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The Impact of Financial Development on Innovation Activities in Emerging and Developing Countries

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Abstract

We investigate in this paper the effect of financial development on innovation in emerging and developing countries. The estimation of panel threshold model for a sample 54 countries during the period 1980-2009 shows the presence of non linear effects in the relationship between financial development and innovation. We find a threshold value of economic development below which the financial development level has no significant impact on innovation and above which financial development has a significant positive impact on innovation. In sum, our findings suggest that the presence of a healthy economic environment is crucial for financial institutions to offer high-quality financial services, promoting more innovation.

Keywords: Financial development, Innovation, Economic development, Threshold effects, Emerging and developing countries

1. Introduction

With the importance of knowledge as a prime driver of economic growth, initiatives aim to enhance a nation's knowledge capacity. Efforts are targeted to strengthen economic and social dimensions of the country as key determinants for successful transtion to knowledge economy. This study adds to the literature by examining the contribution of financial system in shaping the knowledge economy. Its objective is to evaluate the impact of financial development on technological innovation in emerging and developing countries.

Financial intermediaries may favorably affect innovation. Indeed, innovative activity is associated with market frictions and transaction costs which can be moderated by the activity of banks and the provision of specific financial services, leading to more innovative activity (Meierrieks, 2014). Financial development boosts innovation by improving resource allocation and investment toward strategic sectors as well as facilitating technology to promote growth

(Ramirez et al, 2015). Due to the increasing importance of financial development, an empirical literature has developed examining its impact on innovation. The empirical evidence is not conclusive. Some findings suggest that financial intermediaries encourage innovative activities (Maskus et al, 2012, Tee et al 2014; Meierrieks, 2014), others show that financial development spurs innovation conditional in different factors, such as the size of the economy, the type of industries and its institutions (Dabla-Norris et al, 2012; Hsu et al, 2014; Sharma, 2007; Ramirez et al, 2015).

Following Blanco (2013) and Shen and Lee (2006) who find non linear relationship between financial development and economic growth, we suppose in this study the presence of non linear effects in the relation financial development / innovation. Previous studies combine both advanced and emerging countries. In the present paper, we focus on emerging ones. We consider 54 countries during the period 1980-2009 and estimate a panel threshold model developed by Hansen (1999). We find that financial development allows to stimulate innovation only in countries with a high level of economic development. In sum, our findings suggest that the presence of a healthy economic environment is crucial for financial institutions to offer high-quality financial services, promoting more innovation.

This paper is organized as follows. Section 2 presents a review of literature. In Section 3 we introduce the data and empirical methodology. Our empirical findings are presented and discussed in Section 4. Section 5 concludes.

2. Literature Review

Due to the serious problems of motivation and information in innovation activities, financial development is expected to have a significant effect on the innovation of the firm. A well-developed financial system can avoid the information and motivation problems. Indeed, the financial system produces the information needed to improve the ex ante evaluation of investment opportunities and to facilitate control, thereby mitigating motivation problems (Levine, 2005). Findings of the works that have dealt with this problem are not conclusive. Some studies found a positive impact of financial development on innovation. Others found a non linear relationship between these two variables.

Among works that found a positive relationship, we can cite those of Maskus et al. (2012) which examined the impact of national and international financial market development on research and development intensities in 22 manufacturing industries in 18 OECD countries over the period 1990-2003. They found that the most important factor is the capitalization of the private bond market. Foreign direct investment, bank credit to the private sector and capitalization of the financial market have similar effects on R&D intensity. Meierrieks (2014) studied the impact of financial development on innovation in 51 countries between 1993 and 2008. He found that higher levels of financial development coincide with a stronger innovative activity. Tee et al. (2014) examined the role of financial development in promoting innovation activity using panel data for seven East Asian countries for the period 1998-2009. They found that the size of the financial sector and the overall activity of banks and the stock market have positive effects on patent applications.

Some other studies show that financial development spurs innovation conditional in different factors, such as the size of the economy, the type of industries and its institutions. Using firm level data from 2006 to 2013 for a set of developing countries, Ramirez et al. (2015) found that financial development has a negative effect on the probability of a firm to innovate. The effect is conditional on firm size, and only larger firms are the ones that benefit from financial development.Hsu et al. (2014) show that industries that are more dependent on external finance and that are more high-tech intensive exhibit a disproportionally higher innovation level in countries with better developed equity markets. However, the development of credit markets appears to discourage innovation in industries with these characteristics. Using firm level data from a cross-section of 57 countries, Sharma (2007) found that relative to large firms in the same industry, R&D spending by small firms is more likely and sizable in countries at higher levels of financial development.

3. Methodology

3.1 Sample Description

Our sample includes 54 emerging and developing countries[1]. The period covered is 1980-2009. Since some data (like those relative to human capital) are quinquennially, we have collected all variables in this study in every 5 years for the 1980–2009 period.The study uses data for 6 periods: 1980-1985; 1985-1990; 1990-1995; 1995-2000; 2000-2005; 2005-2009.

3.2Panel Threshold Model

According to Hansen (1999), a threshold model with r regimes is defined as follow:

$$Y_{it} = \alpha_i + \beta X + \delta_1 c_{it} I(d_{it} \leq \gamma_1) + \delta_2 c_{it} I(\gamma_1 < d_{it} \leq \gamma_2) + \ldots + \delta_r c_{it} I(\gamma_{r-1} < d_{it}) + \varepsilon_{it} \quad (1)$$

Where $\gamma_1 < \gamma_2 < \ldots < \gamma_{r-1}$.

For the purpose of the present study, we construct the single threshold model as follows:

$$Y_{it} = \alpha_i + \beta X + \delta c_{it} * I(d_{it} \leq \gamma) + \theta c_{it} * I(d_{it} > \gamma) + \varepsilon_{it} \quad (2)$$

Y_{it} represents dependant variable (innovation level), c_{it} is financial development level, d_{it} is the threshold variable: the level of economic development; and γ is the estimated threshold value. X is a vector of control variables. α_i: the fixed effect which represents the heterogeneity of companies under different operating conditions. I(.) is an indicator function. The error term ε_{it} is independent and identically distributed with zero mean and finite variance o ². The subscript i stands for the cross-sections (i = 1, 2,…54) and t indexes time (t = 1, 2,…6). Specification (2)

[1]In this paper, we adopt the ranking of countries according to the report of the International Monetary Fund (IMF, 2012), which classifies countries into two categories: "Advanced Economies" and "Emerging and Developing Economies." Countries included in our sample are: Algeria, Argentina, Bangladesh, benin, Bolivia, Brazil, Burundi, Cameroon, Chile, Colombia, Congo, Costa Rica, Dominican Republic, Equador, Egypt, El Salvador, Fiji, Gabon, Ghana, Guatemala, Haiti, Honduras, Indonesia, Iran, Jamaica, Jordan, Kenya, Malawi, Malaysia, Mali, Mauritius, Mexico, Morocco, Nepal, Nicaragua, Niger, Pakistan, Panama, Paraguay, Perou, Philippines, Senegal, Sierra Leone, South Africa, Sri Lanka, Syria, Thailand, Tunisia, Turkey, Uganda, Uruguay, Venezuela, Zambia, Zimbabwe.

highlights two regimes: one regime for which the variable d_{it} is less than or equal to the threshold γ and a second regime for which the variable d_{it} is greater than the threshold γ. Our equation (2) can be rewritten as follows:

$$\begin{cases} Y_{it} = \alpha_i + \beta X + \delta d_{it} & \text{if } d_{it} \leq \gamma \quad (3) \\ Y_{it} = \alpha_i + \beta X + \theta d_{it} & \text{if } d_{it} > \gamma \quad (4) \end{cases}$$

To estimate this model, we first eliminate the individual effect α_i using the within transformation estimation techniques in the traditional fixed effect model of panel data. By using the ordinary least squares and minimizing the concentrated sum of squares of errors, $S1(\gamma)$, we can obtain the estimators of our threshold value and the residual variance, $\hat{\gamma}$ and $\hat{\sigma}^2$, respectively.

The second step will consist in testing the null hypothesis of linearity, H0: $\delta = \theta$ which can be based on the likelihood ratio test:

$$F1 = (S0 - S1(\hat{\gamma})) / \hat{\sigma}^2,$$

S0 is the sum of squared errors under H0 and S1 the sum of squared residuals under H1. However, as the asymptotic distribution of F1 is non standard, we use the procedure of bootstrap to construct the critical values and p-value.

Upon the existence of threshold effect, H0: $\delta = \theta$, we should test for the asymptotic distribution of threshold estimate, H0: $\gamma = \gamma 0$, and adopt the likelihood ratio test:

$LR1(\gamma) = (S1(\gamma) - S1(\hat{\gamma})) / \hat{\sigma}^2$ with the asymptotic confidence intervals:

$$c(\alpha) = -2\log(1 - \sqrt{1-\alpha}).$$

The panel threshold model is estimated by the computer program Matlab 2012.

3.3Data

We have collected data in every 5 years for the 1980–2009 period.

Dependant variable which measures technological innovation level is the number of patent applications filed in US Patent and Trademark Office (USPTO), denoted by PAT.

Independent variables measure financial development, economic development, human capital, institutional framework and foreign source of knowledge.

To measure financial devolopment level, we use domestic credit to private sector as share of GDP (CRD). Data are from World Development Indicators. This measure is used by Ramirez et al (2015).

To measure economic development, we use per capita GDP, denoted by GDP. The data on PPP

converted GDP per capita, at 2005 constant prices come from Penn World Table.

Human capital stock is measured by the variable EDUC: It's the educational attainment for population aged 15 and over at the secondary level. These ratios are collected from Barro and Lee database.

Institutions are measured by economic freedom index (EF). Data are from Fraser Institut. The freedom index ranges from 0 to 10, with a higher index indicating a higher level of economic freedom.

We employ foreign direct investment as foreign source of knowledge. It is measured by the share of FDI inflows in GDP (FDI). Data are from Word Development Indicators.

All variables PAT, CRD, GDP, EDUC, EF and FDI are in natural logarithm.

4. Findings

Table 1 presents the test statistics F1, F2, and F3, along with their bootstrap p-values. It shows that the tests for a double threshold F2 and a triple threshold F3 are insignificant with a bootstrap p-value of 0,473 and 0,283 respectively. Only the test for a single threshold F1 is significant with a bootstrap p-value of 0,083. Thus, we conclude that financial development has only one threshold effect on country innovation.

The point estimate of the threshold ($\hat{\gamma}$) is 7115,378 PPP and his asymptotic confidence interval is [5539,12; 7730,37].

Table 1. Tests for threshold effects

Single threshold effect test	
Threshold value	7115,378
F1	21,878
P-value	0,083
(Critical value of F 10%, 5%, 1%)	(20,9; 24,2; 33,5)
Double threshold effect test	
Threshold values	1106,95; 7115,378
F2	11,612
P-value	0,473
(Critical value of F 10%, 5%, 1%)	(18,5; 21,5; 29)
Triple threshold effect test	
Threshold values	1106,95; 5620,486; 7115,378
F3	11,178
P-value	0,283
(Critical value of F 10%, 5%, 1%)	(14,6; 16,5; 20,8)

More information can be learned about the threshold estimate from plot of the concentrated likelihood ratio function LR1(γ) in Figure 1.

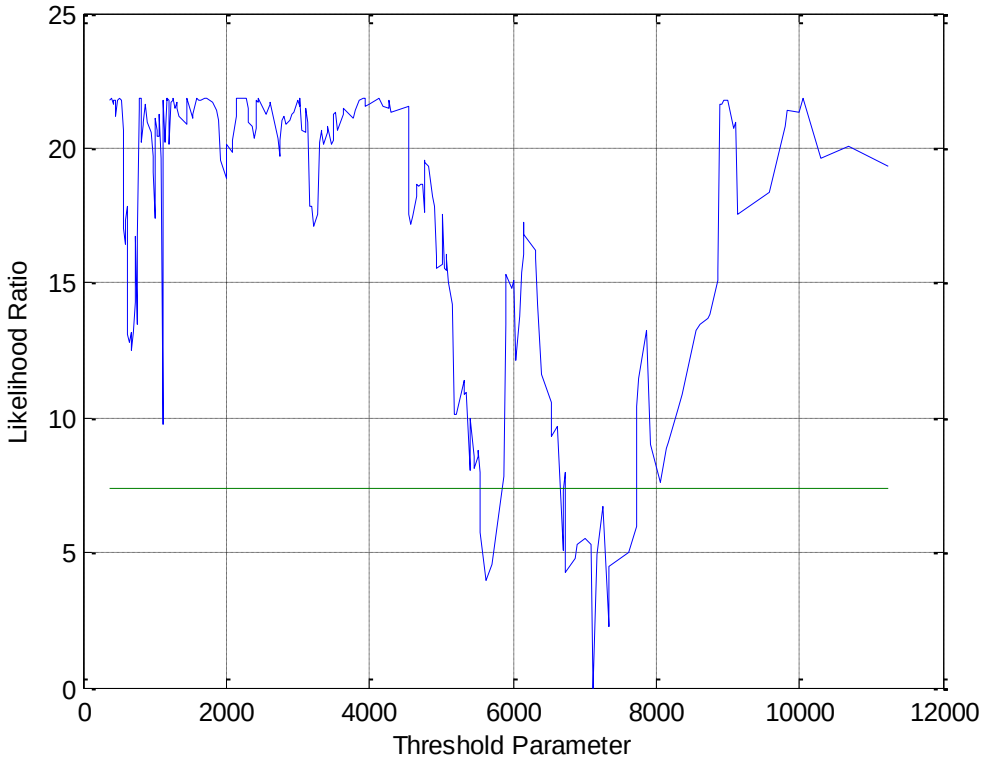

Figure 1.LConfidence Interval Construction in Single Threshold Model

Table 2. Estimation of coefficients

	Coef.	OLS SE	T(OLS)	White SE	T(White)
GDP	0,880	0,223	3,939***	0,227	3,860***
EDUC	0,463	0,126	3,673***	0,130	3,561***
EF	0,193	0,219	0,883	0,191	1,014
FDI	0,070	0,077	0,904	0,057	1,226
CRD I(GDP[2]<= 7115,378)	-0,030	0,069	-0,448	0,054	-0,570
CRDI(GDP > 7115,378)	0,180	0,086	2,091***	0,069	2,591***

Table 2 reports estimation results of the panel threshold model. It shows that the GDP per capita and the education level have a positive and significant impact on innovation. The institutional framework and foreign direct investment are not significant.

The most important finding is that the level of financial development affects innovation. However, this impact is different depending on the regime. In the first one, where the level of economic development is less than or equal to the threshold value (7115,378 PPP), the effect is negative and non significant. In the second regime where countries are characterized by a high level of economic development, the effect is positive and significant at 1%. In this class, when the share in GDP of credit to private sector increases by 1 %, the number of patent applications filed in the USPTO increases by 0,18%. Thus, we find that only countries with a high level of

[2] GDP here is the threshold variable. It is not transformed to natural logarithm.

economic development can benefit in terms of innovation from the increase in the level of financial development. As expected, our results confirm the nonlinear relationship between financial development and innovation. They are consistent with those of Blanco (2013) and Shen and Lee (2006).

5. Conclusion

The purpose of this paper is to investigate the effect of financial development on innovation in emerging and developing countries. The estimation of panel threshold model shows the presence of non linear effects in the relationship between financial development and innovation. We find a threshold value of economic development below which the share of credit to private sector in GDP has no significant impact on innovation and above which credit share has a significant positive impact on innovation.

Our analysis suggests that only countries with relatively higher economic development levels in developing world may reap benefits from financial development.

The present study has important implications. First, the significant presence of threshold effects calls into question the relevance of any econometric specification assuming a linear relationship between financial development and innovation. Second, it is not enough for emerging and developing countries to implement financial reforms, it is still necessary to generate appropiate economic and technological conditions if they want financial development to spur growth through innovation. Finally, we note that these implications are only limited to private financing, and therefore the research is linked to the development of the private financial sector.

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