Does Too Much Finance Harm Economic Growth?

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Abstract
This study provides new evidence on the relationship between finance and economic growth using an innovative dynamic panel threshold technique. The sample consists of 87 developed and developing countries. The empirical results indicate that there is a threshold effect in the finance-growth relationship. In particular, we find that the level of financial development is beneficial to growth only up to a certain threshold; beyond the threshold level further development of finance tends to adversely affect growth. These findings reveal that more finance is not necessarily good for economic growth and highlight that an "optimal" level of financial development is more crucial in facilitating growth.

JEL classification codes: G21, O41

Key words: Finance, economic growth, threshold effects, dynamic panel threshold

1.0 Introduction

A large amount of literature has examined the effect of financial development on economic growth using an array of econometric techniques, such as cross-country, time series, panel data, and firm-level studies:[1] for example, King and Levine (1993a, 1993b), Levine (1997, 2003), Rajan and Zingales (1998), Levine et al. (2000), Beck and Levine (2004), and Beck et al. (2000, 2005). By and large, the empirical evidence has demonstrated that there is a positive long-run association between indicators of financial development and economic growth. In general, all these papers suggest that a well-developed financial market is growth-enhancing, and therefore consistent with the proposition of "more finance, more growth". The preponderance of evidence suggesting the critical importance of the financial system for growth in recent years has shifted the focus of the literature towards examining the determinants or sources of financial development, rather than the finance-growth link itself.[2]

However, the recent 2007-2008 global economic crisis has led both academics and policymakers to reconsider their prior conclusions. The crisis has illustrated the possibilities that malfunctioning financial systems can directly and indirectly waste resources, discourage saving and encourage speculation, resulting in under-investment and a misallocation of scarce resources. As a consequence, it may be that the economy stagnates, unemployment rises and poverty is exacerbated. The drastic falls in real sector activity during the crisis, due to adverse implications of financial

[1] Levine (2003) provides an excellent overview of a large body of empirical literature that suggests that financial development can robustly explain differences in economic growth across countries.

[2] Among the determinants are financial sector policies (Abiad and Mody, 2005; Ang, 2008), legal systems (La Porta et al., 1997, 1998), government ownership of bank (La Porta et al., 2002; Andrianova et al., 2008), political institutions (Girma and Shortland, 2008; Roe and Siegel, 2011; Huang, 2010), culture (Stulz and Williamson, 2003), trade and financial openness (Rajan and Zingales, 2003; Baltagi et al., 2009; Law, 2009), remittances (Aggarwal et al. 2011; Demirgüç-Kunt et al. 2011), institutions (Law and Azman-Saini, 2012, Law et al., 2013).

turbulence, highlight the need for economists and policy makers to question the optimal size of financial systems for sustainable economic growth. Finance is found to promote growth, but is this true regardless of the size and growth of the financial sector? In other words, does a bloated financial system become a drag on the rest of the economy?

Recently, researchers at the Bank for International Settlement (BIS) and International Monetary Fund (IMF) have suggested that the level of financial development is good only up to a point, after which it becomes a drag on growth. This implies that the relationship between finance and growth is a non-linear one or, more specifically an inverted U-shape, where there is a turning point in the effect of financial development. For example, Cecchetti and Kharroubi (2012) find that for private sector credit extended by banks, the turning point is close to 90% of GDP. They also find that the faster the financial sector grows, the slower the economy as a whole grows. This finding indicates that big and fast-growing financial sectors may be very costly for the rest of the economy. They argue that this phenomenon occurs because the financial sector competes with the rest of the economy for scarce resources: financial booms are not, in general, growth-enhancing.[3] Arcand et al. (2012) also highlight that the finance-growth relationship turns negative for high-income countries, where finance starts having a negative effect when credit to the private sector reaches 100% of GDP. They show that their results are consistent with the "vanishing effect" of financial development and that they are not driven by output volatility, banking crises, low institutional quality, or by differences in bank regulation and supervision.

[3] De Gregorio and Guidotti (1995) point out that higher financial intermediation may have negative effects on growth performance if the financial system is liberalized and allowed to operate under a poor regulatory environment, providing one possible explanation for the Cecchetti and Kharroubi results.

The above two recent studies of the non-linear or non-monotonic relationship between finance and growth also accord with previous empirical studies, which show a non-linear relationship.[4] Table 1 provides a summary of this literature, which is also discussed in the following. For example, Rioja and Valev (2004b) find that financial development exerts a strong positive effect on economic growth only when it has achieved a certain level or threshold of financial development; below this threshold, the effect is at best uncertain. They claim that the levels of financial development – high, intermediate and low – play an important role in shaping the effect of finance on growth. In countries with intermediate levels of financial development, the financial system has a large and positive effect on growth. In countries with a high level of financial development, the effect is positive but smaller. In countries with a low level of financial development, however, the financial system is insignificant in fostering economic growth. Shen and Lee (2006) also demonstrate a similar non-linear, inverse U-shaped relationship between financial development and economic growth, where a higher level of financial development tends to slow down economic growth. They argue that this explains why a negative impact is found between banking sector development and growth when a linear form is used for estimating the relationship empirically.

Moreover, the existing evidence also demonstrates that this relationship between finance and growth varies by level of income. For example, Rioja and Valev (2004b) find that there is no significant relationship between financial development and growth in low-income countries, whereas the relationship is positive and significant in middle-income countries, but weakly significant in high-income countries. Nevertheless, De Gregorio and Guidotti (1995) and Huang and Lin (2009)

[4] For an example of the mechanism where financial sector growth reduces economic growth, see Cecchetti and Kharroubi (2013).

find that the positive effect of financial development on economic growth is much more significant in low-income and middle-income countries than in high-income countries.[5] The contradiction between these findings on the finance and growth relationship at different income levels, as well as those of a non-linear relationship between finance and growth indicate there is a need to re-evaluate the relationship of finance and real economic growth in modern economic systems.[6]

This paper provides new evidence that sheds light on the impact of finance on growth. Specifically, we explore whether there exist threshold levels of financial development in the finance-growth relationship. This relationship may be contingent on a country's level of financial development, where finance promotes economic growth after a country's financial development exceeds a certain threshold level. The findings of the study may have important policy implications. If there is clear evidence that more financial development significantly hampers economic development, or that a threshold level exists, then policy makers should propose measures that strengthen the appropriate type and quality of finance rather than just expanding the finance sector in fostering economic development. In addition, knowing the turning point of the relationship between finance and growth is crucial for policy makers, who could focus on other growth-enhancing strategies if the appropriate finance threshold has been achieved.

This study extends the literature in four respects. First, we use a dynamic panel threshold method developed by Kremer et al. (2013) that extends Hansen's

[5] De Gregorio and Guidotti(1995) argue that the weak relationship observed in high income countries is due to the fact that financial development occurs to a large extent outside the banking system, while their proxy for financial development focuses on banking sector development.

[6] Ang (2008) argues that although the positive role of finance on growth has been treated as a stylized fact, there are some methodological reservations about the results of these empirical studies. He points out 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 needed.

(1999) original static setup to endogenous regressors. This method has not been used before in analyzing the non-linear relationship between finance and economic growth. The economic growth model is a dynamic process in nature, thus using a dynamic panel method is more appropriate rather than a static threshold specification such as Hansen (1999). The Hansen (2000) and Caner and Hansen (2004) threshold techniques are able to deal with the dynamic issue, but both techniques are based on cross-section analysis. It is more useful to employ panel data, since it provides more information and reduces multicollinearity, as well as controls for cross country heterogeneity. Therefore, the dynamic panel threshold proposed by Kremer et al. (2013) certainly fills this gap in econometrics literature.

Second, the modelling strategy used by Cecchetti and Kharroubi (2012) and Arcand et al. (2012) to search for a non-linear relationship between finance and growth has one important limitation. The square term of the financial development variable used to capture the threshold impact of finance and growth imposes an a priori restriction that the effect of finance on growth monotonically and symmetrically increases and decreases with the level of financial development. However, it may also be that a certain level of financial development has to be attained before finance can have any impact on growth. Further, negative ranges of the relationship may differ in absolute impact compared to positive ranges: this can be accommodated in a threshold model but not a quadratic specification. Against this backdrop, this study uses a regression model based on the concept of threshold effects to shed light on how finance affects growth. The fitted model allowed the relationship between finance and economic growth to be piecewise linear, with the levels of financial development indicators acting as a regime-switching trigger. Third, we use a dataset sufficiently large to enable robust conclusions to be drawn; specifically, the sample used in this

study consists of annual data for 87 countries from 1980 through 2010. Finally, three financial development indicators are employed in the analysis—private sector credit, liquid liabilities and domestic credit—to capture various aspects of financial development.

This paper is organized as follows: Section 2 lays out the empirical model, the econometric method, and the data; Section 3 contains a discussion of the empirical findings; and Section 4 provides a summary and conclusions.

2.0 Empirical Model, Methodology and the Data

Empirical Model

The empirical model is based on King and Levine (1993a, 1993b), Levine and Zervos (1998) and Cecchetti and Kharroubi (2012) who propose the following linear growth equation to examine the linkages between finance and growth:

$$GROWTH_{it} = \beta \ FIN_{it} + \gamma X_{it} + \varepsilon_{it} \qquad (1)$$

where $GROWTH_{it}$ is the economic growth rate, FIN_{it} 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), ε_i is an error term, $i = 1, \ldots, N$ represents the country and $t = 1, \ldots, T$ represents index the time. Time dummies are included in the specification and all the variables are transformed into logarithms. [7]

[7] In the case of a non-linear model, empirical evidences suggest that the log transformation provides the best fit.

To test the hypothesis outlined in the previous section, we argue that the following Equation (2) is particularly well suited to capture the presence of contingency effects and to offer a rich way of modelling the impact of finance on economic growth. Consequently, we use the dynamic panel threshold regression approach suggested by Kremer et al. (2013) to explore the nonlinear behaviour of finance in relation to the economic growth. Kremer et al. (2013) extend the Hansen (1999) original static panel threshold estimation and the Caner and Hansen (2004) cross-sectional instrumental variable (IV) threshold model, where generalized methods of moments (GMM) type estimators are used to deal with endogeneity. The model, based on threshold regression, takes the following form:

$$GROWTH_{it} = \mu_i + \beta_1 FIN_{it} I(FIN_{it} \leq \lambda) + \delta_1 I(FIN_{it} \leq \lambda) + \beta_2 FIN_{it} I(FIN_{it} > \lambda) + \gamma X_{it} + \varepsilon_{it} \qquad (2)$$

where μ_i is the country-specific fixed effect, the level of financial development (*FIN*) is the threshold variable used to split the sample into regimes or groups and λ is the unknown threshold parameter. $I(\cdot)$ is the indicator function, which takes the value 1 if the argument in parenthesis is valid, and 0 otherwise. This type of modelling strategy allows the role of finance to differ depending on whether *FIN* is below or above some unknown level of λ. X_{it} denotes the vector of explanatory regressors which include lagged values of the dependent variable[8] and other endogenous variables, as well as exogenous variables, for which the slope coefficients are all assumed to be regime independent. The vector of explanatory variables is partitioned into a subset X_{1it} of exogenous (or predetermined) variables uncorrelated with ε_{it}, and a subset of

[8] The lagged dependent variable is proxied by initial income per capita due to the dataset is averaged over several non-overlapping five-year periods. Beck et al. (2000) and Levine (2000) also employed the initial income in the economic growth specification in analysing the effect of financial development on growth.

endogeneous variables X_{2it}, correlated with ε_{it}. The impact of finance on growth will be β_1 (β_2) for countries in a low (high) level of financial development regime. We also allow for differences in the regime intercepts (δ_1). In our empirical application, the initial income is considered as an endogenous variable.

According to Kremer et al. (2013), the standard within transformation and first differencing methods to eliminate the country-specific fixed effects (μ_i) in the dynamic panel are not applicable because both violate the distribution assumptions underlying Hansen (1999) and Caner and Hansen (2004). Thus, the forward orthogonal deviations transformation suggested by Arellano and Bover (1995) is used to eliminate the fixed effects.[9] The unique feature of this transformation is that serial correlation of the transformed error terms is avoided and it maintains the uncorrelatedness of the error terms. This ensures that the estimation procedure derived by Caner and Hansen (2004) for a cross-sectional model can be applied to the dynamic panel specification such as Equation (2).

Following Caner and Hansen (2004), there are three steps to estimate the specification coefficients. First, a reduced form regression is estimated for the endogeneous variables, X_{2it}, as a function of the instruments, Z_{it} by the ordinary least squares (OLS) approach and obtain the fitted values of $\hat{X}_{2it}$.Second, by substituting the predicted values of $\hat{X}_{2it}$ into Equation (2) we estimate the threshold parameter λ with the OLS method. Denote the resulting sum of squared residuals by $S(\lambda)$. This step is repeated for a strict subset of the support of the threshold variable *FIN*. Finally,

[9] Instead of subtracting the previous observation from the contemporaneous one (first-differencing) or the mean from each observation (within transformation), the transformation subtracts the average of all future available observations of a variable.

the estimator of the threshold value λ is selected as the one associated with the smallest sum of squared residuals, i.e. $\hat{\lambda} = \text{argmin}\, S_n(\lambda)$.

In line with Hansen (2000) and Caner and Hansen (2004), the critical values for determining the 95% confidence interval of the threshold value are given by

$$\Gamma = \{\lambda: LR(\lambda) \leq C(\alpha)\}$$

where $C(\alpha)$ is the 95% percentile of the asymptotic distribution of the likelihood ratio statistic $LR(\lambda)$. The underlying likelihood ratio has been adjusted to account for the number of time periods used for each cross section (Hansen, 1999). Once the threshold value ($\hat{\lambda}$) is determined, the slope coefficients can be estimated using the generalized methods of moments (GMM). Following Arellano and Bover (1995), we use lags of the dependent variable as instruments.

However, it should be noted that the GMM application to a sample with a small cross-section dimension, as in the present study, may lead to biased standard errors, biased estimated parameters (Windmeijer, 2005), and a weakened over-identification test (Bowsher, 2002). Roodman (2009) illustrated that the cause of these problems is instrument proliferation. Empirical results may depend on the number (p) of instruments. The author then proposed an innovative solution that reduces the dimensionality of the instrumental variable matrix. Following Roodman (2009), the dimensionality of the instrumental variable matrix was reduced.Therefore, we reduced the instrument count to 1 $(p = 1)$ to avoid an overfit of instrumented variables that might lead to biased coefficient estimates.

The Data

To estimate the models, this study employs panel data of 87 countries for the period 1980 – 2010.[10] In line with the empirical growth literature, the dataset is averaged over five-year periods to validate the use of GMM estimator, where it requires a large number of cross-section units (N) with small number of time periods (T)(i.e. 1980 – 1984, 1985 – 1989, 1990 – 1994, 1995 – 1999, 2000 – 2005, 2006 – 2010). In addition, the data averaging also tends to smooth the business cycle effect. Therefore, a maximum of six observations is available for each variable per country (allowing for lags).

Three measures of banking sector development are employed as measures of financial development, namely private sector credit, liquid liabilities and domestic credit. All these three banking sector development indicators are expressed as ratios to GDP.The datasets are collected from World Development Indicators (WDI) and World Bank Financial Development and Structure Database. The private sector credit is defined as the value of financial intermediary credits to the private sector. Liquid liabilities measure the ability of banks to mobilize funds or the size of the banking system relative to the economy. Domestic credit comprises private credit as well as credit to the public sector (central and local governments as well as public enterprises). These banking sector development indicators are employed since bank credits are the only feasible sources of financing for the majority of the developing countries in the sample. The literature suggests that most economies progress along with the banking system as their choices expand in channelling funds between savers and investors (Levine and Zervos, 1998; Levine, 2002).

[10] The initial sample countries were 99 countries, but we dropped 12 countries due to these countries are identified as outliers using the Cook's distance test. The lists of countries are presented in Table 2a.

The average economic growth rate, initial real GDP per capita (US$ 2000 constant prices), and population growth are obtained from World Development Indicators. Average years of secondary schooling is gathered from the Barro and Lee dataset. Investment (as a percentage of GDP) is collected from Penn World Table 6.3. To check the robustness of the results, we also include other growth determinants namely trade openness, government expenditure, inflation and institutions. The data source is from World Development Indicators, except for institutions, which is from International Country Risk Guide (ICRG). Tables 2a and 2b present the descriptive statistics and correlation matrix of the variables employed in the analysis, respectively.

3.0 Empirical Results

Table 3 reports the results of estimating Equation (2) using three banking sector development indicators.[11] Referring to Model 1, where the financial development measure is private sector credit, the point estimate of the threshold value is 4.482 or 88% of GDP with a corresponding 95% confidence interval [4.416 – 4.708]. The threshold percentage value is quite close to the threshold of 90% computed by Cecchetti and Kharroubi (2012). In our dataset 25 out of 87 countries (or 29%) exceed this threshold value for private sector credit. Having established the existence of a threshold, the next question became how private sector credit affects economic growth. We assess the statistical significance of two regime-dependent finance coefficients $\hat{\beta}_1$ and $\hat{\beta}_2$, where private sector credit is a positive and statistically significant determinant of economic growth if it is less than the threshold. On the other hand, if the private sector credit is higher than the threshold, the impact

[11] We would like to thank Stephanie Kremer for sharing her LIMDEP code for the panel dynamic threshold tests.

on growth is negative and statistically significant. The coefficients are somewhat different in magnitude, contrary to what a quadratic specification would impose.

Model 2 presents results of the repeated analysis, which used liquid liabilities as an alternative proxy for financial development. The threshold value is 4.514 or 91% of GDP. Again, the estimated finance coefficient below the threshold promotes economic growth, as was found in the case of private sector credit. In a scenario where the liquid liabilities in the country are lower than or equal to the threshold, it will exert a positive effect on economic growth. However, the negative impact above the threshold level is insignificant. Turning to Model 3, where the finance proxy is domestic credit, the result reveals that after the threshold value, greater domestic credit has an adverse effect on growth. In other words, more credit will not translate into higher economic growth. The threshold value for domestic credit is 4.595 or 99% of GDP, which is higher than the estimated threshold with private sector credit. In our dataset 32 out of 87 countries (or 37%) exceed this threshold value for domestic credit.

Among the three finance indicators, private sector credit has the strongest positive effect on growth below the threshold, whereas the domestic credit seems to have the highest negative effect on growth beyond the threshold level. The finding that economic growth has a much stronger relation with private sector credit is in line with Levine et al. (2000). They point out that private sector credit is the most important financial development indicator, which reflects the efficiency of banking institutions in providing the credit sources to private sector. On the other hand, domestic credit not only includes credit to private sector, but also state owned enterprises. The growth process tends to deteriorate if state owned enterprises channel the credit to unproductive investment and wasteful activities. The liquid liabilities measure the actual size of the banking sector, or M3 money supply over GDP.

Nevertheless, monetization can be increasing without financial development occurring and it is not an entirely satisfactory indicator of financial development.

In all three models, all the estimated coefficients on initial income, population growth, investment and human capital are consistent with theory. The coefficients on initial income are negative in all models and statistically significant. The coefficient of investment is positive and a significant determinant of economic growth at conventional levels. In contrast, the coefficients of human capital and population growth are positive and negative respectively, but both are insignificant determinants of growth.

The empirical findings are in line with a non-linear relationship between finance and growth that is reported in the literature, where finance is good only up to a certain point, after which it becomes a drag on growth (Shen and Lee, 2006; Cecchetti and Kharroubi, 2012, Arcand et al. 2012). Aghion et al. (2005) also show a declining effect of finance and growth as countries grow richer. The "vanishing effect" of financial development is also consistent with Arcand et al. (2012) and Cecchetti and Kharroubi (2012), who find that finance starts having a negative effect on output growth when credit to the private sector reaches 100% and 90% of GDP, respectively. However, our finding indicates that the private sector credit threshold level is 88% of GDP which is remarkably close to Cecchetti and Kharroubi (2012). The threshold level being slightly lower than the previous finding may due to our method based on a threshold model, which allows the relationship between finance and growth to be piecewise linear, with the finance indicator acting as a regime switching trigger. Moreover, the sample countries and time period are dissimilar to both Cecchetti and Kharroubi (2012) and Arcand et al. (2012). To sum up, the

empirical evidence suggests that the relationship between finance and growth in fact takes on a non-linear or inverse V-shaped relationship.

This study does not examine the causes of the non-linear relationship between finance and growth, but we provide several possible explanations for such relationship, as put forward by the recent literature. First, the reason might be the relative magnitude of types of loans provided by the financial system. Hung (2009) point out that financial development facilitates investment loans that tend to promote growth, while consumption loans which are non-productive tend to impede growth. He managed to replicate the non-linear relationships between finance and growth by integrating consumption loans with investment loans in a standard model of asymmetric information. Beck et al. (2012) also argue that enterprise and household credit plays a key role in shaping the relationship between finance and growth. They find that the growth effect of financial development comes through enterprise rather than household credit to drive the positive impact. Their finding supports the view that financial systems foster economic growth by alleviating firms' financing constraints, and explains the lack of a significant finance-growth link in high-income countries. [12]

Second, the reason for the non-linear relationship between finance and growth might be that financial development helps countries to catch up to the productivity frontier, but has limited or no growth effect for countries that are close to or at the frontier. Aghion et al. (2005) point out that all countries above some critical level of financial development should converge in growth rate, and that in such countries financial development has a positive but eventually vanishing effect on steady-state

[12]According to Beck et al. (2012), most of the financial development in high-income countries has come through additional household lending, which thus might explain why the finance-growth relationship is insignificant across high-income countries.

GDP. Third, the financial system might in reality grow too large relative to the real economy if it extracts excessively high informational rents and in this way attracts too much young talent towards the financial industry (Philippon, 2010, Bolton et al. 2011). Cecchetti and Kharroubi (2012) find that when the financial sector accounted for more than 3.9 per cent of total employment, further development of finance tended to damage economic growth. Another striking finding is the faster the financial sector grows, the slower the economy as a whole grows.

Robustness Checks

A large number of robustness checks were carried out to examine the sensitivity of the results to additional explanatory variables, alternative instruments, sample splitting into developed and developing countries, estimation strategies and methods. The first set of robustness checks involves the additional growth determinant variables, namely trade openness, government expenditure, institutions and inflation. The empirical results are reported in Table 4 where we only present the results of estimating the private sector credit as finance indicator. The results are quantitatively similar to those reported in Table 3, where the location of the private sector credit threshold value remains unaltered at 4.852. More specifically, the two finance coefficients below ($\hat{\beta}_1$) and above ($\hat{\beta}_2$) the threshold are statistically significant at the conventional level, except for Model 4c, where the additional control variable included in the specification is institutions. This finding may suggest that good institutions might moderate the negative impact of finance on growth. As shown in Table 4, all the additional explanatory variables are statistically significant determinants of growth and the signs are consistent with theory. The trade openness and institutions variables are positively associated with growth, while government

expenditure and inflation are negatively associated with growth. Based on the above robustness checks findings, we conclude that the qualitative nature of the results is robust.

Besides using the initial income as instrument, we also further estimate the specifications using additional instrumental variables that are identified in the law, institutions and finance literature, namely, legal origin, creditor rights, natural endowment and religion composition. The empirical results based on single and some combinations of the instrumental variables also indicate similar findings to those reported in Table 3. These results, however, are not reported to save space.

The main results above demonstrate that 25 out of the 87 countries in the sample have finance ratios greater that the threshold level, where most of these countries are the developed countries. This finding motivates us to split the sample countries into developed and developing countries as further robustness checks. The empirical results are reported in Table 5 using only private sector credit as a finance indicator. Since the sample has been divided, the estimated threshold level is definitely higher in developed than in developing countries. In developed countries, the results reported in Model 5a reveal that the estimated coefficients on finance below and above are positive and negative, respectively, but statistically at a weak significance level. On the other hand, for the case of developing countries, both finance coefficients below and above the threshold also show similar signs with developed countries, but greater significance level for the below-threshold coefficient. In addition, the estimated coefficient is larger than the corresponding ones for the developed countries. This finding is consistent with Rioja and Valev (2004b), who also find a much stronger growth-enhancing effect of financial development in developing countries compared to high-income countries. Nevertheless, with a small

sample size for developed countries, these results therefore need to be interpreted with caution since the Arellano and Bond estimator was designed for large cross-section units (N).

The last set of robustness checks involves using the dynamic system generalized methods of moments (GMM) estimator developed by Arellano and Bover (1995) and Blundell and Bond (1998), where we include the square term of finance in the specification. Although this additional square term strategy has limitations, we also estimate the results to confirm the non-linear relation between finance and growth.As shown in Table 6, both coefficients on the finance indicator and the squared term are statistically significant in all three models, with positive and negative signs, respectively. This implies that finance and economic growth have an inverted U-shaped relationship, which is similar to that reported in Table 3 using dynamic panel threshold analysis. The results of the diagnostic tests, namely Sargan and serial correlation tests, suggest that all models are relatively well specified. To shed additional light on the threshold level, we also compute the partial derivative of economic growth with respect to the finance variable. The threshold values for three finance indicators - private sector credit, liquid liabilities and domestic credit are 94%, 97% and 100%, respectively. It seems the threshold values using the quadratic specification are a bit higher if compared to Table 3. To assess the significance of the marginal effect($\frac{\partial Growth}{\partial FIN}$) of all models, we calculate the standard errors as shown in Brambor et al. (2005) and evaluate at the mean, minimum and maximum values of finance. [13] The results suggest that all marginal effects are statistically significant. For

[13] For example, in the case where the model is $Y = \beta_0 + \beta_1 X + \beta_2 X^2$, the marginal effect is $\frac{\partial Y}{\partial X} = \beta_1 + 2\beta_2 X$. Using the covariance matrix, the variance (i.e., standard error) is calculated as $\sigma^2_{\frac{\partial Y}{\partial X}} = \text{var}(\hat{\beta}_1) + 4X^2 \text{var}(\hat{\beta}_2) + 4X \text{cov}(\hat{\beta}_1 \hat{\beta}_2)$.

example, the marginal effect of private sector credit is 0.066 when evaluating at the mean level. This implies that a 1 per cent increase in private sector credit tends to promote an additional 0.066 percent of growth. However, when evaluating at the maximum level of private sector credit, economic growth exhibits a diminishing of 0.067 per cent. This indicates that if private sector credit is getting larger, it does not promote growth but in fact it harms growth. A similar picture emerges for the other two finance indicators namely liquid liabilities and domestic credit. Thus, the empirical results of a non-linear relationship between finance and growth are robust to using dynamic panel estimations.

4.0 Conclusions

This study provided new evidence on the non-linear relationship between finance and economic growth using data from 87 countries covering 1980 through 2005. One major contribution of the paper was the adoption of the dynamic panel model based on the concept of threshold effect proposed by Kremer et al. (2013) to capture rich dynamics in the growth equation. The empirical results indicated that there is a finance threshold in the finance – growth nexus. For financial development below the threshold, finance will exert a positive effect on economic growth. This implies that economic growth will be increased when financial development improves. On the other hand, if the financial development exceeds the threshold, the impact of finance on growth will turn negative suggesting that further financial development will not translate into higher economic growth. The results are robust to three

measures of finance indicators, additional explanatory variables, sub-sample countries, as well as estimation procedures.

The empirical findings suggest that more finance is definitely not always better and it tends to harm economic growth after a point. Therefore, knowing the optimal level and efficient channelling of financial resources to productive activities are important in ensuring the effectiveness of financial development for growth. In terms of policy implications, policy makers could focus less on increasing the size of the financial sector and more on improving its intermediating function. Measures to strengthen quality and moderate finance need to be undertaken, rather than just promoting more finance, in fostering economic development. In addition, if the role of finance is minimal or negative in a particular situation, then other growth-enhancing strategies need to be highlighted in maintaining long-run economic benefits, even though financial development has been identified as one of the most powerful determinants of growth. With respect to the lower threshold level of finance when the countries are divided into developed and developing countries, policy conclusions based on sub-sample countries estimates have to be viewed with caution. In particular, the lower threshold estimates do not necessarily reflect that the finance threshold level has yet to be achieved and that greater expansion of finance is essential.

Our findings only utilized banking sector development indicators. Given that the equity market also plays an important role in channelling funds and firms depend increasingly on equity finance, it is vital to explore whether stock market development also displays non-linear effects on economic growth. Another question is whether the effect of finance on growth is permanent or transitory. How long can the effect persist? We leave these potentially important issues as future research topics.

References

Abiad, A., Mody, A., 2005. Financial reform: what shakes it? What shapes it? American Economic Review 95(1), 63–88.

Aggarwal, R., Demirgüç-Kunt, A., Pería, M. S. M., 2011. Do remittances promote financial development? Journal of Development Economics 96(2), 255–264.

Aghion, P., Howitt, P., Mayer-Foulkes, D., 2005. The effect of financial development on convergence: theory and evidence. Quarterly Journal of Economics 120, 173–222.

Andrianova, S., Demetriades, P., Shortland, A., 2008. Government ownership of banks, institutions and financial development. Journal of Development Economics 85(1-2), 218–252.

Ang, J. B., 2008. Are financial sector policies effective in deepening the Malaysia financial system. Contemporary Economic Policy 26(4), 623–635.

Arcand, J. L., Berkes, E.,Panizza, U., 2012.Too much finance? IMF Working Paper 12/161.

Arellano, M., Bover, O., 1995. Another look at the instrumental-variable estimation of error-components models. Journal of Econometrics 68(1), 29–52.

Baltagi, B. H., Demetriades, P., Law, S. H., 2009. Financial development and openness: panel data evidence. Journal of Development Economics 89(2), 285–296.

Beck, T., Levine, R., Loayza, N., 2000. Finance and the sources of growth. Journal of Financial Economics58(1-2), 261–300.

Beck, T., Levine, R., 2004. Stock markets, banks, and growth. Journal of Banking and Finance 28(3), 423–442.

Beck, T., Demirgüç-Kunt, A., Maksimovic, V. 2005. Financial and legal constraints to firm growth: does size matter? Journal of Finance 60(1), 137–177.

Beck, T., Degryse, H., Kneer, C., 2012. Is more finance better? Disentangling intermediation and size effects of financial systems, Center for Economic Research, Discussion Paper No. 2012-060, Tilburg University.

Blundell, R., Bond, S., 1998. Initial conditions and moment restrictions in dynamic panel data models. Journal of Econometrics 87(1), 115–143.

Bolton, P., Santos, T., Scheinkman, J., 2011. Cream skimming in financial markets. NBER Working Paper No.16804.

Bowsher, C., 2002. On testing overidentifying restrictions in dynamic panel data models. Economics Letters 77(2), 211–220.

Brambor, T., Clark, W. R., Golder, M., 2005. Understanding interaction models: improving empirical analyses. Political Analysis 14(1), 63–82.

Caner, M., Hansen, B. E., 2004. Instrumental variable estimation of a threshold model. Econometric Theory 20(5), 813–843.

Cecchetti, G., Kharroubi, E., 2012. Reassessing the impact of finance on growth. BIS Working Papers No. 381, Bank for International Settlements.

Cecchetti, G., Kharroubi, E., 2013. Why does financial sector growth crowd out real economic growth? Finance and the Wealth of Nations Workshop, Federal Reserve Bank of San Francisco & The Institute of New Economic Thinking, Sept 27, 2013.

De Gregorio, J., Guidotti, P., 1995. Financial development and economic growth. World Development 23(3), 433–448.

Demirgüç-Kunt, A., Córdova, E. L., Pería, M. S. M., Woodruff, C., 2011. Remittances and banking sector breadth and depth: Evidence from Mexico. Journal of Development Economics 95(2), 229–241.

Ergungor, O. E., 2008. Financial system structure and economic growth: structure matters. International Review of Economics and Finance 17(2), 292–305.

Girma, S, Shortland, A., 2008.The political economy of financial development. Oxford Economics Papers 60(4), 567–596.

Hansen, B. E., 1999. Threshold effects in non-dynamic panels: estimation, testing, and inference. Journal of Econometrics 93(2), 345–368.

Hansen, B. E., 2000. Sample splitting and threshold estimation.Econometrica 68(3), 575–603.

Hung, F. S., 2009. Explaining the nonlinear effects of financial development on economic growth. Journal of Economics 97(1), 41–65.

Huang, H. C., Lin, S. C., 2009. Non-linear finance–growth nexus. Economics of Transition 17, 439–466.

Huang, Y., 2010. Political institutions and financial development: an empirical study. World Development 38(12), 1667–1677.

King, G. R., Levine, R., 1993a. Finance and growth: Schumpeter might be right. Quarterly Journal of Economics 108(3), 717–737.

King, G. R., Levine, R., 1993b. Finance, entrepreneurship and growth. Journal of Monetary Economics 32(3), 1–30.

Kremer, S., Bick, A., Nautz, D., 2013. Inflation and growth: new evidence from a dynamic panel threshold analysis. Empirical Economics 44(2), 861–878.

La Porta, R., Lopez-de-Silane, F., Shleifer, A., Vishny, R. W., 1997. Legal determinants of external finance. Journal of Finance 52(3), 1131–1150.

La Porta, R., Lopez-de-Silane, F., Shleifer, A., Vishny, R. W., 1998. Law and finance. Journal of Political Economy 106(6), 1113–1155.

La Porta, R., Lopez-de-Silane, F., Shleifer, A., Vishny, R. W., 2002. Government ownership of banks. Journal of Finance LVII(1): 265–301.

Law, S. H., 2009. Trade openness, capital inflows and financial development in developing countries. International Economic Journal 23(3), 409–426.

Law, S. H., Azman-Saini, W. N. W., 2012. Institutional quality, governance and financial development. Economics of Governance 13(3), 217–236.

Law, S. H., Azman-Saini, W. N. W., Ibrahim, M. H. (2013) Institutional quality thresholds and finance – growth nexus. Journal of Banking and Finance, forthcoming.

Levine, R., 1997. Financial development and economic growth: views and agenda. Journal of Economic Literature 35(2), 688–726.

Levine, R., Zervos, S., 1998. Stock markets, banks and economic growth. American Economic Review 88(3), 537–558.

Levine, R., 2002. Bank-based versus market-based financial systems: which is better? Journal of Financial Intermediation 11(4), 398–428.

Levine, R., 2003. More on finance and growth: More finance, more growth? Federal Reserve Bank of St. Louis Review 85(Jul), 31–46.

Levine, R., Loayze, N., Beck, T., 2000. Financial intermediation and growth: Causality and causes. Journal of Monetary Economics 46(1), 31–77.

Philippon, T., 2010. Financiers versus engineers: should the financial sector be taxed or subsidized? American Economic Journal: Macroeconomics 2(3), 158–182.

Rajan, R., Zingales, L., 1998.Financial dependence and growth. American Economic Review 88(3), 559–586.

Rajan, R., Zingales, L., 2003. The great reversals: the politics of financial development in the twentieth century. Journal of Financial Economics 69(1), 5–50.

Rioja, F., Valev, N., 2004a. Does one size fit all? Are examination of the finance and growth relationship. Journal of Development Economics 74(2), 429–447.

Rioja, F.,Valev, N., 2004b.Finance and the sources of growth at various stages of economic development.Economic Inquiry 42(1), 127–140.

Roe, M. J., Siegel, J. I., 2011. Political instability: effects on financial development, roots in the severity of economic inequality. Journal of Comparative Economics 39(3), 279–309.

Roodman, D., 2009. A note on the theme of too many instruments. Oxford Bulletin of Economics and Statistics 71(1), 135–158.

Shen, C. H., Lee, C. C., 2006. Same financial development yet different economic growth – why? Journal of Money, Credit and Banking 38(7), 1907–1944.

Stulz, R. M., Williamson, R., 2003.Culture, openness and finance.Journal of Financial Economics 70(3), 313–349.

Windmeijer, F., 2005. A finite sample correction for the variance of linear efficient twostep GMM estimators. Journal of Econometrics 126(1), 25–51.

Table 1: Summary of the non-linear studies between finance and growth

Authors	Sample Countries	Type of Data and Sample Period	Methods	Findings
Deidda&Fattouh (2002)	119 developed and developing countries	Cross-sections (1960-1989)	Hansen (2000) threshold regression (Two groups: high and low income countries)	Non-linear relationship between finance and economic growth. Finance is significant determinant of growth in high-income countries but insignificant in low-income countries.
Rioja &Valev (2004a)	74 developed and developing countries	Panel data (1961-1995) Averaged over 5-year interval	Dynamic panel generalized method of moments. (Three regions: low, intermediate and high level of financial development)	Finance has large positive effect on growth in intermediate financial development region. It is positive but the effect is smaller in high region, but insignificant in low region.
Rioja &Valev (2004b)	74 developed and developing countries	Panel data (1961-1995) Averaged over 5-year interval	Dynamic panel generalized method of moments. (Three groups: low, intermediate and high income countries)	Financehas a strong positive influence on productivity growth in more developedeconomies. In low-income economies, the effect of finance on output growth occursthrough capital accumulation.
Shen& Lee (2006)	48 developed and developing countries	Panel data (1976-2001)	Pooled OLS	Non-linear inverse U-shaped relationship between finance (stock market variables) and economic growth; Bank development is better described as a weak inverse U-shaped.
Ergungor (2008)	46 developed and developing countries	Cross-sections (Average from 1980-1995)	2SLSwith heteroscedasticity-consistent standard errors	A non-linear (contingent) relationship between finance (banking sector) and economic growth. Countries that have an inflexible judicial systemgrow faster when they have a more bank-oriented financial system.
Huang & Lin (2009)	71 countries	Cross-sections (Average from 1960-1995)	Caner & Hansen (2004) IV threshold regression (Two regimes: high and low income countries)	Non-linear positive relation between financeand economic growth. The positive effect is more pronounced in the low-income countries than in the high-income countries.
Cecchetti&Kharroubi (2012)	50 developed and emerging countries	Panel data (5-year non-overlapping from 1980-2009)	Pooled OLS with robust standard errors	Financial sector has an inverted U-shaped effect on productivity growth. Financial sector growth is found to be a drag on productivity growth.
Arcand, Berkes&Panizza	>100 developed and developing countries	Cross-sections and panel data (1960-2010)	Semi-parametric estimations	Finance starts having a negative effect on output growth when credit to the private sectorreaches 100% of GDP. The results are consistent with the "vanishing effect"of financial development.

Table 2a Descriptive statistics

N = 87 cross-country. T = 1980 – 2010.

	Unit of Measurement	Mean	Std Dev	Min	Max
Economic Growth	%	1.17	2.98	-12.10	10.85
Initial GDP Per Capita	US$ 2000 constant Price	12.51	1.61	9.04	15.35
Human Capital	Average Years of Schooling	2.05	1.22	0.10	5.72
Population Growth	%	1.71	1.45	-1.27	6.09
Investment	% of GDP	2.99	0.52	-2.75	4.12
Financial Development					
Private Sector Credit	% of GDP	3.51	0.95	0.06	5.38
Liquid Liabilities	% of GDP	3.71	0.69	1.15	5.71
Domestic Credit	% of GDP	3.96	0.75	0.39	5.72
Trade Openness	% of GDP	4.04	0.62	2.25	5.93
Institutions (INS)	Scaled from 0 to 50	3.32	0.42	1.61	3.89
Government Expenditure	% of GDP	2.15	0.47	0.49	3.11
Inflation	%	0.49	3.53	-0.03	64.25

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 2b Correlations

	Growth	Initial	LLY	PRI	DOC	HC	POP	INVT	GOVT	OPEN	INS	INF
Growth	1.00											
Initial	0.22	1.00										
LLY	0.30	0.59	1.00									
PRI	0.27	0.72	0.78	1.00								
DOC	0.23	0.63	0.82	0.79	1.00							
HC	0.28	0.78	0.54	0.59	0.56	1.00						
POP	-0.23	-0.49	-0.34	-0.34	-0.38	-0.46	1.00					
INVT	0.21	0.26	0.37	0.39	0.23	0.24	-0.11	1.00				
GOVT	-0.09	-0.04	0.13	-0.12	0.15	0.21	-0.27	-0.09	1.00			
OPEN	0.11	0.07	0.22	0.10	0.01	0.12	0.02	0.29	0.07	1.00		
INS	0.39	0.73	0.55	0.64	0.51	0.63	-0.39	0.24	0.22	0.04	1.00	
INF	-0.24	-0.09	-0.28	-0.20	-0.13	-0.07	0.08	-0.08	-0.11	-0.07	-0.19	1

Notes: RGDPC = Real GDP per capita; PRC = Private sector credit; LLY = Liquid liabilities;DOC = Domestic credit; INS = Institutions; HC = Human capital; Popu = Population growth; Invt = Investment.

Table 3: Results of dynamic panel threshold estimations
Dependent Variable: Economic growth
Sample Period: 1980 – 2010 (5-year average)

	Model 1 FD = Private Sector Credit	Model 2 FD = Liquid Liabilities	Model 3 FD = Domestic Credit
Threshold Estimates			
$\hat{\lambda}$	4.482	4.514	4.595
95% confidence interval	[4.416 – 4.708]	[4.318 – 4.820]	[4.595 – 4.862]
Impact of Finance			
$\hat{\beta}_1$	0.293 (0.129)**	0.276 (0.136)**	0.265 (0.149)
$\hat{\beta}_2$	-0.188 (.0.087)**	-0.651 (0.434)	-0.258 (0.109)**
Impact of covariates			
$InitialIncome_{it}$	-0.753 (0.335)**	-0.827 (0.415)**	-0.797 (0.368)**
$Population\ Growth_{it}$	-0.287 (0.365)	-0.335 (0.435)	-0.267 (0.306)
$Investment_{it}$	0.466 (0.185)**	0.479 (0.193)**	0.435 (0.203)**
$Human\ Capital_{it}$	0.735 (0.427)	0.675 (0.506)	0.633 (0.626)
$\hat{\delta}_1$	-18.413 (13.462)	-15.231 (10.554)	-1.377 (1.095)
Observations	435	435	435
N	87	87	87

Notes: The standard errors are reported in parentheses. Time dummies were jointly significant and are not reported here to save space.*** and ** indicate significance at 1% and 5% levels, respectively.

Table 4: Results of dynamic panel threshold estimations with additional explanatory variable
Dependent Variable: Economic growth
Sample Period: 1980 – 2010 (5-year average)

	Model 4a	Model 4b	Model 4c	Model 4d
Threshold Estimates				
$\hat{\lambda}$	4.482	4.482	4.482	4.482
95% confidence interval	[4.416 – 4.708]	[4.416 – 4.708]	[4.416 – 4.708]	[4.416 – 4.708]
Impact of Finance				
$\hat{\beta}_1$	0.253	0.212	0.271	0.289
	(0.103)**	(0.095)**	(0.124)**	(0.121)**
$\hat{\beta}_2$	-0.391	-0.377	-0.415	-0.267
	(0.169)**	(0.216)	(0.189)**	(0.134)**
Impact of covariates				
$\text{InitialIncome}_{it}$	-0.810	-0.805	-0.797	-0.761
	(0.285)***	(0.291)***	(0.294)***	(0.278)***
$\text{Population Growth}_{it}$	-0.322	-0.252	-0.269	-0.231
	(0.366)	(0.317)	(0.374)	(0.285)
Investment_{it}	0.375	0.351	0.347	0.364
	(0.147)**	(0.155)**	(0.138)**	(0.151)**
$\text{Human Capital}_{it}$	0.262	0.276	0.263	0.298
	(0.342)	(0.361)	(0.366)	(0.308)
$\text{Trade Openness}_{it}$	0.397	-	-	-
	(0.183)**			
Institutions_{it}	-	0.766	-	-
		(0.218)***		
$\text{Government Expenditure}_{it}$	-	-	-0.348	-
			(0.169)**	
Inflation_{it}	-	-	-	-0.169
				(0.084)**
$\hat{\delta}_1$	-18.611	-15.858	-18.479	-17.018
	(15.419)	(11.192)	(13.775)	(9.186)
Observations	435	435	435	435
N	87	87	87	87

Notes: The standard errors are reported in parentheses. Time dummies were jointly significant and are not reported here to save space. *** and ** indicate significance at 1% and 5% levels, respectively.

Table 5: Results of dynamic panel threshold estimations – developed and developing countries
Dependent Variable: Economic growth
Sample Period: 1980 – 2010 (5-year average)

	Model 5a Developed Countries	Model 5b Developing Countries
Threshold Estimates		
$\hat{\lambda}$	4.400	3.912
95% confidence interval	[4.316 – 4.492]	[3.885 – 3.956]
Impact of Finance		
$\hat{\beta}_1$	0.211	0.324
	(0.114)*	(0.157)**
$\hat{\beta}_2$	-0.132	-0.098
	(0.067)*	(0.053)*
Impact of covariates		
$InitialIncome_{it}$	-0.421	-1.057**
	(0.426)	(0.451)
$Population\ Growth_{it}$	-0.398	-0.235
	(0.571)	(0.289)
$Investment_{it}$	0.427	0.479
	(0.216)**	(0.193)**
$Human\ Capital_{it}$	0.315	0.675
	(0.278)	(0.761)
$\hat{\delta}_1$	-0.497	4.151
	(5.027)	(5.967)
Observations	130	305
N	26	61

Notes: The standard errors are reported in parentheses. Time dummies were jointly significant and are not reported here to save space. ***, ** and * indicate significance at 1%, 5% and 10% levels, respectively.

Table 6: Results of dynamic panel GMM estimations
Dependent Variable: Economic growth
Sample Period: 1980 – 2010 (5-year average)

	Model 6a FD = Private Sector Credit	Model 6b FD = Liquid Liabilities	Model 6c FD = Domestic Credit
Initial Income$_{it}$	-0.882	-0.891	-0.912
	(39.962)***	(40.422)***	(31.545)***
Financial Development$_{it}$	0.315	0.228	0.101
	(2.39)**	(2.136)**	(2.335)**
Financial Development$_{it}^2$	-0.071	-0.050	-0.022
	(-2.30)**	(-2.346)**	(-3.328)***
Institutions$_{it}$	0.176	0.179	0.172
	(5.292)***	(5.821)***	(5.703)***
Population Growth$_{it}$	-0.125	-0.141	-0.079
	(-0.887)	(-0.635)	(-0.832)
Investment$_{it}$	0.232	0.228	0.245
	(3.636)***	(3.254)***	(3.761)***
Human Capital$_{it}$	0.036	0.029	0.032
	(1.478)	(1.215)	(1.586)
Sargan test of over identifying restrictions	1.181	3.122	3.313
	(0.950)	(0.681)	(0.652)
Arellano-Bond tests for AR(1)	-3.892	-3.866	-4.018
	(0.000)***	(0.000)***	(0.000)***
Arellano-Bond tests for AR(2)	0.621	0.135	0.162
	(0.530)	(0.891)	(0.875)
Observations	435	435	435
N	87	87	87
Marginal Effect, $\frac{\partial Growth}{\partial FIN}$			
Mean	0.066**	0.042**	0.014**
Min	0.311**	0.170**	0.092**
Max	-0.067**	-0.057**	-0.025***

Notes: The t-statistics are reported in parentheses, except for Sargan, AR(1) and AR(2) tests, which are p-values. Time dummies were jointly significant and are not reported here to save space. *** and ** indicate significance at 1% and 5% levels, respectively.