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Master's Thesis of Economics

Financial Development and Economic Growth with Dynamic Threshold Model

동태적 임계값 모형을 통한 금융 발전과 경제성장에 관한 연구

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Financial Development and Economic Growth with Dynamic Threshold Model

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Abstract

Keyword : threshold model, financial development, economic growth, global financial crisis
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This paper focuses on analyzing the non-linear relationship between financial development and economic growth, with a particular emphasis on the period from 1980 to 2019. Previous studies have encountered limitations in providing a clear explanation of this relationship as they relied on linear models and failed to account for regulatory changes and policies related to capital adequacy in the financial sector before and after financial crises. To overcome these limitations, the authors employ a dynamic panel threshold model. Using this model and country panel data from 23 advanced economies, the analysis reveals that the impact of financial development on economic growth varies based on the threshold. Specifically, until a certain threshold, financial development has a positive impact on economic growth, but beyond that point, it is estimated to have a negative influence on economic growth. Additionally, the study finds that the threshold increases over time, providing empirical evidence of the relationship between financial development and financial stability measures. This research offers valuable insights into the non-linear relationship between financial development and economic growth across different time periods and emphasizes the necessity of considering regulatory changes and crises in economic analysis.

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Chapter 1. Introduction

1.1. Study Background

Numerous studies have analyzed the impact of financial development on economic growth. Notably, King and Levine (1993), Levine (1997), and Rajan and Zingales (1998) have contributed to this area of research. Levine (1997) particularly revealed a positive relationship between financial development and economic growth. However, a notable limitation of these analyses is their reliance on linear models, making it challenging to apply them to events like the 2008 financial crisis.

The global crisis at that time was triggered by financial bubbles resulting from mispriced derivative products and other financial instabilities. Applying the previous studies roughly implies that under the same constraints, a more developed financial sector should have a positive impact on the economy. However, this was not the case during the crisis, highlighting the need for more nuanced analyses in the presence of such financial turbulences.

Therefore, to explain this phenomenon, the necessity for methodological complementarity has been emphasized. Recent studies, such as Law and Singh (2014), Arcand et al. (2015), and Swamy and Dharani (2019), have revealed a non-linear relationship between financial development and economic growth, wherein up to a certain threshold, financial development has a positive impact on economic growth. However, beyond that level, it exerts a negative influence. Particularly, an examination of Law and Singh (2014) indicates that when the variable of financial development, represented by private sector credit, constitutes 88% of the GDP, it demonstrates a positive effect on the economy until that point. Subsequently, it transitions into a negative impact.

The aforementioned studies have demonstrated the significance of identifying non-linear relationships, unlike their predecessors. However, they did not analyze these relationships on a period-by-period basis. The rationale for conducting period-specific analyses is as follows: During the periods covered by these studies – Law and Singh (2014) for 1980–2010, Arcand et al. (2015) for 1960–2010, and Swamy and Dharani (2019) for 1983 to 2013 – financial development's positive impact on economic growth was not simply left unattended from a national policy perspective.

The Bank for International Settlements (BIS) introduced the minimum capital requirement in 1988 to ensure the soundness of financial institutions, and subsequently revised and supplemented it to align with the times (Basel II Accord in 2007 and Basel III Accord in 2013). As a result, member countries worldwide sought to meet the Basel II and Basel III standards during different periods. Consequently, previous studies that calculated average thresholds for relatively short periods ranging from 30 to 50 years failed to meticulously analyze the non-linear relationship between financial development and economic growth in accordance with each period and the variations in countries' policy-driven capital adequacy regulations before and after financial crises.

In conclusion, the limitation of previous research lies in their inability to conduct a comprehensive analysis of the non-linear relationship between financial development and economic growth based on different periods and the regulatory changes in countries' policy-driven capital adequacy before and after financial crises.

The following developing country list is based on Law and Singh (2014) that render them less suitable for larger-scale panel dataset research. Additionally, they rely on exogeneity assumptions concerning the regressors and/or the threshold variable. For instance, standard least squares approaches like those employed by Hansen (2000) and Seo and Linton (2007) require exogeneity assumptions for all the covariates. Even in the case of dynamic panel models, Kremer et al. (2013) attempted to accommodate endogeneity in the regressors, but their discussion relied on the assumption that either the regressors or the transition variable or both are exogenous, which poses a limitation.

The model used in this paper, Seo and Shin (2016), overcomes these limitations. Seo and Shin (2016) consider the case of dynamic panels and design it to allow for both the threshold variable and regressors can be endogenous using the GMM technique. Furthermore, when conducting empirical analysis, the STATA package version of Seo and Shin (2016), which is the ***xthenreg*** package by Seo et al. (2019), was utilized.

Based on these previous studies, this paper aims to analyze whether there exists a non-linear relationship between financial development and economic growth, specifically by dividing the analysis into distinct periods. The time periods considered are as follows: period 1: 1980-1989, period 2: 1990-1999, period 3: 2000-2009, and period 4: 2010-2019, encompassing the overall period from 1980 to 2019. For our analysis, we employ country panel data, focusing on 23 advanced economies. We chose advanced economies as they are more likely to adhere to rules regarding financial stability, such as the Basel Accords, due to their relatively developed financial systems.

As a proxy for financial development, we utilize the data on domestic credit to the private sector. To conduct the non-linear analysis, we adopt the dynamic panel threshold model proposed by Seo and Shin (2016) as our chosen model.

In Chapter 2, we provide a detailed explanation of the model and data used in our study. Chapter 3 presents the analysis results for the main findings. In Chapter 4, we conduct robustness checks to validate the obtained results. Finally, in Chapter 5, we conclude the paper by summarizing the key findings and implications.

Chapter 2. Model and Data

2.1 Model

The following is a concise summary of the model description in Seo and Shin (2016), highlighting key points. For detailed proofs and explanations, please refer to Seo and Shin (2016) for more information.

The specific form of the model is as follows:

$$y_{it} = \left(1, x_{it}^{'}\right)\phi_1 1\{q_{it} \leq \gamma\} + \left(1, x_{it}^{'}\right)\phi_2 1\{q_{it} > \gamma\} + \epsilon_{it}$$

$$\text{for } i = 1, \cdots, n\,; t = 1, \cdots, T \qquad (1)$$

In this model, y_{it} is scalar stochastic variable of interest, x_{it} = $k_1 \times 1$ vector of time-varying regressor, $1\{\cdot\}$ is indicator function, q_{it}= transition variable, γ is threshold parameter, ϕ_1 and ϕ_2 are the slope parameters, α_I is unobserved individual fixed effect, ν_{it} zero mean idiosyncratic random disturbance.

This model extends the existing threshold effect model for panel data proposed by Hansen (1999) into a dynamic panel threshold model, as presented by Dang et al. (2012), Kremer et al. (2013), etc. However, it differs in allowing for both the threshold variable and regressor to be endogenous using a general GMM approach based on the first-difference transformation. As a result, it overcomes the limitations of the exogeneity assumptions for the regressor and/or transition variable found in the existing literature. The specific form of the model after the first-difference transformation is as follows:

$$\Delta y_{it} = \beta^{'} \Delta x_{it} + \delta^{'} X_{it}^{'} 1_{it}(\gamma) + \Delta\epsilon_{it} \qquad (2)$$

Where Δ is the first difference operator, $\underbrace{\beta}_{k_1 \times 1} = (\phi_{12}, \cdots, \phi_{1,k_1+1})$,

$$\underbrace{\delta}_{(k_1+1)\times 1} = \phi_2 - \phi_1, \quad \underbrace{X_{it}}_{2\times(1+k_1)} = \begin{bmatrix} (1, x_{it}^{'}) \\ (1, x_{i,t-1}^{'}) \end{bmatrix} \underbrace{1_{it}(\gamma)}_{(1+k_1)\times 1} = \begin{bmatrix} 1\{q_{it} > \gamma\}. \\ -1\{q_{i,t-1} > \gamma\} \end{bmatrix}.$$

Following the above discussion, we proceed to conduct the Linearity (threshold effect) test.

$$\mathrm{H}_0 : \delta = 0, for\ any\ \gamma \in \Gamma$$

$$\mathrm{H}_1 : \delta \neq 0, for\ some\ \gamma \in \Gamma$$

It tested by bootstrap in Seo and Shin (2016) for 1,000 times.

2.1.1.FD GMM estimation

For the threshold variable q_{it} to be endogenous, $E(q_{it}\Delta\epsilon_{it}) \neq 0$ such that q_{it} does not belong to the set of instrumental variable, $\{z_{it}\}_{t=t_0}$. Consider the following l −dimensional column vector of the sample moment condition:

$$\bar{g}_n(\theta) = \frac{1}{n}\sum_{i=1}^{n} g_i(\theta) \quad ,$$

Where

$$\underbrace{g_i(\theta)}_{l\times 1} = \begin{bmatrix} z_{it_0}\left(\Delta \mathrm{y}_{\mathrm{it}_0} - \beta'\Delta x_{it_0} - \delta' X'_{it_0} 1_{it_0}(\gamma)\right) \\ \vdots \\ Z_{iT}\left(\Delta y_{iT} - \beta'\Delta x_{iT} - \delta' X'_{iT} 1_{iT}(\gamma)\right) \end{bmatrix} \qquad (3)$$

Assuming that $Eg_i(\theta) = 0$ if and only if $\theta = \theta_0$ and let $g_i = g_i(\theta_0) = \left(\mathrm{z}'_{it_0}\Delta\epsilon_{\mathrm{it}_0}, \cdots, z'_{iT}\Delta\epsilon_{iT}\right)'$ and$\Omega = \mathrm{E}(\mathrm{g_i} g'_i)$ where Ω is assumed to be positive definite. For a positive definite matrix $\mathrm{W_n}$ such that

$$\mathrm{W_n} \to^p \Omega^{-1}$$

let

$$\bar{J}_n(\theta) = \bar{g}_n(\theta)' W_n\, \bar{g}_n(\theta) \qquad (4)$$

Then the GMM estimator of θ is given by

$$\hat{\theta} = \arg\min_{\theta\in\Theta} \bar{J}_n \qquad (5)$$

Since the model is linear in ϕ for each $\gamma \in \Gamma$, and the objective function $\bar{J}_n(\theta)$ is not continuous in γ with $\theta = (\phi', \gamma')'$, the grid search algorithm is practical : for a fixed γ, let

$$\bar{g}_{1n} = \frac{1}{n}\sum_{i=1}^{n} g_{1i} \quad \text{, and } \quad \bar{g}_{2n}(\gamma) = \frac{1}{n}\sum_{i=1}^{n} g_{2i}$$

Where

$$\underbrace{g_{1i}}_{l \times 1} = \begin{bmatrix} z_{it_0}\Delta \mathrm{y}_{\mathrm{it}_0} \\ \vdots \\ Z_{iT}\Delta y_{iT} \end{bmatrix}, \qquad \underbrace{g_{2i}(\gamma)}_{l \times (k-1)} = \begin{bmatrix} z_{it_0}\left(\Delta x_{it_0}, \mathbf{1}_{it_0}(\gamma)' X_{it_0}\right) \\ \vdots \\ Z_{iT}(\Delta x_{iT}, \mathbf{1}_{iT}(\gamma)' X_{iT}) \end{bmatrix}$$

Then, the GMM estimator of β and δ, for a given γ, is given by

$$\left(\hat{\beta}(\gamma)', \hat{\delta}(\gamma)'\right)' = \left(\bar{g}_{2n}(\gamma)' W_n\, \bar{g}_{2n}(\gamma)\right)^{-1} \bar{g}_{2n}(\gamma)' W_n\, \bar{g}_{1n}$$

Denoting the objective function evaluated at $\hat{\beta}(\gamma)$ and $\hat{\delta}(\gamma)$ by $\hat{J}_{\mathrm{n}}(\gamma)$, obtain the GMM estimator of θ by

$$\hat{\gamma} = \arg\min_{\gamma \in \Gamma} \hat{J}_n(\gamma), \quad \text{and } \left(\hat{\beta}', \hat{\delta}'\right)' = \left(\hat{\beta}(\hat{\gamma})', \hat{\delta}(\hat{\gamma})'\right)'$$

The two−step optimal GMM estimator is obtained as follows :

1. Estimate the model by minimizing $\bar{J}_n(\theta)$ with either $\mathrm{W_n} = l_l$ or with the equation given in Box 1 and collect residuals, $\widehat{\Delta\epsilon_{\iota t}}$.
2. Estimate the paprameter θ by minimizing $\bar{J}_n(\theta)$ with

$$W_n = \left(\frac{1}{n}\sum_{i=1}^{n} \hat{g}_i\, \hat{g}_i' - \frac{1}{n^2}\sum_{i=1}^{n} \hat{g}_i \sum_{i=1}^{n} \hat{g}_i' \right)^{-1} \qquad (6)$$

Where $\hat{g}_i = \left(\widehat{\Delta\epsilon_{\iota t_0}} z_{it_0}', \cdots, \widehat{\Delta\epsilon_{\iota \mathrm{T}}} Z_{it}'\right)'$.

Box 1

$W_n =$

$$\begin{pmatrix} \frac{2}{n}\sum_{i=1}^{n} z_{it_0} z_{it_0}' & \frac{-1}{n}\sum_{i=1}^{n} z_{it_0} z_{it_{0+1}}' & 0 & \cdots \\ \frac{-1}{n}\sum_{i=1}^{n} z_{it_{0+1}} z_{it_0}' & \frac{2}{n}\sum_{i=1}^{n} z_{it_0} z_{it_{0+1}}' & \ddots & \ddots \\ 0 & \ddots & \ddots & \frac{-1}{n}\sum_{i=1}^{n} z_{iT-1} z_{iT}' \\ \vdots & \ddots & \frac{-1}{n}\sum_{i=1}^{n} z_{iT} z_{iT}' & \frac{2}{n}\sum_{i=1}^{n} z_{iT} z_{iT}' \end{pmatrix}$$

(7)

2.1.2.Asymptotic Theory

Partition $\theta = (\theta_1', \gamma)'$, where $\theta_1 = (\beta', \delta')'$. As the true value of δ is δ_n, the true values of θ and θ_1 are denoted by θ_n and θ_{1n} respectively. Define

$$\underbrace{G_\beta}_{l \times k_1} = \begin{bmatrix} -E(z_{it_0} \Delta x_{it_0}') \\ \vdots \\ -E(z_{iT} \Delta x_{iT}') \end{bmatrix},$$

$$\underbrace{G_\delta}_{l \times (k_1+1)} (\gamma) = \begin{bmatrix} -E(z_{it_0} 1_{it_0}(\gamma)' X_{it_0}) \\ \vdots \\ -E(z_{iT} 1_{iT}(\gamma)' X_{iT}) \end{bmatrix},$$

And $\underbrace{G_\gamma}_{l \times 1} (\gamma)$ (see Box 2) where $E_t[\cdot|\gamma]$ denotes the conditional expectation given $q_{it} = \gamma$ and $p_t(\cdot)$ the density of q_{it}.

Box 2

$$\underbrace{G_\gamma}_{l \times 1} (\gamma) = \begin{bmatrix} \{E_{t_{0-1}}[z_{it_0}(1, x_{it_{0-1}}')|\gamma] p_{t_{0-1}}(\gamma) - E_{t_0}[z_{it_0}(1, x_{it_0}')|\gamma] p_{t_0}(\gamma)\}\delta_0 \\ \vdots \\ \{E_{T-1}[z_{iT}(1, x_{iT-1}')|\gamma] p_{T-1}(\gamma) - E_T[z_{iT}(1, x_{iT}')|\gamma] p_T(\gamma)\}\delta_0 \end{bmatrix}$$

Assumption 1. The true value of β is fixed at β_0 while that of δ depends on n such that $\delta_n = \delta_0 n^{-\alpha}$ for some $0 \leq \alpha \leq 1/2$ and $\delta_0 \neq 0.\delta_n$ are interior points of Θ. Ω is finite and positive define.

Assumption 1 allows for both the standard setup, $\delta_n = \delta_0 \neq 0$ for all n, and the diminishing setup, $\delta_n \to 0$ $as\ n \to \infty$.

Assumption 2. (i) The threshold variable, q_{it} has a continuous and bounded density, $p_t(\cdot)$, such that $p_t(\cdot)$, such that $p_t(\gamma_0) > 0$ for all $t = 1, \cdots, T$; (ii) $E_t(z_{it}(x'_{it}, x'_{i,t-1})|\gamma)$ is continuous at γ_0, where $E_t(\cdot|\gamma) = E(\cdot|q_{it} = \gamma)$.

The Assumption 2 means smoothness assumption. It ensures distribution of the threshold variable and conditional moments are standard.

Assumption 3. Leg $G = (G_\beta, G_\delta(\gamma_0), G_\gamma(\gamma_0))$, Subsequently, G possesses full column rank, which serves as a conventional rank condition in the GMM framework to ensure identification.

Theorem 1. Under Assumption 1−3, as $n \to \infty$,

$$\begin{pmatrix} \sqrt{n}\begin{pmatrix} \hat{\beta} - \beta_0 \\ \hat{\delta} - \delta_n \end{pmatrix} \\ n^{\frac{1}{2}-\alpha}(\hat{\gamma} - \gamma_0) \end{pmatrix} \to^d N(0, (G'\Omega^{-1}G)^{-1})$$

Theorem 1 ensures that the FD−GMM asymptotically conforms to the normal distribution, regardless of whether α=0 or not.

2.2 Data

The dependent variable used in this study is GDP growth (annual %). The transition variable (q_{it}) representing financial development is Domestic credit to Private Sector (% of GDP). The explanatory variables (x_{it}) include the 1−period lagged dependent variable, Human Capital, Population Growth, Foreign Direct Investment, and Inflation. Moreover, 2−period lagged dependent variable is used as an instrumental variable.

The data names, correlation matrix, and data summary, including abbreviations used in this paper, are as follows:

Table 1 : Data name

Variable	Data Name	From
GR	GDP Growth (annual %)	World Development Indicator (WDI)[①]
DCPS	Domestic Credit to Private Sector (% of GDP)	WDI
DBA	Deposit Money Bank Asset	Financial Development and Structure Dataset[②]
HC	Human Capital (Average Years of Secondary Schooling)	Penn World Table 10.0[③]
POP	Population Growth (annual %)	WDI
FDI	Foreign Direct Investment, Net Inflow (% of GDP)	WDI
INFLA	Inflation, Consumer Price (annual %)	WDI

Both the World Development Indicators and the Financial Development and Structure Dataset are data provided by the World Bank. The Penn World Table (PWT) is a dataset developed and curated by scholars at the University of California, Davis, and the Groningen Growth Development Centre of the University of Groningen. The data I have utilized is publicly accessible and available for use.

Table 2 : Correlation Matrix

Variable	GR_{it}	$GR_{i,t-1}$	$GR_{i,t-2}$	DCPS	HC	POP	FDI	INFLA
GR_{it}	1.000							
$GR_{i,t-1}$	0.508	1.000						
$GR_{i,t-2}$	0.314	0.535	1.000					
DCPS	−0.225	−0.224	−0.188	1.000				
HC	0.033	0.028	0.005	−0.064	1.000			
POP	0.209	0.259	0.307	−0.008	0.014	1.000		
FDI	0.050	0.151	0.098	−0.012	−0.007	0.042	1.000	
INFLA	0.059	0.060	0.073	−0.133	0.029	0.139	−0.047	1.000

① https://databank.worldbank.org/source/world-development-indicators
② https://www.worldbank.org/en/publication/gfdr/data/financial-structure-database
③ https://www.rug.nl/ggdc/productivity/pwt/pwt-releases/pwt100

Table 3 : Data Summary

Variable	Mean	Std. dev.	Min	Max	Obs.
GR_{it}	2.331	2.815	−10.823	25.176	943
$GR_{i,t-1}$	2.495	2.518	−10.149	25.176	920
$GR_{i,t-2}$	2.511	2.608	−10.149	25.176	897
DCPS	4.543	0.428	3.266	5.383	943
DBA	101.021	42.007	22.934	241.549	943
HC	2.367	0.722	0.538	3.892	943
POP	0.648	0.604	−1.854	6.017	943
FDI	2.987	7.317	−37.676	86.479	943
INFLA	4.964	18.157	−4.478	373.215	943

The criteria for this dissent are based on the World Economic Outlook of April 2011 by the IMF. The list of 23 advanced economies considered in this study is as follows:

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Table 4 : Advanced economy list

1	Australia	9	Greece	17	Portugal
2	Austria	10	Ireland	18	South Korea
3	Belgium	11	Israel	19	Spain
4	Canada	12	Italy	20	Sweden
5	Denmark	13	Japan	21	Switzerland
6	Finland	14	Netherlands	22	UK
7	France	15	New Zealand	23	USA
8	Germany	16	Norway		

Chapter 3. Empirical Results

3.1 Linear Model

Before presenting the main results of our analysis, we provide the results of the Linear Model for comparison, employing the approach proposed by Arellano and Bond (1991).

$$\Delta y_{it} = \Delta X_{it}\beta + \gamma \Delta y_{i,t-1} + u_{it}$$
$$\text{for } i = 1, \cdots, n \,;\, t = 1, \cdots, T \tag{3}$$

The outcomes are as follows:

Table 5 : Linear Analysis

GR_it	Period 1	Period 2	Period 3	Period 4
$GR_{i,t-1}$	0.459	0.199	0.238	0.060
	(0.223).	(0.074)*	(0.076)*	(0.059)
$DCPS_{i,t-1}$	-7.864	-4.706	-3.921	-4.780
	(5.474)	(2.305).	(0.640)***	(1.115)***
$HC_{i,t-1}$	0.685	0.174	-0.335	-0.018
	(0.349).	(0.227)	(0.145).	(0.201)
$POP_{i,t-1}$	-2.540	-1.186	-0.818	-0.831
	(1.873)	(0.623)	(0.552)	(0.416)
$FDI_{i,t-1}$	-0.468	0.199	-0.016	-0.011
	(1.265)	(0.111)	(0.018)	(0.175)
$INFLA_{i,t-1}$	-0.021	-0.201	-0.712	-1.030
	(0.018)	(0.067)*	(0.149)***	(0.104)***

Regarding the impact of financial development on economic growth, the Domestic Credit to Private Sector (DCPS) shows a negative influence for all periods. In other words, it suggests that as financial development advances in all time periods, it has a detrimental effect on economic growth. Intuitively and in line with empirical studies, this result contradicts the basic macro mechanism. Considering the intuitive economic rationale, as DCPS increases (indicating a higher degree of financial development), it can positively affect GDP (economic growth) through increased investment and consumption by firms. Empirical studies mentioned in the Introduction, such as

Law and Singh (2014), Arcand et al. (2015), and Swamy and Dharani (2019), have highlighted that DCPS can have a positive impact on economic growth.

However, if DCPS is high, it could lead to household bankruptcies, ultimately resulting in a negative impact on economic growth. This perspective is valid, and the objective of this paper is to determine the exact point up to which DCPS positively affects economic growth and the threshold beyond which it has a negative effect.

In essence, the aim is to ascertain the precise threshold at which DCPS transitions from positively influencing economic growth to negatively affecting it, exploring the extent to which DCPS contributes positively to economic growth.

3.2 Main Result

Using the model proposed by Seo and Shin (2016), the results of the non-linear analysis are as follows:

Table 6 : A dynamic panel threshold model of economic growth

$x_{it} \backslash q_{it}$	Period 1	Period 2	Period 3	Period 4
	Lower regime(ϕ_1)			
$GR_{i,t-1}$	0.168 (0.462)	2.193 (0.976)*	−0.855 (0.662)	−0.215 (0.064)**
$DCPS_{i,t-1}$	44.036 (23.916).	74.132 (36.875)*	−12.150 (11.524)	19.626 (16.569)
$HC_{i,t-1}$	1.025 (0.925)	−1.239 (2.740)	1.231 (0.475)*	1.484 (1.149)
$POP_{i,t-1}$	26.443 (13.267)*	−22.778 (13.371).	−2.753 (9.989)	0.645 (4.975)
$FDI_{i,t-1}$	−5.215 (3.124).	−0.969 (1.634)	0.031 (0.064)	−0.015 (0.065)
$INFLA_{i,t-1}$	−0.599 (0.391)	−0.395 (1.263)	−1.978 (1.956)	0.013 (0.799)
	Upper regime(ϕ_2)			
$GR_{i,t-1}$	0.276 (0.256)	−0.926 (0.443)*	3.465 (1.003)**	0.710 (0.433)
$DCPS_{i,t-1}$	−14.087 (33.944)	−32.241 (62.084)	−46.407 (21.507)*	−0.170 (11.493)
$HC_{i,t-1}$	−0.538 (0.403)	−1.190 (1.009)	−1.960 (1.248)	−0.960 (1.173)
$POP_{i,t-1}$	−1.588 (4.365)	8.889 (8.396)	−8.683 (7.198)	−1.528 (4.255)
$FDI_{i,t-1}$	−0.722 (1.932)	0.137 (0.795	−0.378 (0.223).	−0.009 (0.020)
$INFLA_{i,t-1}$	−0.003 (0.117)	0.902 (0.503)	5.016 (1.360)**	−0.759 (0.562)
Threshold	3.980 (0.199)***	4.027 (0.285)***	4.798 (0.117)***	4.546 (0.335)***
Linearity (p−value)	0.0	0.0	0.0	0.0

Firstly, examining the threshold and DCPS, we observe an increasing trend in the threshold until the 2000s. Specifically, it means that the threshold of the ratio of DCPS to GDP increases from 53.517% to 56.092% and further to 121.268%. Consequently, over time, the threshold is forming at higher levels. Excluding the 2000s, we can check the coefficient sign of DCPS changing from positive to negative. To explain this with the numerical values from the 1990s, when DCPS is up to 56.092% of GDP, it positively affects the economy. However, once DCPS exceeds 56.092%, it begins to negatively impact economic growth.

This trend implies that over time, the absolute level at which DCPS can positively influence economic growth has increased. This could be attributed to national-level institutional management of financial development through prudential regulations, which has allowed for an increase in the accommodating level of DCPS. This finding is substantiated by the actual data. However, it is noteworthy that this threshold experienced a sharp increase of more than twice compared to previous years, particularly in the 2000s. To delve into this aspect more closely, the following analysis is conducted.

Period 3 exhibits a more pronounced negative relationship between DCPS and GDP growth (GDPGR) compared to other periods. Considering the factors influencing this relationship, the global financial crisis comes to mind. As well-known, the global financial crisis was triggered by the misvaluation and usage of many derivative products, a substantial portion of which was based on individual credit (Feldkircher, 2014; Lane and Milesi-Ferretti, 2011; Cecchetti et al., 2011). In light of the results of this study, during this period, there were incorrect valuations of derivative products, and as a consequence, the abnormally accumulated DCPS had a higher threshold for negatively impacting economic growth compared to previous periods. In other words, under normal circumstances, the DCPS should have negatively affected economic growth, but due to the bubble, it did not, and only well beyond a certain point did it begin to exert a negative impact on economic growth. That point was the threshold, and it coincided with the outbreak of the global financial crisis. Furthermore, this negative impact on the economy was more significant than in previous periods.

To further examine whether the argument aligns temporally with the data, we scrutinize the results in more detail. The number of upper regime observations in Period 3 was 87 out of a total of 230 data points, accounting for approximately 38%. Additionally, almost half of these upper regime observations (37 observations, 43%) were concentrated between 2007 and 2009, when the financial crisis occurred. This implies that the majority of upper regime observations that exerted a strong negative impact on the economy were clustered around the global financial crisis. In conclusion, through empirical confirmation, it is demonstrated that DCPS was one of the factors contributing to the global financial crisis during Period 3, and its specific degree can be measured as the threshold.

In Period 4, it was observed that the threshold decreased slightly to 65.763% compared to the previous periods. This can be explained by the fact that advanced economies, after experiencing the previous crises, implemented measures such as the Basel III Accord and other prudential regulations, which did not permit abnormal accumulations of derivatives or credits. The coefficient in the upper regime also showed relatively lower values, which can be attributed to the global economy's efforts to rectify the past missteps.

Next, the effects of Lagged GDP Growth rate were examined, showing varying patterns across different periods. For instance, during the 1980s, positive correlations were observed in all regimes. However, in the 2000s, lower regime exhibited a negative correlation, while the upper regime showed a positive correlation, with a relatively higher coefficient of 3.465. This reflects a pattern where the global financial crisis led to negative growth, but with the implementation of monetary policies, a rapid transition to positive growth was observed.

Subsequently, Human Capital was examined. Except for the 1990s, Human Capital positively influenced economic growth in the lower regime. However, in the upper regime beyond the threshold, it had a negative impact on the economy, contrary to intuitive expectations. This can be explained by Tobin (1984), who argued that as the financial sector with monopolistic characteristics grows, and becomes more complex, the inefficiency in society increases. Kneer (2013) empirically demonstrated Tobin(1984) argument, showing that as the financial sector grows, the phenomenon of brain drain occurs in fields where Human Capital is concentrated, such as the R&D industry. Based on this perspective, when the growth in the financial sector exceeds the threshold, the distribution of Human Capital becomes inefficient, resulting in a negative impact on economic growth.

Next, let's examine Population Growth. It shows an inconsistent pattern. Barlow (1994) previously indicated that there is no significant correlation between population growth and economic growth. Additionally, Heady and Hodge (2009) analyzed that population growth had a negative impact on economic growth after the 1980s. Furthermore, considering that population growth is aggregate data, the mixed results in this paper should be viewed with caution. To provide a more detailed explanation, additional data regarding population structure or the degree of labor-intensive industries in each country would be necessary.

Moving on to Foreign Direct Investment (FDI), it seems to have a predominantly negative impact in almost all periods and regimes. These results align with those of Carkovic and Levine (2005). Carkovic and Levine (2005) found that FDI has a negative impact on economic growth when inflows occur in advanced economies. Thus, the results of this paper can be considered as a confirmation of their findings.

Finally, inflation has a consistently negative impact on the economy when the regime is in the lower state, which aligns with the basic macroeconomic notion of a negative correlation between economic growth and inflation. However, when financial development reaches a substantial level, i.e., beyond the threshold, the negative impact on economic growth significantly diminishes. Even in the 2000s, inflation showed a positive relationship with economic growth. These findings are in line with Rousseau and Yilmazkuday (2009). Rousseau and Yilmazkuday (2009) demonstrated that when inflation is below 3.95% in an economy with significant financial sector development, it has a positive impact on economic growth. In this study's results, during the upper regime in the 2000s, inflation exceeded the 3.95% threshold in only two instances, suggesting a positive impact on the economy.

Chapter 4. Robustness Check

The robustness check is conducted from three perspectives. First, I verify the validity of instrumental variables. Initially, only the 2-period lagged data of the dependent variable was employed as instrumental variables. However, in the robustness check, we further include the 3-period lagged data of the dependent variable as instrumental variables and re-examine the validation.

Secondly, the validity of the financial development variable is examined by verifying if similar results are obtained when using alternative data for financial development. For this purpose, Deposit Money Bank Assets (DBA) are utilized as an alternative data for financial development, following Law et al. (2013). Accordingly, the transition variable, q_{it}, is represented by DBA.

lastly, the analysis is extended to focus on developing countries rather than advanced economies, aiming to explore any differences and assess the robustness of the main findings in the paper.

4.1 Validity of Instrumental Variables

As mentioned above, we proceed with the analysis by augmenting the existing instrumental variable, the 2-period lagged data of the dependent variable, with the additional 3-period lagged data. The correlation matrix incorporating the 3-period lagged data and the data for the DBA used in section 4.2 is presented as follows

Table 7 : Correlation matrix 2

Variable	GR_{it}	$GR_{i,t-1}$	$GR_{i,t-2}$	$GR_{i,t-3}$	DCPS	DBA	HC	POP	FDI	INFLA
GR_{it}	1.000									
$GR_{i,t-1}$	0.505	1.000								
$GR_{i,t-2}$	0.317	0.542	1.000							
$GR_{i,t-3}$	0.281	0.334	0.533	1.000						
DCPS	−0.227	−0.239	−0.203	−0.163	1.000					
DBA	0.039	0.048	0.024	0.026	0.172	1.000				
HC	0.037	0.037	0.003	0.055	−0.057	−0.015	1.000			
POP	0.204	0.252	0.310	0.340	−0.006	−0.040	0.016	1.000		
FDI	0.049	0.150	0.097	0.027	−0.019	−0.002	0.000	0.042	1.000	
INFLA	0.057	0.059	0.073	0.074	−0.123	−0.007	0.018	0.127	−0.042	1.000

The correlation between GR_(i,t−1) and GR_(i,t−3) is observed to be 0.334, indicating a relatively high correlation compared to other explanatory variables. Therefore, we aim to examine whether the inclusion of these variables as instrumental variables enhances the accuracy of the analysis compared to the previous approach. The analysis results with the inclusion of these variables as instrumental variables are as follows:

Table 8 : A dynamic panel threshold model – another IV

$x_{it} \backslash q_{it}$	Period 1	Period2	Period3	Period 4
	Lower regime(ϕ_1)			
$GR_{i,t-1}$	−0.735	0.528	−0.450	−0.318
	(0.345)*	(1.026)	(1.706)	(0.072)***
$DCPS_{i,t-1}$	9.590	25.270	−1.623	18.594
	(13.655)	(48.079)	(21.192)	(11.729)
$HC_{i,t-1}$	0.535	−1.415	−0.799	1.964
	(0.769)	(1.885)	(2.345)	(0.617)**
$POP_{i,t-1}$	26.150	2.319	−6.937	0.378
	(12.415)	(6.888)	(15.048)	(2.849)
$FDI_{i,t-1}$	0.018	−2.110	0.151	0.033
	(2.181)	(1.618)	(0.153)	(0.059)
$INFLA_{i,t-1}$	−0.907	0.096	−3.718	−0.136
	(0.352)	(0.666)	(4.247)	(0.604)
	Upper regime(ϕ_2)			
$GR_{i,t-1}$	0.295	−1.033	2.714	0.601
	(0.428)	(0.439)	(1.072)*	(0.292)*
$DCPS_{i,t-1}$	−6.324	−47.794	−24.635	4.128
	(22.483)	(58.629)	(48.309)	(13.567)
$HC_{i,t-1}$	0.306	1.255	−2.152	−0.470
	(0.399)	(0.833)	(2.608)	(0.678)
$POP_{i,t-1}$	−1.163	−17.827	−20.356	−1.425
	(2.650)	(10.880)	(11.782)	(2.884)
$FDI_{i,t-1}$	−1.599	1.717	−0.069	0.005
	(0.654)	(0.918).	(0.192)	(0.023)
$INFLA_{i,t-1}$	−0.001	−0.401	7.228	−0.660
	(0.089)	(1.056)	(4.885)	(0.582)
Threshold	3.980	4.208	4.710	4.551
	(0.102)***	(0.345)***	(0.341)***	(0.342)***
Linearity (p−value)	0.0	0.0	0.0	0.0

The analysis results show that the values and trends of the threshold are similar. However, it can be observed that the overall standard deviation of the variables has increased. This can be explained by the findings pointed out by Andersen and Sørensen (1996). They noted that when the sample size is small in GMM-based analysis, an increase in the number of moment conditions may lead to an increase in bias and RMSE. In this study, each period's sample consists of 207 observations, which cannot be considered large, and with the addition of instrumental variables, the number of moment conditions increased from the original 77 to 84. The magnitude of this increase can be interpreted as increasing bias in the overall analysis. Therefore, it reconfirms that using only the dependent variable's 2-period lagged data as instrumental variables, as employed in the main text, is more appropriate.

4.2 Alternative Transition Variable

Table 9 : A dynamic panel threshold model – Deposit money bank asset

$x_{it} \backslash q_{it}$	Period 1	Period 2	Period 3	Period 4
	Lower regime(ϕ_1)			
$GR_{i,t-1}$	0.065 (0.491)	0.260 (0.632)	−0.658 (0.850)	−0.133 (0.251)
$DBA_{i,t-1}$	−0.041 (0.124)	−0.199 (0.714)	−0.312 (0.322)	0.187 (0.122)
$HC_{i,t-1}$	−0.047 (0.373)	1.142 (1.035).	3.179 (2.211)	2.843 (1.313)
$POP_{i,t-1}$	2.251 (4.217)	−14.613 (6.038).	17.179 (8.600).	−4.341 (4.071)
$FDI_{i,t-1}$	−0.837 (1.074)	−1.421 (1.794)	−1.245 (0.458)*	−0.108 (0.054).
$INFLA_{i,t-1}$	−0.292 (0.148).	−0.388 (1.057)	2.737 (3.028)	−0.171 (0.619)
	Upper regime(ϕ_2)			
$GR_{i,t-1}$	−0.723 (0.924)	−0.121 (0.286)	0.828 (0.456)	0.385 (0.362)
$DBA_{i,t-1}$	0.246 (0.149)	0.119 (0.054).	0.125 (0.092)	0.009 (0.068)
$HC_{i,t-1}$	1.708 (0.967)	0.575 (0.867)	−0.119 (1.093)	−0.552 (0.797)
$POP_{i,t-1}$	−0.889 (4.950)	1.907 (10.067)	−2.202 (2.378)	3.551 (2.337)
$FDI_{i,t-1}$	−3.508 (4.264)	−0.003 (0.753)	0.057 (0.219)	0.042 (0.036)
$INFLA_{i,t-1}$	0.003 (0.054)	−0.222 (0.500)	−2.432 (1.118)	−1.208 (0.470)*
Threshold	78.185 (16.298)***	70.369 (36.778)	87.785 (16.320)***	104.771 (25.107)***
Linearity (p-value)	0.0	0.0	0.0	0.0

Similar to the results obtained for DCPS in the main analysis, DBA also shows a sharp increase in the threshold during period 2 and period 3. However, contrary to the main analysis, period 4 also exhibits an upward trend in the threshold. This can be attributed to prudential regulations that incentivized banks to hold more equity.

Moreover, with respect to DBA, except for period 4, it has a positive impact on economic growth in the upper regime while having a negative impact in the lower regime. The negative aspect in the lower regime can be explained by Hakenes and Schnabel (2011), who demonstrated that smaller banks are more exposed to risks compared to larger banks. Hence, lower values of DBA may expose banks to more risks, leading to a negative impact on the economy.

Similarly, Haan and Pohhosyan (2012) found that larger banks exhibit lower earning volatility, indicating that higher values of DBA contribute to higher stability in banks and, consequently, have a more positive impact on economic growth, as evident in the robustness check results (Creel et al., 2015).

Overall, the results suggest that even with different financial development variables, similar conclusions to those of the main analysis can be drawn. Furthermore, the threshold model effectively captures the differences based on the characteristics of financial development variables.

4.3 Developing Country Analysis

The following developing country list is based on Law and Singh (2014).

Table 10 : Developing country list

1	Algeria	17	Ghana	32	Latvia	47	Senegal
2	Bangladesh	18	Guatemala	33	Luxembourg	48	Sierra Leone
3	Bolivia	19	Guyana	34	Malawi	49	Singapore
4	Brazil	20	Haiti	35	Malaysia	50	South Africa
5	Cameroon	21	Honduras	36	Mali	51	Sri Lanka
6	Chile	22	Hong Kong	37	Mexico	52	Sudan
7	Colombia	23	Hungary	38	Morocco	53	Syria
8	Congo	24	Iceland	39	Niger	54	Thailand
9	Costa Rica	25	India	40	Pakistan	55	Togo
10	Cote Divoire	26	Indonesia	41	Panama	56	Trinidad & Tobago
11	Dem. Rep. of Congo	27	Iran	42	Papua New Guinea	57	Tunisia
12	Ecuador	28	Jamaica	43	Paraguay	58	Turkiye
13	Egypt	29	Jordan	44	Peru	59	Uruguay
14	El Salvador	30	Kenya	45	Philippines	60	Venezuela
15	Gabon	31	Kuwait	46	Saudi Arabia	61	Zambia
16	Gambia						

Table 11 : A dynamic panel threshold model – Developing country

$x_{it} \backslash q_{it}$	Period 1	Period 2	Period 3	Period 4
	Lower regime(ϕ_1)			
$GR_{i,t-1}$	−0.292 (0.086)**	0.359 (0.034)***	−0.194 (0.055)***	0.064 (0.014)***
$DCPS_{i,t-1}$	−0.292 (1.984)	−0.894 (0.886)	−2.751 (1.076).	−6.894 (0.829)***
$HC_{i,t-1}$	−1.782 (0.437)***	−5.086 (0.442)***	2.390 (0.277)***	−4.267 (0.167)***
$POP_{i,t-1}$	−0.229 (0.958)	3.064 (0.967)*	−3.883 (1.040)***	21.685 (2.003)***
$FDI_{i,t-1}$	0.231 (0.121)	−0.022 (0.024)	0.052 (0.019)*	−0.255 (0.031)***
$INFLA_{i,t-1}$	−0.035 (0.003)***	0.001 (0.000)***	−0.013 (0.004)*	0.115 (0.013)***
	Upper regime(ϕ_2)			
$GR_{i,t-1}$	0.780 (0.078)***	−0.281 (0.050)***	0.464 (0.139)**	0.171 (0.016)***
$DCPS_{i,t-1}$	23.779 (2.841)***	−17.454 (2.063)***	−13.244 (5.220)*	−4.466 (0.826)***
$HC_{i,t-1}$	0.083 (0.299)	3.385 (0.499)***	−4.595 (0.566)***	−0.138 (0.078)
$POP_{i,t-1}$	−1.989 (0.292)***	0.133 (0.355)	−0.522 (0.446)	−0.493 (0.595)
$FDI_{i,t-1}$	0.238 (0.069)**	0.027 (0.025)	−0.041 (0.036)	0.088 (0.013)***
$INFLA_{i,t-1}$	0.001 (0.002)	0.006 (0.002)*	−0.452 (0.143)*	−0.003 (0.003)
Threshold	2.946 (0.143)***	3.002 (0.172)***	3.655 (0.118)***	2.859 (0.044)***
Linearity (p−value)	0.0	0.0	0.0	0.0

Examining the results, the threshold exhibits a similar trend to the main results in the main analysis. The difference lies in the level of the threshold, which is lower in studies focusing on developing countries compared to the analysis conducted on advanced economies in the main paper. Intuitively, this is a reasonable finding. Developing countries may not have as robust prudential regulations or crisis management measures in place as advanced economies, even with relatively lower levels of financial sector development. As a result, the point at which the economy fails to positively accommodate the growth in the financial sector and experiences a negative impact on economic growth occurs at a lower level in developing countries compared to advanced economies.

Therefore, for developing countries, the need to enhance crisis management capabilities may be more critical than aiming for financial sector growth at the same level as advanced economies. This suggestion arises from the results, which demonstrate that developing countries are more susceptible to negative impacts on economic growth when experiencing even relatively modest growth in their financial sectors.

Chapter 5. Conclusion

Through the Threshold Model, we investigated how the growth of the financial sector in advanced economies influences economic growth. The results revealed a non−linear relationship where the development of the financial sector initially has a positive impact on the economy until a certain threshold level is reached, after which it starts to exert a negative impact. The threshold point continued to increase until the 2000s, indicating a continuous improvement in crisis management capabilities concerning financial sector development over time. However, after the sharp increase in the threshold during the 2000s, it decreased in the 2010s. The excessively high level of financial development that positively impacted economic growth during the 2000s was abnormal, and the global financial crisis proved it to be unsustainable. Consequently, in the 2010s, various measures were taken to address this issue, leading to a normalization and enhancement of financial development levels that each economy can manage.

By accurately understanding the intuitive nature of the threshold levels, policymakers can utilize this information to make informed decisions. They can assess the current state of the financial development's impact on economic growth and implement appropriate contraction or expansion policies to align with the desired economic outcomes.

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국문초록

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본 논문은 1980년부터 2019년까지의 기간을 중점으로 하여 금융 발전과 경제 성장 간의 비선형적 관계를 분석한다. 이전 연구들은 선형 모델을 사용하여 금융 위기 이전과 이후의 규제 변화와 금융에서의 자기자본 적정성 확보 정책 등으로 이의 관계를 명확히 설명하지 못하는 한계가 존재하였다. 이러한 한계를 극복하기 위해 동적 패널 임계값 모델을 사용하였다. 이의 모델과 23개 선진국의 국가 패널 데이터를 활용한 분석 결과 금융 발전이 경제 성장에 미치는 영향이 임계값에 따라 다르다는 것을 발견하였다. 구체적으로, 특정 임계값까지는 금융 발전이 경제 성장에 긍정적인 영향을 미치지만, 그 이후로는 경제 성장에 부정적인 영향을 미친다는 결과가 추정되었다. 또한, 임계값은 시간이 지남에 따라 증가하는데, 이는 금융 발전에 따른 금융 안정성 조치들을 실증적으로 보여준다. 본 연구는 시기별로 금융 발전과 경제 성장 사이의 비선형적 관계에 대한 통찰력을 제공하며, 경제 분석에서 규제 변화와 위기에 대한 고려의 필요성을 제시한다.