Financial development and economic growth: Evidence of non-linearity

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Abstract

This paper explores the non-linear relationship between financial development and economic growth. It mainly relies on the Panel Smooth Transition Regression (PSTR) model of Gonzalés et al. (2005) and three metrics of financial development to endogenously assess the impact of financial development on growth. Using a sample of 43 advanced and developing economies over the period 1975–2009, the paper highlights that financial development supports economic growth in low-income and lower middle income countries by enhancing saving and investment behaviour. However, in more developed economies, the impact of financial development is nil or negative, reflecting that further credit provisioning in these economies tend to exacerbate financial vulnerabilities, which is detrimental to growth.

Keywords: Financial Development; Economic Growth; Non-linearity; System GMM; PSTR
JEL Classification: C33; O11; O16; O47

I. Introduction and data

Financial development has been largely recognized as a key driver of economic growth. Since the work of Goldsmith (1969), Shaw (1973) and Mckinnon (1973), evidence supporting the intuition that finance is good for economic growth has been growing. Following King and Levine (1993a, 1993b) and Levine (2005) a large literature based on cross-country analyses and controlling for biases arising from endogeneity and omitted variables has emerged. At the microeconomic level, a number of studies also analyzed the relationship between financial development and economic growth. Greenwood, Sanchez, and Wang (2009) find that through their screening and monitoring activities, financial intermediaries improve capital allocation, supporting growth.

This paper aims to contribute to this growing literature by providing new evidence on the non-linear relationship between finance and growth using three measures of financial development. It relies on System GMM and PSTR methodologies to overcome a number of shortcomings in estimating the finance-growth nexus.

The paper uses three indicators to proxy financial development following Giuliano and Ruiz-Arranz (2009). First is M3, which represents the amount of liquid liabilities of the financial system, including central banks, commercial banks, and other financial intermediaries. Second is CREDPR, which captures domestic credit to the private sector such as loans, trade credits, and other accounts receivable that establish a claim for repayment. Third is CREDBANK, the credit provided by the banking sector, which measures all credit to various sectors on a gross basis. All three indicators are expressed as a share of GDP.

The dependent variable, economic growth, is captured by real GDP per capita growth in constant dollars.[1] A set of control variables captures the common determinants of economic growth such as initial GDP per capita (GDP_0); inflation (INF), measured as the annual percentage change in the consumer price index; openness (OPEN) to international trade, defined as the ratio of the sum of exports plus imports of goods to total output; the average number of years of secondary schooling (SCHOOL), obtained from Barro-Lee series, government consumption ratio (GOVC), and investment ratio (INV). All independent variables are turned into log-form except the average years of secondary schooling (SCHOOL). The sample consists of 43 advanced and developing countries over the period 1975-2009. To properly handle the human capital variable, which is only available every 5 years, and control for business cycle fluctuations, the sample is transformed into 7 non-overlapping 5-year periods.

Part of the literature on financial development-growth nexus is plagued by some methodological shortcomings – the lack of suitable methodology to control for endogeneity, reverse causality of financial variables and unobserved effects. This paper addresses these issues by relying on the Dynamic Panel Data approach (System GMM) of Arellano and Bover (1995).

[1] All variables are from the World Bank World Development Indicators database.

II. Non-linear and threshold estimations

II.1. Dynamic panel data approach (System GMM)

A first pass to test the non-linear relationship between financial development and growth consist in splitting the sample based on the median (below and above levels) of GDP[2] per capita. The System GMM represents a system of two equations: the variables in level and in difference:

$$\begin{cases} \Delta GROWTH_{i,t} = \beta_1 \Delta \log(GDP\_0)_{i,t-1} + \beta_2 \Delta FINDEV_{i,t} + \beta_3 \Delta X_{i,t} + \Delta\mu_t + \Delta\varepsilon_{i,t} \\ GROWTH_{i,t} = \beta_0 + \beta_1 \log(GDP\_0)_{i,t-1} + \beta_2 FINDEV_{i,t} + \beta_3 X_{i,t} + \mu_t + \eta_i + \varepsilon_{i,t} \end{cases} \quad (1)$$

Where $GROWTH_{i,t}$ denotes the growth of GDP per capita, log $(GDP\_0)_{i,t-1}$ is the initial level of GDP per capita, $FINDEV_{i,t}$ defines the three measures of financial development and $X_{i,t}$ describes the matrix of control variables. μ_t is a time specific effect, η_i is an unobserved country-specific effect , $\varepsilon_{i,t}$ is the time-varying error term, i and t index respectively country and time. The coefficient of interest here is β_2 which measure the marginal impact of financial development on growth.

Focusing on variables that capture financial development, the results, using the System GMM, show that the impact of financial development is positive and significant for less developed countries in our sample - below the median level- while it is nil or negative though non-significant for countries above the median income level (Table 1). This result illustrates that while financial development support economic growth for low-income and lower middle income countries (with per capita income below USD 1,200), it can switch from boosting growth to holding it back at higher level of economic development.

These results hold for all three measures of financial development, corroborating some previous findings in the empirical literature. Aghion et al. (2005) show that the relationship between finance and growth turns insignificant at higher levels of economic development, while Arcand, Berkes and Panizza (2012) show that the link even turns negative at very high levels of financial development.

[2] The results with the GDP per capita are similar with those with the log.

Table 1: Financial Development and Growth, Non-linearity with System GMM

	System GMM (dependent variable: GDP GROWTH)					
	Financial Development Variables					
	M3/GDP		CREDPR		CREDBANK	
	Lower income	Higher income	Lower income	Higher income	Lower income	Higher income
Independent Variables						
log(GDP_0)	-0.0005 (0.021)	-0.036** (0.017)	-0.007 (0.02)	-0.03* (0.017)	0.012 (0.021)	-0.03* (0.017)
M3/GDP	0.001*** (0.0007)	-0.000 (0.0001)				
CREDPR			0.002*** (0.0012)	-0.0004 (0.0003)		
CREDBANK					0.002*** (0.0006)	-0.0002 (0.0003)
log(GOVC)	-0.15*** (0.058)	-0.17*** (0.049)	-0.136** (0.055)	-0.18*** (0.048)	-017*** (0.057)	-0.16*** (0.048)
log(INV)	-0.07* (0.041)	0.17*** (0.049)	-0.08* (0.042)	0.17*** (0.048)	-0.09** (0.043)	0.16*** (0.047)
log(OPEN)	0.019 (0.059)	0.007 (0.032)	0.035 (0.05)	0.019 (0.033)	-0.000 (0.054)	0.022 (0.033)
SCHOOL	0.0001 (0.019)	0.009 (0.01)	0.005 (0.019)	0.01 (0.01)	0.008 (0.019)	0.008 (0.009)
log(INFL)	-0.016 (0.011)	0.003 (0.01)	-0.013 (0.01)	0.005 (0.009)	-0.019* (0.011)	0.004 (0.009)
CONSTANT	0.52 (0.40)	0.08 (0.26)	0.46 (0.35)	0.02 (0.26)	0.58 (0.37)	0.018 (0.25)
Observations	148	150	148	150	148	150
AR (1) test	0.12	0.10	0.20	0.15	0.11	0.22
AR (2) test	0.10	0.37	0.20	0.41	0.01	0.41
Hansen test	0.50	0.32	0.21	0.18	0.11	0.30

*Note: Robust standard errors in parentheses: *** p<0.01,** p<0.05, * p<0.1. Diagnostic tests reveal no evidence against the validity of the instruments used by the System GMM estimator.*

II.2. Endogenous non-linear estimation: Panel Smooth Transition Regression

The Panel Smooth Transition Regression (PSTR) developed by González et al. (2005) as a generalization of the Hansen (1999) Panel Threshold Regression model, considers the speed of transition from one regime to the other.
The PSTR model is as follows:

$$GROWTH_{i,t} = \beta_0 FINDEV_{i,t} + \beta_1 FINDEV_{i,t} g(\log(GDP_{i,t}), \gamma, \delta) + u_i + \varepsilon_{i,t} \quad (2)$$

The transition function is given by a logistic function:

$$g(\log(GDP_{i,t}), \gamma, \delta) = \frac{1}{\left[1 + \exp(-\gamma(\log(GDP_{i,t}) - \delta))\right]}, \ \gamma > 0 \quad (3)$$

Where $g(\log(GDP_{it}), \gamma, \delta)$ is a continuous function that is bounded by the interval [0, 1]. It depends on the transition variable i.e. log of GDP per capita($(\log(GDP_{it}))$ a smooth parameter γ, and a threshold parameter δ.

The advantage of this method compared to System GMM is that it incorporates the change effect of individual heterogeneity in the same country over time. Besides, the PSTR allows the effect of financial development on economic growth to vary with the level of economic development and to endogenously determine the threshold. Accordingly, the marginal impact of the financial development variables is given by:

$$e_{i,t} = \frac{\partial GROWTH_{i,t}}{\partial FINDEV_{i,t}} = \beta_0 + \beta_1 g(\log(GDP_{i,t}), \gamma, \delta) \quad (4)$$

The properties of the transition function involve:

$$\beta_0 \le e_{i,t} \le \beta_0 + \beta_1 \text{ if } \beta_1 > 0 \text{ or } \beta_0 + \beta_1 \le e_{i,t} \le \beta_0 \text{ if } \beta_1 < 0$$

When estimating the parameters of the PSTR model, the individual effects u_i are removed by eliminating individual-specific means. It is therefore a transformed model by non-linear least squares, the so-called within model that one estimates (González et al. (2005)). The testing procedure consists in first examining the linearity against the PSTR model and then determining the number r of transition function.

Considering equation (2), the linearity check consists in testing the hypothesis: $H_0 : \gamma = 0$ or $H_0 : \beta_0 = \beta_1$. Then three standard tests are applied using these statistics: Lagrange Multiplier of Fisher(LM_F), Wald test(LM), and Pseudo Likelihood-ratio(LRT). The results of these tests in the PSTR estimations (Table 2) show that the linearity hypothesis is rejected for our indicators of financial development. This highlights that the impact of financial development on economic growth is a function of the level of development. The null hypothesis of no nonlinearity is not rejected, indicating that our three equations with respectively CREDBANK, M3/GDP and CREDPR need a transition function. The transition function implies

that there is a threshold point at which the effect of financial development on growth can be adverse.

The estimated parameters considering the three proxies for financial development are respectively $\beta_0 = 0.0152$ and $\beta_1 = -0.0159$ using CREDBANK, $\beta_0 = 0.0192$ and $\beta_1 = -0.020$ using M3/GDP, $\beta_0 = 0.018$ and $\beta_1 = -0.022$ using CREDPR. The β_0s and β_1s are respectively positive and negative – financial development has positive impact on growth but this effect is decreasing and becomes negative for higher middle income and high income countries.

In addition, according to the Bayesian Information Criterion (BIC), the best model is the one where credit by the banking sector (CREDBANK) is the proxy for financial development. The marginal impact of this financial development variable decreases with the level of economic development (Figure 1).

Figure 1: Income level and marginal impact of credit on growth

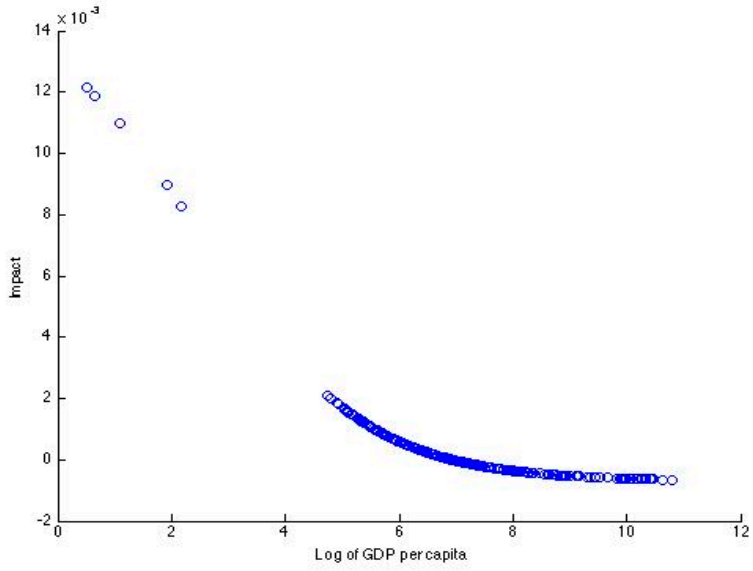

Table 2: Parameter estimates for the PSTR model

Threshold variable		log (GDP)	
Financial Variables	CREDBANK	M3/GDP	CREDPR
N° of transition function (r^*)	1	1	1
$(H_0: r = 0 \; vs \; H_1: r = 1)$			
Fisher Test of linearity	20.992 (0.000)	15.603 (0.000)	16.002 (0.001)
Wald Test	22.735 (0.000)	17.235 (0.000)	17.550 (0.000)
LRT Test	23.643 (0.000)	17.750 (0.000)	20.444 (0.000)
$(H_0: r = 1 \; vs \; H_1: r = 2)$			
Fisher test of no remaining nonlinearity	0.020 (0.887)	5.231 (0.023)	0.026 (0.886)
Wald Test	0.024 (0.877)	6.054 (0.014)	0.034 (0.862)
LRT Test	0.024 (0.877)	6.116 (0.013)	0.020 (08062)
$(H_0: r = 2 \; vs \; H_1: r = 3)$			
Fisher test of no remaining nonlinearity		0.000 (0.988)	
Wald Test		0.000 (0.987)	
LRT Test		0.000 (0.987)	
Parameter β_0	0.0152 (0.0042)	0.0192 (0.0028)	0.018 (0.0013)
Parameter β_1	-0.0159 (0.0042)	-0.0181 (0.0027)	-0.022 (0.0013)
Location parameter δ	2.5445	4.4888	3.275
Smooth parameterγ	0.7015	2.5746	0.825
Number of Observations	301	301	301
BIC	-5.3161	-5.2957	-5.2560

Note: The test of linearity has an asymptotic $F(1, TN - N - 1)$ distribution under H_0 and $F(1, TN - N - 2)$ for the no remaining nonlinearity test with N the number of individuals and T the number of periods. For statistics, the p-values are in parentheses. For parameters, β_0 and β_1 the standard errors are parentheses and are adjusted for heteroskedascity.

III. Conclusion

This paper investigated the relationship between financial development and growth using System GMM and PSTR methods. The results show evidence of a non-linear financial development-growth nexus. Financial development has promoted growth in less developed countries in our sample while its impact in more developed economies is nil or negative. The PSTR estimations endogenously estimate a non-linear relationship between financial development and growth and highlights that financial development is conducive to growth in low-income and lower middle income countries but can be detrimental to growth in more developed economies. These findings have important implications for the current debate on financial deepening. In advanced economies better surveillance and monitoring of the financial system could help contain its potential negative impact on growth. In low-income and lower middle income economies, appropriately sequenced financial development should support much needed growth and economic development.

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APPENDIX: Country list

Argentina, Benin, Bolivia, Botswana, Brazil, Canada, China, Colombia, Cote d'Ivoire, Dominican Republic, Ecuador, France, Germany, Guatemala, Honduras, India, Indonesia, Iran, Islamic Republic of, Ireland, Italy, Jordan, Kenya, Malawi, Mali, Mexico, Nepal, Nicaragua, Niger, Pakistan, Peru, Philippines, Qatar, Senegal, South Africa, Sri Lanka, Sweden, Syrian Arab Republic, Thailand, Togo, Tunisia, Turkey, Uruguay, Zimbabwe.