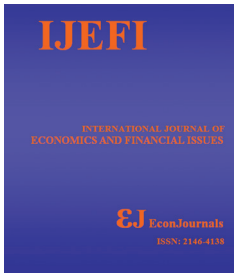

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Level or Growth, Which is More Important? Influence of Human Capital on Spillovers from Foreign Direct Investment

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ABSTRACT

The paper examines the spillover benefits of Foreign Direct Investment (FDI) in relation to their contribution to economic growth, by utilizing a cross-country panel framework over the last four decades. The findings suggest that only when the host country has a certain threshold level of human capital, FDI contributes positively to economic growth through technology diffusion. It is also found that in general terms, the growth of human capital, and not the level of human capital, in the host economy interacts more strongly with FDI to produce positive externalities. This indicates that countries can compensate for their lower levels of human capital stock by substituting it with higher rates of human capital growth.

Keywords: Human Capital, Technology Spillover, Foreign Direct Investment
JEL Classifications: F14, F43

1. INTRODUCTION

Technology diffusion plays a central role in the process of economic development (Borensztein et al., 1998). Unlike the neo-classical growth model, endogenous growth theory has increasingly focused on understanding and endogenising technical progress. Consequently, the theory predicts that R and D, education, training, and other investments in knowledge creation may generate positive externalities (spillovers) that prevent diminishing returns to scale for labour and physical capital.

Technical progress can be based on the creation of entirely new knowledge or on the adaptation, transfer or even imitation (learning by looking) of existing foreign technology (Blomström and Kokko, 2002). Foreign direct investment (FDI) by multinational corporations (MNCs) is considered to be a major channel for the access to advanced technologies by developing countries. Findlay (1978) suggests that FDI increases the rate of technological progress in the host country through a "contagion" effect from the more advanced technology, management practices etc. used by the foreign firms. However, although FDI can be deemed as a causal determinant of the level and growth of human capital in a country, the dualistic nature of the inter-relationship between human capital and FDI entails that the stock of the human capital in a country limits its capability to absorb foreign, advanced technology. As noted by (Berg, 2001), "it is the quality of the labour force, its accumulated experience and human capital, its education system, and so on, that determines an economy's ability to create new ideas and adapt old ones."

Recent literature (Borensztein et al., 1998; Benhabib and Spiegel, 1994; Aitken and Harrison, 1999) suggests that a minimum "threshold" level of human capital is required to ensure the effective absorption of foreign technology. Blomström and Kokko (2002) suggests that the relationship FDI and human capital could be highly non-linear and simultaneous in nature. For example, host countries with relatively high levels of human capital will attract large amounts of technology-intensive foreign MNCs that contribute significantly to the further development of local labour skills. In contrast, economies with lower initial levels of human capital will experience smaller inflows of FDI, and those foreign firms that enter are likely to use simpler technologies that contribute only marginally to local learning and skill development. However, none of the aforementioned research has attempted to address the inter- linkage between FDI and growth of human capital. Intuition suggests that once the "threshold" level of human

capital has been achieved, both stock and growth of human capital will have substantial bearing on investment decisions of MNCs. For instance, as MNCs act as forward-looking maximizing agents, a relatively high level of human capital growth offers them with greater flexibility emanating from variety of choice. In addition, cost advantages may also arise from a rapidly increasing human capital stock.

2. LITERATURE REVIEW

The inter-linkage between FDI and host countries' economic growth has been explored empirically by several scholars. For instance, (Balasubramanyam et al., 1996) used cross-country data for the period 1970-85 to study the relation between FDI and growth in import-substituting and export- promoting nations. Borensztein et al. (1998) used cross-country data for 1970-79 and 1980-89 to study the FDI-growth relationship and the possible complementarity between FDI and the host country's human capital. They conclude that "FDI contributes to economic growth only when a sufficient absorptive capability of the advanced technologies is available in the host economy," thus referring to the minimum "threshold" level of human capital. In addition, they identify FDI as a vehicle for the adoption of new technologies. De Mello (1997) states that the "ultimate impact of FDI on output growth in the recipient economy depends on the scope for efficiency spillovers to domestic firms."

Ram and Zhang (2002) explain that FDI accelerates host countries' growth by (1) augmenting domestic savings and investment, (2) helping transfer of technology from the "leaders," (3) increasing competition in the host country's domestic market, (4) increasing exports and earning foreign exchange, and (5) imparting several other types of positive externalities (spillovers) to the economy at large.

In examining the inter-relationship between Human Capital, FDI and technology diffusion (Blomström and Kokko, 2002) notices that "the transfer of technology from MNC parents to its affiliates and other host country firms is not only embodied in machinery, equipment, patent rights, and expatriate managers and technicians, but is also realized through the training of local employees. This training affects most levels of employees, from simple manufacturing operatives through supervisors to technically advanced professionals and top-level managers. While most recipients of training are employed in the MNCs' own affiliates, the beneficiaries also include employees among the MNCs' suppliers, subcontractors and customers. The types of training range from on-the-job training, seminars, formal schooling to overseas education, perhaps at the parent company, depending on the skills needed. The various skills gained through the relation with the foreign MNCs may spill over directly - when the MNCs do not charge the full value of the training provided to local firms — or over time, as the employees move to other firms or set up their own businesses."

Research undertaken (Tanna and Topaiboul, 2005; Ram and Zhang, 2002) to identify the causality between human capital accumulation and FDI do not find evidence of complementarity between FDI and the host country's (average) level of education (proxy for level of human capital).

3. THEORETICAL FRAMEWORK

Borensztein et al. (1998) developed a theoretical model to analyze the functional relationship between FDI and economic growth. However, they only consider the "level-effect" of human capital, whereby higher levels of human capital interact with FDI to produce a positive effect on growth. We argue that the interaction between growth of human capital and FDI is equally (if not more) important in determining economic growth. To demonstrate this growth-effect of human capital, we will augment the Borensztein et al. (1998) model to include the growth effect of human capital.

The model utilizes the following neo-classical production function specification:

$$Y_t = A\, H_t K_t^{1-\alpha},\ 0 < \alpha < 1 \quad (1)$$

Where A represents the exogenous state of technology, H denotes human capital, and K stands for physical capital. The initial level of human capital is taken as given and grows at constant rate,

$$H(t) = H_0 e^{pt} \quad (2)$$

In accordance with (Robert and Sala-i-Martin, 1994) technological progress is defined as an increase in the number of varieties of capital goods available i.e., capital deepening. Physical capital consists of an aggregate of different varieties of capital goods, and hence capital accumulation takes place through the expansion of the number of varieties. At each instant in time, the stock of domestic capital is given by Ethier (1982):

$$K = \left\{ \int_0^N x(j)^{1-\alpha}\, dj \right\}^{1/(1-\alpha)} \quad (3)$$

That is, capital is a composite of different variables of capital goods, each one being denoted by x(j).

The total number of varieties of capital goods (N), is produced by two types of firms, domestic and foreign firms present in the economy. The domestic firms produce n varieties out of the total variety N, and the foreign firms produce n* varieties:

$$N = n + n^* \quad (4)$$

Firms specialize in each variety of capital good and rent out to producers. At equilibrium, rental rate (L) equates with marginal productivity of capital good:

$$L = \frac{\partial Y}{\partial K} = m(j) = (1 - \pm) AH^{\alpha}\ x(j)^{-\alpha} \quad (5)$$

Discarding domestic innovation completely, an increase in x(j) can only occur through foreign technology adaptation. A fixed setup cost (F) is incurred in the adaptation process

$$F=F\left(n^*,\frac{N}{N^*}\right),\ \text{where}\ \frac{\partial F}{\partial n^*}<0,\frac{\partial F}{\partial\left(\frac{N}{N*}\right)}<0 \tag{6}$$

In addition to the fixed cost, a maintenance cost C is incurred per period of time. Borensztein et al. (1998) assume a constant marginal cost of production of x(j) = 1. However, over an infinite time horizon, a higher level of human capital growth rate (p) will bring substantial cost advantages to the firm. Rapid expansion of the work-force may lead to bidding down of wages. Competition may foster qualitative improvements of the human capital. Also, foreign firms will face lesser degree of wage rigidity due to the labor variety they can draw from. Therefore,

$$C=C(1,p)=\ p^*,\frac{\partial C}{\partial p,}<0 \tag{7}$$

With a constant interest rate (r), the profit function is:

$$\pi(j)=-F\left(n^*,\frac{N}{N^*}\right)+\int_0^\infty\left[m(j)x(j)-p^*x\right]e^{-rt}\ dt \tag{8}$$

To maximize (8), we substitute (5) and differentiate with respect to x(j):

$$\frac{\partial\pi}{\partial x}=(1-\alpha)A\,H^{\alpha}x\,(j)^{-\alpha}-p^*=0 \tag{9}$$

$$x(j)=\frac{A^{\frac{1}{\alpha}}(1-\alpha)^{\frac{2}{\alpha}}H}{p^{*\frac{1}{a}}} \tag{10}$$

$$m(j)=\frac{p^*}{1-\alpha} \tag{11}$$

With free entry and exit, the zero-profit condition holds, π(j) = 0

$$0=-F\left(n^*,\frac{N}{N^*}\right)+\left[m(j)x(j)-p^*x\right]\int_0^\infty e^{-rt}\,dt \tag{12}$$

$$r=F^{-1}\left(n^*,\frac{N}{N^*}\right)\varphi H \tag{13}$$

$$\varphi=\ A^{\frac{1}{\alpha}}\ \alpha\ (1-\alpha)^{\frac{2-\alpha}{\alpha}}\ p^* \tag{14}$$

All the firms are owned by the households. The size of each household (i.e., the level of human capital) grows at rate p. Each member of the household supplies 1 unit of labor at every point in time. Each household has $\frac{H(t)}{S}$ members and it rents whatever capital it owns to firms. It has initial capital holdings of $\frac{K_0}{H}$, where K_0 is the initial level of capital in the economy and S is the no. of households. The household's utility function takes the form:

$$U=\int_{t=0}^{\infty}e^{-\rho t}\ u\left(C(t)\right)\frac{H(t)}{S}dt \tag{15}$$

$$u\left(C(t)\right)=\frac{C(t)^{1-\theta}}{1-\theta}\quad,\ \theta>0 \tag{16}$$

Where the discount rate is ρ and θ is the coefficient of relative risk aversion. The household's budget constraint is:

$$\int_0^\infty e^{-rt}\ C(t)\frac{H(t)}{S}\ dt\le\frac{K_0}{S}+\int_{t=0}^{\infty}e^{-rt}\ \frac{H(t)}{S}\left(p^*+F\left(n^*,\frac{N}{N^*}\right)\right)dt \tag{17}$$

Where r is the real interest rate (equivalent to marginal capital). The total labor income for $\frac{H(t)}{S}$ is:

$$\begin{aligned}\int_0^\infty e^{(-r+p)t}\ C(t)\frac{H_0}{S}\ dt&\le K_0\frac{H_0}{S}+\int_{t=0}^{\infty}e^{-rt}\ e^{pt}\ \frac{H_0}{S}p^*\\&\quad+\int_0^\infty e^{-rt}\ \frac{H_0}{S}\ F\left(n^*,\frac{N}{N*}\right)\ dt\\&=\int_0^\infty e^{(-r+p)t}\ C(t)\ dt\le K_0+\int_{t=0}^{\infty}e^{-rt}\ e^{pt}\ p^*\\&\quad+\int_0^\infty e^{-rt}\ e^{\rho t}\ F\left(n^*,\frac{N}{N*}\right)dt\end{aligned} \tag{18}$$

By substituting (2) and (16) in (15), we get the objective function:

$$U=\frac{H_0}{S}\int_{t=0}^{\infty}\frac{C(t)^{1-\theta}}{1-\theta}e^{\beta t}\ dt,\quad\beta=-\rho+p \tag{19}$$

Assuming no savings, we can set up the Lagrangian by using (18) and (17):

$$L=\frac{H_0}{S}\int_{t=0}^{\infty}\frac{C(t)^{1-\theta}}{1-\theta}e^{\beta t}\ dt+\lambda\left[\begin{array}{l}K_0-\int_{t=0}^{\infty}e^{(-r+p)t}\ C(t)\\+\int_{t=0}^{\infty}e^{-rt}\ e^{pt}\ F\left(n^*,\frac{N}{N^*}\right)\\+\quad\int_{t=0}^{\infty}e^{-rt}\ e^{pt}\ p^*\ dt\end{array}\right] \tag{20}$$

The first-order condition yields:

$$\frac{\partial L}{\partial C(t)}=\frac{H_0}{S}\ e^{\beta t}C(t)^{-\theta}=\lambda e^{(-r+p)t} \tag{21}$$

Taking logs and differentiating with respect to t,

$$\beta-\theta\frac{C(t)}{C(t)}=-r+p \tag{22}$$

Without savings, the rate of growth of consumption is equivalent to rate of growth of output (g_y)

Table 1: FDI and per capita GDP growth, panel of four decades (1960-2000)

Coefficient (standard errors)						
Regression No.	1.1	1.2	S1.3	1.4	1.5	1.6
FDI	0.0000179	0.0000202		−0.000314*		0.000583*
	(0.0000277)	(0.0000271)		(0.000241)		(0.000147)
Human Capital	0.00115*	0.000791*	0.000785*	0.000844*	0.000829*	0.00127*
	(0.0000755)	(0.000120)	(0.000119)	(0.000121)	(0.000121)	(0.0000688)
Growth of human capital		0.206*	0.206*	0.122*	0.154*	
		(0.05471)	(0.05464)	(0.06467)	(0.0607)	
FDI*HC				−0.00000680		−0.0000794*
				(0.00000476)		(0.0000208)
FDI*growth of human capital				0.00033342*	0.0002133*	
				(0.00013959)	(0.000111)	
Sub-Saharan Africa	−0.242*	−0.269*	−0.278*	−0.256*	−0.251*	
	(0.0803)	(0.0787)	(0.0777)	(0.0786)	(0.0787)	
Dummy						
R^2	0.561	0.584	0.583	0.592	0.589	0.5705
F-stat	111.09	91.16	121.57	75.12	93.02	115.10

*Denotes significance at α=0.05

By substituting (19), therefore,

$$g_y = \frac{1}{\theta}(r-\rho) \quad (23)$$

$$g_y = \frac{1}{\theta}\left(F^{-1}\left(n^*, \frac{N}{N^*}\right)\varphi H - \rho\right) \quad (24)$$

Hence, higher rate of growth of human capital leads to higher rate of income growth. Consequently, we revise the model of Borensztein et al. (1998) to include the effect of human capital growth on FDI and output growth:

$$g_y = \beta_0 + \beta_1 FDI^* + \beta_2(FDI \times H) + \beta_3 H + \beta_4 H^* + \beta_5(FDI \times H^*) + \varepsilon \quad (25)$$

Where,

g_y: Denotes average annual rate of growth of real GDP for the period,

FDI*: Is the average FDI (inflows)/GDP ratio for the period,

H: Is mean years of education for the population aged 15 years and older,

H*: Is average growth in mean years of education for the population aged 15 years and older,

FDI×H: Is the interaction variable between human capital level and FDI,

FDI×H*: Is the interaction variable between human capital growth and FDI,

ε: Represents the myriad other influences on growth, assumed to be orthogonal.

4. DATA

The study covers a total of 68 countries[1]. Since the concept of technology diffusion is essentially related to developing countries, the flow of FDI from the 25 high-income OECD countries to these 73 developing countries will be observed. The study period is from 1970 to 2000. Data on FDI inflows have been collected from Balance of Payments statistics compiled by IMF. National accounts data, such as growth rate of income, initial income have been collected from Penn World Table 1. The growth rate measure is the annual rate of per capita real GDP. The data on human capital stock and growth is collected from the recent data compiled by Cohen and Soto (2007).

5. RESULTS

The empirical analysis attempts to estimate the effect of FDI on economic growth, and to examine the channels through which FDI may be beneficial for growth. In particular, as discussed in the section 3, we examine whether FDI interacts with stock and growth of human capital to affect growth rates. The following table summarizes the major findings of the research.

The main regression results (1.1 and 1.6) indicate that FDI has a positive overall effect on economic growth, although the magnitude of this effect depends on the stock of human capital available in the host economy. Inclusion of the interaction between FDI and human capital (1.6) improves the overall performance of the regression. However, the effect of FDI on growth is not robustly significant (1.4). This perverse result, however, may be the result of multicollinearity caused the inclusion of both FDI and FDI*H which are highly correlated in both levels and growth rates. However, the inclusion of both these terms in the regression is necessary to determine the education threshold, found to be approximately 0.79[2] years average attainment level of secondary education, beyond which the negative effect of FDI is offset by the positive effect of FDI*H.

This allows us to conclude that all countries with secondary school attainment above 0.79 will benefit positively from FDI.

1 Data on human capital is available for 93 countries. Excluding the 25 high-income OECD countries leaves us with 68 countries.

2 The threshold value is calculated as: Consider lnFDI and lnFDI*H as the two regressors with estimates α and ß respectively (where α>0 and ß<0). To calculate the minimum level at which the overall effect is positive (αlnFDI+ßlnFDI*H=0), H = antilog (−α/ß).

The African dummy is found to be robustly significant in all regressions (1.1-1.5), thus indicating that the structural parameters of the countries from this region is acting as a hindrance to their prospects of economic growth.

All the regressions (1.1-1.6) indicates that the level of human capital has a strongly positive effect and thus is a strong determinant of economic growth. However, the growth in the level of human capital is found to be the most significant determinant of positive economic growth. As regressions (1.2-1.5) suggest, if the level of human capital of a host economy increases by one percent, a resultant economic growth of 0.2-0.15% occurs.

Since we observe from (1.1 and 1.2) that FDI has an apparently positive but insignificant effect on economic growth, we can drop it from our analysis without negatively affecting the predictive validity of the regression (as indicated by the minimal change in the R^2 = 1.3). Nonetheless, the major objective of our research is achieved through the regression results from 1.4. They indicate that when we include interaction of FDI with both level and growth of human capital, the latter only is found to be positively significant. Hence, we can conclude that the interaction among FDI and growth of human capital has a much more significantly positive effect on economic growth than the interaction between FDI and level of human capital. This fully contradicts the result obtained by Borensztein et al. (1998), where it was concluded that the interaction between FDI and level of human capital has strongly positive effect on economic growth.

The results from 1.5 suggests that our results are robust; even after dropping the interaction term between FDI and level of human capital, the interaction term between FDI and growth of human capital remains positively significant and the overall performance of the regression is not affected.

6. CONCLUSION

There are two major policy implications for an existent co-relationship between human capital growth, FDI and consequential economic growth. (1) Continued investment in human capital formation is necessary to ensure higher levels of FDI and growth, (2) even for countries with relatively lower of levels of human capital stock (but above the minimum "threshold" level), investment in the growth of the initial endowment will lead to higher levels of FDI and accordingly economic growth. Therefore, this research lends credence to the theory that countries with lower levels of human capital (usually developing countries) will find it possible to emulate the growth rates of countries with higher levels of capital (usually developed countries) through massive and continued investment in human capital. In essence, they can compensate for their lower levels of human capital stock by substituting it with higher levels of human capital growth.

However, further research is required to identify and evaluate the various channels through FDI and growth of human capital interacts to produce the aforementioned positive impact on economic growth.

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