Journal of Banking & Finance 37 (2013) 5373–5381

Contents lists available at SciVerse ScienceDirect

Journal of Banking & Finance

journal homepage: www.elsevier.com/locate/jbf

Institutional quality thresholds and the finance – Growth nexus

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ARTICLE INFO

Article history:
Available online 30 March 2013

JEL classification:
G20
O43

Keywords:
Finance
Economic growth
Institutions
Threshold effects

ABSTRACT

Using an innovative threshold estimation technique, this study examines whether the growth effect of financial development in countries with distinct levels of institutional development differs. The results demonstrate that there is a threshold effect in the finance-growth relationship. Specifically, we found that the impact of finance on growth is positive and significant only after a certain threshold level of institutional development has been attained. Until then, the effect of finance on growth is nonexistent. This finding suggests that the financial development-growth nexus is contingent on the level of institutional quality, thus supporting the idea that better finance (i.e., financial markets embedded within a sound institutional framework) is potent in delivering long-run economic development.

1. Introduction

A large amount of literature has examined the relationship between financial development and economic growth using cross-country, time series, panel data, and firm-level studies (King and Levine, 1993a, 1993b; Demetriades and Hussein, 1996; Levine, 1997, 2003; Rajan and Zingales, 1998; Levine et al., 2000; Al-Yousif, 2002; Beck and Levine, 2004; Bertocco, 2008; Hasan et al., 2009; Jalil et al., 2010; Rahaman, 2011; Kendall, 2012).[1] By and large, the empirical evidence has suggested that there is a positive long-run association between indicators of financial development and economic growth. According to Levine (1997), financial intermediaries enhance economic efficiency, and ultimately economic growth, by helping allocate capital to its best uses. Moreover, the existing evidence also demonstrates that this relationship is very likely to be nonlinear where the effect of finance on growth may vary by stage and level of economic development. For example, Deidda and Fattouh (2002) and Rioja and Valev (2004a) found that there is no significant relationship between financial development and growth in low-income countries, whereas the relationship is positive and significant in high-income countries.[2] In addition, Rioja and Valev (2004b) pointed out that financial development exerts a strong positive effect on economic growth only when it has achieved a certain level or threshold; below this threshold, the effect is at best uncertain. Shen and Lee (2006), Ergungor (2008), Hung (2009) and Cecchetti and Kharroubi (2012) also discovered patterns of nonlinearity in the relationship between financial development and growth.[3] In general, all these papers suggested that a well-developed financial market is both growth-enhancing and consistent with the proposition of "more finance, more growth."[4]

However, recent researchers have suggested that "better finance, more growth" is a more accurate proposition than "more finance, more growth." These researchers have argued that a financial system embedded in a sound institutional framework is more important for growth. Arguably, an increase in financial development, as captured by standard financial development indicators, may not result in increased growth due to corruption in the banking system or political interference that may divert credit to

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[1] Levine (2003) provided an excellent overview of a large body of empirical literature that suggests that financial development can robustly explain differences in economic growth across countries. Ang (2008) pointed out that although the positive role of finance on growth has become a stylized fact, there are some methodological reservations about the results of these empirical studies.

[2] However, Huang and Lin (2009) pointed out that the positive effect between financial development and growth is larger in low-income countries than in high-income countries.

[3] Ang (2008) emphasized that an appropriate specification of the functional form is critical in understanding the finance-growth relationship since several studies have demonstrated that the finance-growth nexus may be nonlinear, and more research in this area is necessary.

[4] One of the main conclusions that Levine (2003) drew from empirical work is that the size of the banking system and the liquidity of stock markets are each positively linked to economic growth.

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http://dx.doi.org/10.1016/j.jbankfin.2013.03.011

unproductive or even wasteful activities. Demetriades and Andrianova (2004) and Arestis and Demetriades (1996) highlighted that varying relationships may reflect differences in the quality of finance, which is determined by the quality of financial regulation and rule of law. Likewise, Al-Yousif (2002) suggested that the relationship between financial development and economic growth cannot be generalized across countries because economic policies are country specific and their success depends on the efficiency of the institutions implementing them.

Although "better finance, more growth" is a plausible conjecture, there exists limited direct evidence to confirm that institutions make a difference in the way financial development affects economic growth. An exception is the study by Demetriades and Law (2006), who, using a linear interaction model, found that financial development has larger effects on economic growth when the financial system is embedded within a sound institutional framework. They also found that financial development is most potent in middle-income economies, where its effects are particularly large when institutional quality is high. In low-income economies, more finance without sound institutions may not succeed in delivering long-run economic development. The relevance of institutional quality is clearly supported by this finding; the researchers concluded that "better finance, more growth" has much wider application than "more finance, more growth." However, this type of modeling strategy has one limitation. The interaction term (constructed as a product of financial development and institutions) used to capture the contingency impact of finance on growth imposes a priori restriction that the effect of financial development on economic growth monotonically increases (or decreases) with the level of institutional development. It may be that a certain level of institutional quality has to be attained before financial development can have any impact on growth. This conjecture requires a more a flexible modeling strategy that can accommodate different kinds of financial development-growth-institutions interactions.

This paper provides new evidence that sheds light on the role that institutions play in mediating the influence of financial development on growth. Specifically, we explore whether there exists an institutional quality threshold in the finance-growth relationship. This relationship may be contingent on institutional quality, where financial development promotes economic growth after institutions exceed a certain threshold level. The findings of the study may have important policy implications. If there is clear evidence that weak institutions significantly hamper the finance-growth nexus, then policy makers should propose measures that strengthen institutions economically to improve the functioning of financial markets and boost economic development. In addition, the paper highlights a potential effect of institutions on growth through indirect channels. For example, Law (2009) found that the institutional channel outperforms the competition channel in ensuring the positive effects of openness on financial development in developing countries. Mishkin (2009) also emphasized that globalization promotes financial development and economic growth in developing countries via institutional reforms.

This study extends the literature in four respects. First, we used a regression model based on the concept of threshold effects. The fitted model allowed the relationship between financial development and growth to be piecewise linear, with the institutions indicator acting as a regime-switching trigger. Second, we used a dataset sufficiently large to enable robust conclusions to be drawn; specifically, the sample used in this study consisted of annual data from 85 countries from 1980 through 2008. Third, two datasets were employed in the analysis, corresponding to institutions datasets from the International Country Risk Guide (ICRG) and the World Bank Worldwide Governance Indicators (WGIs). Finally, three financial development indicators were employed in the analysis-private sector credit, liquid liabilities, and commercial bank assets-to capture various aspects of banking sector development.

This paper is organized as follows: Section 2 lays out the empirical model, the threshold regressions of Hansen (2000) and Caner and Hansen (2004), and the data; Section 3 contains a discussion of the empirical findings; and Section 4 provides a summary and conclusions.

2. Empirical model and the data

2.1. Empirical model

The empirical model is based on King and Levine (1993a, 1993b) and Levine and Zervos (1998). Since publication of their works, it has become common practice to examine the empirical linkages between finance and growth using the following linear cross-country growth equation:

$$\text{GROWTH}_i = \beta' \text{FD}_i + \gamma X_i + \varepsilon_i \quad (1)$$

where GROWTH_i is the average growth rate in country i, FD_i is the country's level of financial development, X is a vector of controls (initial income per capita, investment-gross domestic product (GDP) ratio, population growth rates, and human capital), and ε_i is a noise term. All the variables are transformed into logarithm.

To test the hypothesis outlined in the previous section, we argue that the following Eq. (2) is particularly well suited to capture the presence of contingency effects and to offer a rich way of modeling the influence of institutional development on the impact of financial development in economic growth. Consequently, we use the threshold regression approach suggested by Hansen (2000) to explore the nonlinear behavior of finance in relation to the economic growth. The model, based on threshold regression, takes the following form:

$$\text{GROWTH}_i = (\beta_1 \text{FD}_i + \gamma_1 X_i)\text{I}(\text{INS} \leqslant \lambda) + (\beta_2 \text{FD}_i + \gamma_2 X_i)\text{I}(\text{INS} \geqslant \lambda) + \varepsilon_i \quad (2)$$

where INS (i.e., level of institutional development) is the threshold variable used to split the sample into regimes or groups and λ is the unknown threshold parameter. $\text{I}(\cdot)$ is the indicator function, which takes the value 1 if the argument in the indicator function is valid, and 0 otherwise. This type of modeling strategy allows the role of finance to differ depending on whether institutions are below or above some unknown level of λ. In this equation, institutions act as sample-splitting (or threshold) variables. The impact of financial development on growth will be β_1 and β_2 for countries with a low or high regime, respectively. It is obvious that under the hypothesis $\beta_1 = \beta_2$ and $\gamma_1 = \gamma_2$ the model becomes linear and reduces to (1). Models such as (2) have been used in the analysis of trade and growth (Khoury and Savvides, 2006), knowledge spillovers (Falvey et al., 2007), foreign direct investment (FDI) and growth (Azman-Saini et al., 2010), and FDI and income inequality (Wu and Hsu, 2012), among other topics.

The first step of our estimation was to test the null hypothesis of linearity H_0: $\beta_1 = \beta_2$ against the threshold model in Eq. (2). Since the threshold parameter λ was not identified under the null, this became a non-standard inference problem and the Wald or LM test statistics therefore did not carry their conventional chi-square limits (see Hansen, 1996, 2000). Instead, inferences were implemented by calculating a Wald or LM statistic for each possible value of λ and subsequently basing inferences on the supremum of the Wald or LM across all possible λs. The limiting distribution of this supremum statistic is non-standard and depends on numerous model-specific nuisance parameters. Since tabulations were not possible, inferences were conducted via a model based on bootstrap whose validity and properties were established by Hansen (1996). Once an estimate of λ was obtained (as the minimizer of the residual

sum of squares computed across all possible values of λ), estimates of the slope parameters followed trivially as $\hat{\beta}(\hat{\lambda})$ and $\hat{\gamma}(\hat{\lambda})$.

The financial development and economic growth literature has also highlighted the possibility of a simultaneity bias caused by the joint determination of financial development and economic growth. Accordingly, to address the empirical relevance of financial development on economic growth while controlling for potential endogeneity, this study employs the threshold regression with instrumental variables (IV) proposed by Caner and Hansen (2004) for further robustness checks. This approach allows us to deal with the endogeneity of financial development, so as to concentrate on the causal effects of the exogenous component of financial development and uncover threshold effects, if any, on the nexus. In addition, this approach does not split the sample of countries according to some predetermined rule, but allows the data to determine which regime a country belongs to. Eq. (2) can be modified into the instrumental threshold regression as

$$\mathrm{GROWTH}_i = (\beta_1 \mathrm{FD}_i + \gamma_1 X_i)\mathrm{I}(\mathrm{INS}_i \le \lambda) + (\beta_2 \mathrm{FD}_i + \gamma_2 X_i)\mathrm{I}(\mathrm{INS} > \lambda) + \varepsilon_i \quad (3)$$

$$\mathrm{FD}_i = (\delta_1 Z_i + \varphi_1 X_i)\mathrm{I}(\mathrm{INS}_i \le \lambda) + (\delta_2 Z_i + \varphi_2 X_i)\mathrm{I}(\mathrm{INS} > \lambda) + \mu_i \quad (4)$$

where Z_i is a vector of instrumental variables and the order condition is satisfied. The most important condition for this approach is that the threshold variable INS_i is treated as being exogenous.

Caner and Hansen (2004) suggest a three-step procedure to estimate the regression coefficients. First, we regress FD_i on Z_i by the ordinary least square (OLS) approach and obtain the fitted values of FD_i. Second, by substituting the predicted values of FD_i into Eq. (3) we estimate the threshold parameter λ with the OLS method which is similar to that in Hansen (2000). Finally, based on the estimate of λ, we can divide the whole sample into two sub-samples and estimate the slope parameters using the generalized method of moments (GMM). Moreover, Caner and Hansen (2004) propose a supremum Wald (sup W) statistic to test for the existence of a threshold effect and derive the asymptotic distribution of this statistic. Since the asymptotic distribution depends on nuisance parameters, we follow Caner and Hansen (2004) to use a bootstrap procedure to obtain the correct (asymptotic) p-value.

2.2. The data

In this study, to estimate Eq. (2), we used two cross-country datasets corresponding to two institutions data sources. We do not pursue a panel data approach because: (i) the economic growth model adopted in this study is based on a dynamic specification in which the lag dependent variable is included as explanatory variable. The purpose of this estimation strategy is to control for convergence effect as suggested by many theoretical models. However, the theory for the case of dynamic panel threshold has not been developed. The panel threshold approach suggested by Hansen (1999) is only valid for a non-dynamic specification. Hence, the Hansen (2000) and Caner and Hansen (2004) cross-section threshold approaches which can handle dynamic estimation are employed; (ii) institutions are deep factors and usually move slowly and thus their observed variation from year to year may be rather small (Chong and Calderon, 2000). In addition, the institutional quality is measured with a great deal of impression with subjective indices. Moreover, the timing of variations in institutional indices can be rather imprecise. Actual variations in the quality of institutions may be reflected on perceptions with a lag, and the lag may differ from one country to the next and from one institutional change to the other. Therefore, in order to cope with this concern we prefer to estimate the relationship based on cross-section observations; (iii) according to Hauk and Wacziarg (2009), financial development is imperfectly measured and persistent, which means that its growth effects are likely to be underestimated by a panel-data approach relative to a cross-section approach,[5] and (iv) the use of cross-countries analysis will enable a comparison between our results and the cross-country study in the literature.

The first institutions dataset employed was from the International Country Risk Guide ($\mathrm{INS}_{\mathrm{ICRG}}$) – a monthly publication of Political Risk Services (PRS), the number of countries was 85[6] and the period covered was 1980 through 2008. Following Bekaert et al. (2005), three PRS indicators were used to measure the overall institutional environment: (i) *corruption*, which reflects the likelihood that officials will demand illegal payment or use their position or power to their own advantage, (ii) *rule of law*, which reveals the degree to which citizens are willing to accept established institutions to make and implement laws and to adjudicate disputes, and (iii) *bureaucratic quality*, which represents autonomy from political pressure, strength, and expertise to govern without drastic changes in policy or interruptions in government services, as well as the existence of an established mechanism for recruitment and training of bureaucrats. These three variables were scaled from 0 to 10, where higher values implied better institutional quality and vice versa. The institutions indicator was obtained by summing these three indicators.[7]

The second institutions dataset was assembled by Kaufmann et al. (2009) from World Governance Indicators (WGIs). The same sample countries were employed but the sample period covered 1996 through 2008. The indicators were constructed based on information gathered through a wide variety of cross-country surveys as well as polls of experts. Kaufmann et al. (2009) used a model of unobserved components, which enabled them to determine levels of coverage in approximately 212 countries for each of their indicators. They constructed six different indicators, each representing a different dimension of institutional quality and governance.[8] However, we employed only three indicators to represent the institutions: (i) *control of corruption*, (ii) *rule of law*, and (iii) *government effectiveness*.[9] We selected only these three indicators because they aligned with the first institutions dataset of ICRG measures (corruption, rule of law, and bureaucratic quality). Langbein and Knack (2010) pointed out that the WGI essentially measures the same underlying governance concept although the six measures were meant to capture conceptually distinct dimensions. They also argued that these six indicators are highly correlated; thus, the second institutions dataset ($\mathrm{INS}_{\mathrm{WGI}}$) was obtained by averaging the above three indexes.

With respect to financial development, we focused only on the three banking sector development indicators (all expressed as ratios to GDP), namely, (i) private sector credit, (ii) liquid liabilities, and (iii) commercial bank assets, because bank credits are the only feasible sources of financing for the majority of the developing countries in the sample. In addition, the number of available observations for stock market development indicators was insufficient to conduct sample-splitting regression. The data were taken from

[5] Hauk and Wacziarg (2009) also point out that this may explain why Benhabib and Spiegel (2000) found no significant interaction between initial GDP and financial development using panel data on 92 countries from 1960 to 1985.

[6] The list of countries is presented in Table 1.

[7] Due to strong correlations among these separate indicators, with the consequent risk of multicollinearity, the three PRS variables were added to form an institutions index (Bekaert et al., 2005). Numerous studies have employed this dataset in empirical analysis, including Easterly and Levine (1997), Hall and Jones (1999), Chong and Calderon (2000), Clarke (2001), Demetriades and Law (2006), Law (2009), Law and Azman-Saini (2012).

[8] The six governance indicators were measured in units ranging from about −2.5 to 2.5, with higher values corresponding to better governance outcomes.

[9] The definitions of Kaufmann et al.'s (2009) institutions indicators are presented in Appendix I.

the Financial Structure Database of the World Bank. The average growth rate, initial real GDP per capita (US$ 2000 constant prices), and population growth were obtained from World Development Indicators. Average years of secondary schooling was gathered from the Barro and Lee dataset. Investment (as a percentage of GDP) was collected from Penn World Table 6.3.

Tables 1 and 2 present the descriptive statistics and correlation matrix of the variables employed in the analysis, respectively. As demonstrated in the tables, all three financial development indicators are highly positively correlated. For example, the correlation between private sector credit and commercial bank assets is 0.902, whereas between private sector credit and liquid liabilities it is 0.741. In addition, the two institutions datasets are also positively correlated, where the correlation is 0.853 between INS_{ICRG} and INS_{WGI}.

3. Empirical results

3.1. Hansen (2000) threshold regression

Table 3 reports the results of estimating Eq. (2) using two institutional quality variables, taken from ICRG (INS_{ICRG}) and WGI (INS_{WGI}). The statistical significance of the threshold estimate was evaluated by *p*-value calculated using the bootstrap method with 1000 replications and 15% trimming percentage. As shown in all models, the bootstrap *p*-values indicate that the test of no threshold effect can be rejected. Thus, the sample can be split into two regimes. For example, referring to Models 1a and 1b, where financial development is measured by private sector credit, the empirical results favor a threshold model, regardless of whether the institutions came from the ICRG (INS_{ICRG}) or WGI (INS_{WGI}). The point estimate of the threshold value of institutions is 3.377 with a corresponding 95% confidence interval [3.366, 3.377] for Model 1a. This implies that countries with threshold values of less than 3.377 are classified into the low-INS group (i.e., low institutional quality) while those with greater values are classified into the high-INS group (high institutional quality). We also tested whether the high-INS group could be split further into sub-regimes. The bootstrap *p*-values were insignificant for the second sample split, which suggests that only the single threshold in Eq. (2) is adequate for all models.

Having established the existence of an institutional quality threshold, the next question became how institutions affect the financial development-growth relationship. Table 4 presents the empirical results of Eq. (2), with private sector credit as a financial development indicator. Since the data favor a threshold model, we focused on the threshold model specifications. Versions (a) and (b) represent the institutions dataset from ICRG (INS_{ICRG}) and WGI (INS_{WGI}), respectively. Turning first to Model 1a, the coefficients estimates of financial development are insignificant when institutions (INS_{ICRG}) fall below the threshold level. In contrast, above the threshold level of the institutions, the effect of financial development on growth becomes significant and positive. On the other hand, when the institutions variable was measured by WGI (INS_{WGI}) in Model 1b, the results revealed that below the institutions threshold, financial development is negative and an insignificant determinant of growth, but it is positive and significant in influencing growth above the institutions threshold level. This finding suggests that institutions can replicate nonlinear relationships between financial development and growth, which

Table 1
Descriptive statistics 85 cross-country, 1980–2008.

	Unit of measurement	Mean	Std dev.	Minimum	Maximum
Economic growth	%	0.0125	0.0167	−0.0377	0.0553
Initial income (1979)	US$ 2000 constant price	7.8598	1.5150	5.1070	10.2078
Human capital	Average years of schooling	2.1749	1.1809	0.1760	5.1304
Population growth	%	1.7394	1.0855	−0.3547	4.0875
Investment	% Of GDP	2.9062	0.5297	1.5747	3.9300
Financial development					
Private sector credit	% Of GDP	0.4883	0.3685	0.0085	1.5146
Commercial bank assets	% Of GDP	0.5392	0.3851	0.0098	2.0639
Liquid liabilities	% Of GDP	0.5334	0.4131	0.0522	2.8550
Institutions (INS)					
INS_{ICRG}	Scaled from 0 to 30	3.3459	0.3449	2.3365	3.8581
INS_{WGI}	Scaled from −2.5 to 2.5	1.1455	0.2013	−2.3600	2.4094

Countries: Algeria, Argentina, Australia, Austria, Bangladesh, Belgium, Bolivia, Brazil, Cameroon, Canada, Chile, Colombia, Congo, Democratic Republic of Congo, Costa Rica, Cote d'Ivoire, Denmark, Ecuador, Egypt, El Salvador, Finland, France, Gabon, Gambia, Germany, Ghana, Greece, Guatemala, Guyana, Haiti, Honduras, Hong Kong, Hungary, Iceland, India, Indonesia, Iran, Ireland, Israel, Italy, Jamaica, Japan, Jordan, Kenya, Kuwait, Latvia, Luxembourg, Malawi, Malaysia, Mali, Mexico, Morocco, Netherlands, New Zealand, Niger, Norway, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Philippines, Portugal, Saudi Arabia, Senegal, Sierra Leone, Singapore, South Africa, South Korea, Spain, Sri Lanka, Sudan, Sweden, Switzerland, Syria, Thailand, Togo, Trinidad & Tobago, Tunisia, Turkey, UK, USA, Uruguay, Venezuela, Zambia.

Table 2
Correlations.

	Growth	Initial	PRC	CBA	LLY	INS_{ICRG}	INS_{WGI}	HC	Popu	Invt
Growth	1.000									
Initial	0.268	1.000								
PRC	0.491	0.707	1.000							
CBA	0.477	0.661	0.902	1.000						
LLY	0.417	0.487	0.741	0.806	1.000					
INS_{ICRG}	0.493	0.744	0.697	0.651	0.481	1.000				
INS_{WGI}	0.551	0.836	0.789	0.734	0.534	0.853	1.000			
HC	0.422	0.796	0.735	0.669	0.484	0.646	0.795	1.000		
Popu	−0.512	−0.596	−0.509	−0.515	−0.329	−0.515	−0.678	−0.588	1.000	
Invt	0.598	0.635	0.597	0.605	0.468	0.567	0.639	0.606	−0.635	1.000

Notes: Growth = economic growth; Initial = initial income; PRC = private sector credit; CBA = commercial bank assets; LLY = liquid liabilities; INS_{ICRG} = institutions (International Country Risk Guide); INS_{WGI} = institutions (World Governance Indicator); HC = human capital; Popu = population growth; Invt = investment.

Table 3
Threshold estimates of institutions (INS).

	Model 1 Institutions = INS_{ICRG}	Model 2 Institutions = INS_{WGI}
	FD = private sector credit	
	Model 1a	Model 1b
First sample split		
LM test for no threshold	17.600	20.523
Bootstrap *p*-value	0.011	0.002
Threshold estimate	3.377	−0.994
95% Confidence interval	(3.366, 3.377)	(−1.338, −0.650)
Second sample split		
LM test for no threshold	12.319	12.914
Bootstrap *p*-value	0.083	0.097
	FD = liquid liabilities	
	Model 2a	Model 2b
First sample split		
LM test for no threshold	16.863	19.154
Bootstrap *p*-value	0.008	0.002
Threshold estimate	3.377	−0.650
95% confidence interval	(3.366, 3.377)	(−1.338, −0.285)
Second sample split		
LM test for no threshold	11.485	13.061
Bootstrap *p*-value	0.111	0.091
	FD = commercial bank assets	
	Model 3a	Model 3b
First sample split		
LM test for no threshold	17.657	20.075
Bootstrap *p*-value	0.001	0.002
Threshold estimate	3.366	−0.65
95% confidence interval	(3.366, 3.386)	(−1.338, −0.026)
Second sample split		
LM test for no threshold	11.167	10.267
Bootstrap *p*-value	0.212	0.314

Note: H_0: no threshold effect.

is consistent with empirical work by Deidda and Fattouh (2002), Rioja and Valev (2004b), Shen and Lee (2006), Ergungor (2008), Hung (2009) and Cecchetti and Kharroubi (2012).

In Models 1a and 1b, all the estimated coefficients on initial income, human capital, population growth, and investment are consistent with theory. The coefficients on initial income are negative in all models regardless of whether below or above the institutions threshold. However, below the institutions threshold, human capital and population growth are statistically significant determinants of economic growth. However, the investment variable is positive and statistically significant in promoting growth above the threshold level.

Table 5 presents results of the repeated analysis, which used liquid liabilities as a proxy for financial development. The results are broadly similar to those obtained using private sector credit, reported in Table 4. The results concerning the non-linear relationship between financial development and economic growth still hold. The estimated institutions threshold above which financial development significantly promotes economic growth is exactly the same as that found in the case of private sector credit. Again, all the estimated coefficients on initial income, human capital, population growth, and investment are consistent with theory. Table 6 reports the results for the model using another financial development indicator, commercial bank assets. Empirical evidence shows that the same result cannot be established in the model. This finding demonstrates that economic growth responds differently to different financial development measures. Again, both Tables 5 and 6 also indicate that the positive relationship between investment and growth holds only in countries that have exceeded the institutions threshold level. However, human capital has a significant effect on growth below the estimated institutions threshold level.

The above findings demonstrate that economic growth responds differently to financial development indicators when considering institutional differences. Economic growth has a much stronger association with the private sector credit than with liquid liabilities and commercial bank assets.[10] This finding is in line with Levine et al. (2000), who show that there is a strong connection between private sector credit and economic growth. They also point out that their preferred measure of financial development is private sector credit, which is probably the most important finance indicator. This measure reflects more precisely the efficiency of banking institutions in providing the credit sources to private sector. Our empirical findings highlight that credit channel seems to drive the results since private sector credit is statistically significant determinant of growth but commercial bank assets are insignificant. Better institutional quality plays a pivotal role in ensuring the ability of financial institutions to facilitate efficient borrowing, hence, prevent credit divergence to unproductive investment activities.

To verify the sensitivity of the estimated threshold value, we replaced real economic growth with real GDP per capita and performed the same analysis using private sector credit and liquid liabilities. The empirical results are summarized in Tables 7a and 7b. Again, the data favor a single threshold model, and the hypothesis of a no-threshold model was rejected. The empirical results also reveal that in countries with low levels of institutional development, there is no significant relationship between financial development (both private sector credit and liquid liabilities) and real GDP per capita. This is reflected in the coefficient on financial development which is highly significant in the second regime (high institutional development), but insignificant in the first regime (low institutional development). In short, the results concerning the non-linear relationship between financial development and growth still hold; the nexus between these two variables is significantly positive only in the high institutional development regime.[11]

Rousseau and Wachtel (2005) pointed out the 1980s was the main drivers of the finance economic growth relationship, but from 1990s onwards the data was susceptible to the Lucas critique who argued that finance has no role in promoting economic growth. Therefore, we also split the sample into before and after 1990s using the ICRG institutions dataset. We exclude the WGI dataset for sample splitting due to the dataset is only available from 1996 onwards. The empirical results also indicate that financial development promotes economic growth only in the high institutions regime, regardless the sample period was before 1990s or after 1990s.[12]

3.2. Caner and Hansen (2004) instrumental variable threshold regression

It is also well known in the literature that the 'finance' variable is highly endogenous and the issue of reverse causation.[13] This is

[10] The coefficient on private sector credit is higher than liquid liabilities in the high institutions regime threshold regression, but commercial bank assets indicator is insignificant in the threshold regression estimations.

[11] Again, the commercial bank assets variable is an insignificant determinant of real GDP per capita in two sub-sample split periods. Though not reported, this result is available from the authors upon request. The sensitivity results are also robust to different trimming percentages.

[12] The empirical results, however, are not reported to save space but are available upon request.

[13] Demetriades and Hussein (1996), Al-Yousif (2002), Calderón and Liu (2003), Bangake and Eggoh (2011) demonstrate that financial development and economic growth are mutually causal, that is, causality is bidirectional.

Table 4
Regression results using institutions (INS) as a threshold variable. Dependent variable: economic growth; Financial development: private sector credit/GDP.

	Linear model	Threshold Model 1a institutions = INS_{ICRG}		Threshold Model 1b institutions = INS_{WGI}	
	OLS without threshold	Regime 1 INS < 3.377	Regime 2 INS > 3.377	Regime 1 INS < −0.994	Regime 2 INS > −0.994
Constant	0.0139	0.0266	0.0044	0.0088	0.0283***
	(0.0141)	(0.0148)	(0.0132)	(0.0259)	(0.0101)
Initial income	−0.0066***	−0.0060***	−0.0091***	−0.0061**	−0.0100***
	(0.0016)	(0.0017)	(0.0015)	(0.0027)	(0.0009)
Private sector credit	0.0158***	0.0091	0.0093**	−0.0225	0.0157***
	(0.0050)	(0.0107)	(0.0043)	(0.0240)	(0.0043)
Human capital	0.0026	0.0047**	0.0007	0.0075**	0.0003
	(0.0014)	(0.0018)	(0.0014)	(0.0035)	(0.0011)
Population growth	0.0042***	−0.0048***	−0.0001	−0.0032***	−0.0021
	(0.0014)	(0.0016)	(0.0014)	(0.0010)	(0.0043)
Investment	0.0152***	0.0081	0.0281***	0.0082	0.0227***
	(0.0045)	(0.0043)	(0.0036)	(0.0044)	(0.0035)
R-sq	0.5181	0.3721	0.6727	0.2913	0.7024
Heteroskedasticity test (*p*-value)	0.0307	–	–	–	–
No. observations	85	50	35	32	53

Notes: the standard errors are reported in parentheses (White corrected for heteroskedasticity). Results correspond to trimming percentage of 15%.
** Indicate significance at 5% level.
*** Indicate significance at 1% level.

Table 5
Regression results using institutions (INS) as a threshold variable. Dependent variable: economic growth; Financial development: liquid liabilities/GDP.

	Linear model	Threshold Model 2a institutions = INS_{ICRG}		Threshold Model 2b institutions = INS_{WGI}	
	OLS without threshold	Regime 1 INS < 3.377	Regime 2 INS > 3.377	Regime 1 INS < −0.650	Regime 2 INS > −0.650
Constant	−0.0097	0.0272	0.0068	0.0044	0.0091
	(0.0154)	(0.0147)	(0.0150)	(0.0237)	(0.0154)
Initial income	−0.0061***	−0.0057***	−0.0094***	−0.0045**	−0.0101***
	(0.0017)	(0.0016)	(0.0015)	(0.0022)	(0.0011)
Liquid liabilities	0.0091***	0.0130	0.0058**	−0.0171	0.0063**
	(0.0027)	(0.0107)	(0.0026)	(0.0170)	(0.0028)
Human capital	0.0040***	0.0044**	0.0019	0.0061***	0.0021
	(0.0014)	(0.0018)	(0.0015)	(0.0023)	(0.0013)
Population growth	−0.0045***	−0.0053***	−0.0003	−0.0030**	−0.0009
	(0.0015)	(0.0018)	(0.0017)	(0.0012)	(0.0037)
Investment	0.0153***	0.0069	0.0281***	0.0065	0.0295***
	(0.0049)	(0.0044)	(0.0042)	(0.0050)	(0.0048)
R-sq	0.5049	0.3844	0.6776	0.2619	0.7480
Heteroskedasticity test (*p*-value)	0.0082	–	–	–	–
No. observations	85	50	35	38	47

Notes: the standard errors are reported in parentheses (White corrected for heteroskedasticity). Results correspond to trimming percentage of 15%.
** Indicate significance at 5% level.
*** Indicate significance at 1% level.

Table 6
Regression results using institutions (INS) as a threshold variable. Dependent variable: Economic growth; Financial development: Commercial bank assets/GDP.

	Linear model	Threshold Model 3a institutions = INS_{ICRG}		Threshold Model 3b institutions = INS_{WGI}	
	OLS without threshold	Regime 1 INS < 3.366	Regime 2 INS > 3.366	Regime 1 INS < −0.650	Regime 2 INS > −0.650
Constant	0.0104	0.0300**	−0.0049	0.0044	0.0041
	(0.0148)	(0.0147)	(0.0178)	(0.0228)	(0.0153)
Initial income	−0.0062***	−0.0059***	−0.0089***	−0.0046**	−0.0098***
	(0.0017)	(0.0017)	(0.0016)	(0.0023)	(0.0011)
Commercial bank assets	0.0109**	0.0165	0.0005	0.0251	0.0028
	(0.0053)	(0.0150)	(0.0004)	(0.0195)	(0.0043)
Human capital	0.0036**	0.0046**	0.0018	0.0057**	0.0022
	(0.0015)	(0.0021)	(0.0014)	(0.0023)	(0.0013)
Population growth	−0.0040***	−0.0056***	−0.0014	−0.0026**	−0.0007
	(0.0015)	(0.0019)	(0.0017)	(0.0011)	(0.0037)
Investment	0.0153***	0.0064	0.0319***	0.0063	0.0308***
	(0.0048)	(0.0044)	(0.0045)	(0.0049)	(0.0047)
R-sq	0.4995	0.3908	0.6253	0.2811	0.7143
Heteroskedasticity test (*p*-value)	0.0143	–	–	–	–
No. observations	85	47	38	38	47

Notes: the standard errors are reported in parentheses (white corrected for heteroskedasticity). Results correspond to trimming percentage of 15%.
** Indicate significance at 5% level.
*** Indicate significance at 1% level.

Table 7a
Robustness check using real GDP per capita as dependent variable. Financial development: private sector credit/GDP.

	Linear model	Threshold Model 4a institutions = INS_{ICRG}		Threshold Model 4b institutions = INS_{WGI}	
	OLS without threshold	Regime 1 INS < 3.289	Regime 2 INS > 3.289	Regime 1 INS < −0.178	Regime 2 INS > −0.178
Constant	4.7765***	3.4760***	5.3754***	4.5069***	6.6209***
	(0.6893)	(0.6354)	(1.2774)	(0.7969)	(1.1544)
Private sector credit	1.0518***	2.1555	0.4644**	−0.1444	0.5540**
	(0.3171)	(1.1535)	(0.2031)	(1.1963)	(0.2186)
Human capital	0.6245***	0.7884***	0.5029***	0.6293**	0.4439***
	(0.1231)	(0.2624)	(0.1131)	(0.2718)	(0.1194)
Population growth	−0.1984	0.2779	−0.4569***	−0.0421	−0.2691**
	(0.1293)	(0.1606)	(0.1010)	(0.2132)	(0.1286)
Investment	0.5743***	0.3628	0.7886**	0.3336	0.5384**
	(0.2371)	(0.2145)	(0.3960)	(0.3763)	(0.2346)
R-sq	0.7723	0.6161	0.7782	0.4106	0.4163
Heteroskedasticity test (*p*-value)	0.2373	–	–	–	–
No. observations	85	38	47	41	44

Notes: the standard errors are reported in parentheses (white corrected for heteroskedasticity). Results correspond to trimming percentage of 15%.
** Indicate significance at 5% level.
*** Indicate significance at 1% level.

Table 7b
Robustness check using real GDP per capita as dependent variable. Financial development: Liquid liabilities/GDP.

	Linear model	Threshold Model 5a institutions = INS_{ICRG}		Threshold Model 5b institutions = INS_{WGI}	
	OLS without threshold	Regime 1 INS < 3.289	Regime 2 INS > 3.289	Regime 1 INS < −0.178	Regime 2 INS > −0.178
Constant	4.5988***	2.9942***	5.4148***	4.6052***	6.6538***
	(0.8032)	(0.8159)	(1.4088)	(0.7964)	(1.2547)
Liquid liabilities	0.4593***	0.7374	0.2786**	−0.7989	0.3693***
	(0.1471)	(0.7011)	(0.1377)	(0.9268)	(0.1369)
Human capital	0.7622***	0.8903***	0.5387***	0.6179**	0.4967***
	(0.1158)	(0.2613)	(0.0872)	(0.2712)	(0.0856)
Population growth	−0.2158	0.3047	−0.4699***	−0.0725	−0.2578**
	(0.1386)	(0.1769)	(0.1069)	(0.2125)	(0.1278)
Investment	0.6353**	0.5199	0.7693**	0.3231	0.6247**
	(0.2725)	(0.2718)	(0.3432)	(0.4136)	(0.2707)
R-sq	0.7579	0.5773	0.7817	0.4230	0.5607
Heteroskedasticity test (*p*-value)	0.5022	–	–	–	–
No. observations	85	38	47	41	44

Notes: the standard errors are reported in parentheses (white corrected for heteroskedasticity). Results correspond to trimming percentage of 15%.
** Indicate significance at 5% level.
*** Indicate significance at 1% level.

Table 8
Robustness check using IV and threshold regression. Dependent variable: economic growth; Financial development: private sector credit/GDP.

		Threshold Model 6a institutions = INS_{ICRG}		Threshold Model 6b institutions = INS_{WGI}	
	Sup W stat	82.4721***		78.6125***	
	(*p*-value)	(0.0001)		(0.0001)	
		Regime 1 INS < 3.385	Regime 2 INS > 3.385	Regime 1 INS < −0.987	Regime 2 INS > −0.987
Constant		0.0358	0.0105	0.0107	0.0328**
		(0.0204)	(0.0161)	(0.0288)	(0.0156)
Initial income		−0.0066***	−0.0122**	−0.0077**	−0.0135**
		(0.0025)	(0.0051)	(0.0035)	(0.0058)
Private sector credit		0.0121	0.0138**	−0.0314	0.0208***
		(0.0119)	(0.0064)	(0.0326)	(0.0056)
Human capital		0.0039**	0.0015	0.0062**	0.0013
		(0.0016)	(0.0022)	(0.0031)	(0.0011)
Population growth		−0.0054***	−0.0012	−0.0040***	−0.0032
		(0.0014)	(0.0010)	(0.0015)	(0.0039)
Investment		0.0076	0.0221***	0.0077	0.0209**
		(0.0039)	(0.0058)	(0.0059)	(0.0041)
R-sq		0.3744	0.6811	0.3021	0.7136
No. observations		49	36	33	55

Notes: following Caner and Hansen (2004), we use the Sup W statistic to test for the presence of threshold effects. The corresponding *p*-values are calculated using 10,000 bootstrap replications. The standard errors are reported in parentheses (white corrected for heteroskedasticity).
The instrumental variables (IV) are the log of initial financial development, legal origins (British and French) and creditor rights.
** Indicate significance at 5% level.
*** Indicate significance at 1% level.

because countries with higher economic growth may be better able to afford infrastructure that is conducive to financial development. In addition, the richer countries tend to demand relatively more for financial services. The potential endogeneity of 'finance' implies that the least squares (LSs) estimation of the data may yield biased and inconsistent coefficient estimates, hence, hypotheses tests can be seriously misleading. To diminish such problems of simultaneity bias, a number of finance-growth studies utilize the instrumental-variable (IV) technique (For example, Beck et al., 2000; Levine et al., 2000; McCaig and Stengos, 2005 and Kendall, 2012). To control for the endogeneity or reverse causation, we instrument financial development variable with legal origins, creditor rights as well as initial values of financial development. These instruments are chosen based on the theoretical and empirical work in the literature. La Porta et al. (1997, 1998) suggest that the legal origins in general can explain cross-country differences in financial development. They argue that the legal origin of a country materially influences its legal treatment of shareholders, the laws governing creditor rights, the efficiency of contract enforcement, and accounting standard. Shareholders and creditors enjoy greater protection in English common law countries than in French civil law countries.[14] Djankov et al. (2007) find that stronger protection of creditor rights is positively correlated with financial institutions. Both datasets for legal origins and creditor rights are obtained from La Porta et al. (1997) and Djankov et al. (2007), respectively.

Before conducting the IV estimations, the Hausman test is carried out to test for endogeneity based on the full sample countries. If there is no endogeneity problem, then both LS and IV are consistent. The Hausman test results (the statistic is 16.83 and its p-value is 0.00) indicate that there exists the endogeneity problem where the financial development indicator is proxied by private sector credit, regardless the institutions variable is measured by INS_{ICRG} or INS_{WGI}. However, the Hausman results reveal that the other two financial development indicators namely liquid liabilities and commercial bank assets are exogenous. Therefore, we should prefer LS results for these two indicators because it is the most efficient. This finding is consistent with Levine et al. (2000), Beck et al. (2000) and Levine (2003), where they also concludes that simultaneity bias does not seem to be the cause of the relationship between finance and growth. Therefore, we proceed to the threshold model with an IV approach proposed by Caner and Hansen (2004) only for private sector credit as financial development measure. The Hansen J-statistic is also far from rejection of its null hypothesis that the null set of orthogonality conditions is valid. The evidence thus indicates that the three instruments for financial development are appropriate.[15]

Table 8 presents the results of the Caner and Hansen (2004) IV threshold regression. Threshold values are estimated by using the two-stage least squares (2SLS) regression approach and the coefficients are estimated by the GMM approach. Based on the result of endogeneity test, we only estimate private sector credit as financial development indicator with both institutions from ICRG and WGI as the threshold variable in this section. The sup-Wald test statistics along with their bootstrap p-values indicate a significant presence of a threshold effect in the finance-growth nexus, suggesting two separate regimes, conditional on the quality of institutions. The empirical results demonstrate that in the regime with high quality institutions, financial development (private sector credit) has a substantial positive impact on economic growth. In the regime with low quality institutions, financial development has no impact on growth. The findings are consistent regardless the institutions indicator is measured by ICRG or WGI. Overall, the results of Table 8 are similar to those reported in Table 4. Therefore, the empirical results are robust to the alternative IV threshold estimation method.

4. Conclusions

Using data from 85 countries covering 1980 through 2008, this study examined whether there exists an institutions threshold in financial development and growth. One major contribution of the paper was the adoption of the regression model based on the concept of threshold effect proposed by Hansen (2000) to capture rich dynamics in the relationship between finance and growth. The empirical results indicated that there is a significant institutions threshold in the financial development-economic growth nexus. For institutions below the threshold, financial development has an insignificant effect on growth. However, the growth effect of financial development turns out to be significant and positive for institutions above the threshold level. These findings suggest that the financial development-growth nexus is contingent on institutions, where financial development promotes growth after institutions exceed a certain threshold level. The results are robust to Caner and Hansen (2004) instrumental variable (IV) threshold regression, two institutional quality measures as well as sample split estimations.

The empirical results suggest that a better institutions environment allows an economy to exploit the benefits of financial development on economic growth. This finding seems to indicate that the quality of finance matters for economic development, where better institutional quality is potent in ensuring the effectiveness of financial development in delivering long-run economic benefits. Nevertheless, low quality of institutions tends to distort the ability of financial intermediaries to channel resources to finance productive activities efficiently.[16] To address the causal aspect of the finance and growth, the IV threshold regression which is able to deal with endogeneity also demonstrates that financial development is statistically significant determinant of economic growth.

Since the effect of financial development on growth kicks in after institutions reach a certain threshold, policy makers should improve the level of institutional development (such as enhancing the rule of law, cracking down on corruption, improving government efficiency and transparency) to explore the benefits of financial sector reforms in promoting economic growth. In addition, if a country increasing finance, which is beyond the certain institutional threshold, tends to benefit from increased economic growth rates. Despite these important findings, our research also elicits another interesting result where some aspects of financial development seem to react more rigorously to better institutions. Different finance indicators response differently to institutional development, and whether different types of institutions might have dissimilar influence on financial development. We leave this possibility for future research.

[14] Levine et al. (2000) demonstrate that legal origins are good instruments for financial development because they were established too long ago to suffer from reverse causation, and they have a strong effect on financial development. Beck et al. (2003) show that the historically determined differences in legal traditions help explain international differences in financial systems today.

[15] The first-stage result reveals that the coefficients of initial financial development, British legal origin and creditor rights are positive and significant at conventional level, whereas the coefficient on French legal origin is negative but only significant at 10% level. The full estimation results are not reported to save space but are available upon request.

[16] This finding is in agreement with Koetter and Wedow's (2010) findings; they showed that the quality indicator of financial development has a significantly positive effect on growth using a bank-specific efficiency indicator.

Table A
Definition of institutional quality indicators (Kaufmann et al., 2009).

Indicators	Definition
Government effectiveness	The quality of public services, the quality of the civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation, and the credibility of the government's commitment to such policies
Rule of law	The extent to which agents have confidence in and abide by the rules of society, in particular the quality of contract enforcement, the police, and the courts, as well as the likelihood of crime and violence
Corruption	The extent to which public power is exercised for private gain, including petty and grand forms of corruption, as well as "capture" of the state by elites and private interests

Appendix A

Table A

References

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