 4.102]
lto2	0.514	[-1.181 , 1.095]
Triple Threshold	-1.181	[-1.277 , -0.652]

Table 17
Threshold Effect Self-Sampling Test

Model	F-statistic	P-values	BS times	Critical Value 1%	5%	10%
Single Threshold	8.683**	0.030	500	8.683	6.343	4.614
Double threshold	32.567**	0.044	500	32.567	30.63	23.227
Triple Threshold	10.728***	0.000	500	10.728	10.728	7.169

Table 18
The Result of Robustness Test

	fe1	fe_robust1
FD_2	-0.0256	-0.0256
	(-1.56)	(-1.83)
lntie	0.129***	0.129*
	(4.45)	(4.16)
ir	0.0000429	0.0000429
	(0.01)	(0.01)
lngovexp	0.234**	0.234
	(2.44)	(2.57)
lnfai	-0.0630	-0.0630
	(-0.95)	(-1.61)
lnerhe	0.0242	0.0242
	(0.41)	(0.25)
$FD_1(FO \leq \gamma_1)$	0.0541***	0.0541*
	(2.86)	(3.56)
FD_1	0.116***	0.116*
	(3.69)	(3.08)
$FD_1(FO > \gamma_2)$	0.0440***	0.0440**
	(5.62)	(8.17)
_cons	8.518***	8.518***
	(17.43)	(13.85)
r2	0.996	0.996
r2_w	0.996	0.996
N	63	63
F	1401.2	.

t statistics in parentheses
p<0.1, ** p<0.05, *** p<0.01

The results of the robustness test, with individual effects and heteroscedasticity removed, show: When FO (financial openness) is less than 0.514, the effect of FD_1 (the financial market transaction volume component) on economic growth is significantly positive, whether or not heteroscedasticity is taken into account. When FO is greater than 4.102, it also has a significant positive impact on economic growth, but the positive impact tends to decrease. When FO is between the two values, the relationship between financial market transaction volume and economic growth remains significantly positive, and this positive effect reaches its highest value.

Using equation (3.4) and FO (financial openness component) as a threshold, we test whether the threshold effect of financial market scale component(FD_2) on economic growth is affected by different levels of financial openness.

Table 19
Threshold Estimates and Confidence Intervals

	Threshold Estimates	[95%Conf. Interval]
Single Threshold	1.095	[0.525 , 1.614]
Double threshold		
Ito1	4.102	[4.072 , 4.102]
Ito2	1.095	[-1.501 , 1.095]
Triple Threshold	-1.501	[-1.577 , -0.021]

Table 20
Threshold Effect Self-Sampling Test

Model	F-statistic	P-values	BS times	Critical Value		
				1%	5%	10%
Single Threshold	10.562	0.148	500	18.036	18.036	12.354
Double threshold	18.437	0.158	500	29.094	29.094	27.792
Triple Threshold	1.739**	0.042	500	2.109	1.739	1.436

The result shows there should be no thresholds.

Conclusions and recommendations
Conclusions
Table 21
Results of Static Panel Threshold Estimations

	Linear Regression	5.3.1(Eq.3.3) FD1 as a thred.	5.3.2(Eq.3.3) FD2 as a thred.	5.3.3.1(Eq.3.4) FO as a thred.(FD1)	5.3.3.2(Eq.3.4) FO as a thred.(FD2)
r (95%conf.interval)	---	no thresholds	r1=-0.436 [-0.583-2.424] r2=-0.895 [-1.061-0.765]	r1=4.102 [3.517-4.102] r2=0.514 [-1.181-1.095]	no thresholds
β_1'			-0.0390** (-4.33)	0.0541* (3.56)	
β_2'	---	---	0.00949 (0.24)	0.116* (3.08)	---
β_3'			-0.0426(**) (-1.85)	0.0440** (8.17)	
Financial variable	FD1-0.171** FD2--0.078** FO-0.016		FD1-0.134(***) (2.38)	FD2--0.0256 (-1.83)	
lntie	0.277***		0.140*** (14.11)	0.129* (4.16)	
ir	0.006		-0.00263 (-0.55)	0.0000429 (0.01)	
lngoverxp	-0.314		0.227(**) (2.35)	0.234(**) (2.57)	
lnfai	0.580***		-0.0356 (-0.68)	-0.0630 (-1.61)	
lnerhe	-0.763***		0.170(**) (1.18)	0.0242 (0.25)	
-cons	7.650***		8.084*** (12.98)	8.518*** (13.85)	

Dependent variable: Economic growth.⌇SEP⌇
t statistics in parentheses
* p<0.1, ** p<0.05, *** p<0.01

According to the results of 5.3.2 combined with the financial development and financial openness data of Beijing, Tianjin, and Hebei, the financial market scale component (FD$_2$) in Beijing from 2000-2014 and in Tianjin from 2000-2001 is smaller than -0.895, indicating that the development of financial openness in this period hurts the development of the region's economy; these figures in Tianjin from 2008-2020 and in Hebei from 2000-2020 are both larger than -0.436, indicating that the development of financial openness has a greater negative impact on the economic development of the region. From the review of the results of 5.3.3.1 combined with the data on financial development and financial openness of Beijing, Tianjin, and Hebei, it can be seen that the financial openness component (FO) in Beijing from 2000-2005, Tianjin from 2000-2012 and Hebei from 2000-2020 are all less than 0.514, which shows that the development of financial market transaction volume (FD$_1$) has a weak positive impact on the development of the region's economy during this period; the indicator is greater than 4.102 in Beijing from 2019-2020, which promotes the development of financial market transaction volume (FD$_1$) and has a positive impact on the region's economic development, but with a decreasing trend. When the indicator is between 0.514-4.102 in Beijing from 2006-

2018 and in Tianjin from 2013-2020, the development of transaction volume in the financial market (FD_1) has reached an optimal level to promote the economic development of the region.

Considering that FD_1 mainly represents the volume of financial market transactions, including credit scale, the volume of securities transactions, and the volume of insurance income, etc., FD_2 mainly represents the number of banking institutions and insurance institutions. From the research results, in the Beijing-Tianjin-Hebei region, Beijing has the highest degree of financial openness. Therefore, a possible explanation for the research results of 5.3.2 is that for Beijing, which has the highest degree of financial openness, the number of banking and insurance institutions in the region during 2000-2014 does not correspond to the higher degree of financial openness. Under these circumstances, the development of financial openness harms economic growth because the number of service posts of financial institutions cannot meet their development needs. Due to the low level of financial openness in Tianjin and Hebei, the number of banks and insurance institutions in Tianjin from 2008-2020 and in Hebei from 2000-2020 is too inflated compared to the lower level of financial openness, which is even more unfavorable to economic growth in this region. The possible explanation for the research results of 5.3.3.1 is that the level of financial openness in Beijing has exceeded the optimal level after 2019, which is manifested in the accumulation of more financial risks with the excessive growth of the volume of financial market transactions, making the development of the volume of financial market transactions play a decreasing role in promoting economic growth in the region. Since 2013, the financial openness degree in Tianjin is currently at the optimal level to promote economic growth through the development of the volume of financial market transactions. Hebei, on the other hand, still needs to increase its financial openness degree to further increase the volume of financial market transactions and add more vitality, thereby promoting the region's economic growth at a faster pace.

Recommendations

In light of the above conclusions, we recommend

First, considering Beijing's relatively high level of financial openness, the current scale of its financial institutions is insufficient to enable its financial openness policies to promote economic growth effectively. Investment in increasing the number of banks and insurance institutions should continue, allowing Beijing's high level of financial openness to positively impact economic growth. On the other hand, Tianjin and Hebei, given their relatively underdeveloped levels of financial openness, already have financial institution scales that exceed their optimal sizes. The number of banks and insurance institutions in these regions should be appropriately reduced to return to a reasonable range. This adjustment will better align the scale of financial institutions with the level of financial openness in these regions, maximizing their potential to promote economic growth.

Second, relative to the current scale of Beijing's financial market transactions, its level of financial openness exceeded its threshold value in 2019, diminishing the role of financial development in promoting economic growth. Therefore, future investments in Beijing's financial openness policies can be reduced. Currently, Tianjin's financial openness is at an optimal level, and it can be moderately increased in the future. Hebei, on the other hand, has the lowest level of financial openness among the three regions. Efforts should be focused on significantly improving Hebei's financial openness level and increasing policy support to quickly bring Hebei's financial openness to a level where it positively contributes to economic growth.

This study suggests that only through the above approaches can the optimization of financial development and openness levels in the three regions be achieved, thereby fully leveraging each region's role in the economic integration of the BTH region. This will facilitate faster and better realization of economic integration in the BTH region.

Declaration of Competing Interest
None.

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