Does Human Capital Augment FDI's Impact on Economic Growth? A Theoretical Explanation

William Sheng Liu[1, 2,a,*], Frank Agbola[3,b,] and Bei-Bei Wu[1,c]

[1]Research Centre for International Trade and Economics, Guangdong University of Foreign Studies, 2 Baiyudadaobei, Baiyun District, Guangzhou 510420, China

[2]Centre for Cantonese Merchant Research, Guangdong University of Foreign Studies, 2 Baiyudadaobei, Baiyun District, Guangzhou 510420, China

[3]Newcastle Business School, 1 University Drive, Callaghan NSW 2308, Australia

[a]wsl_economics@126.com, [b]Frank.Agbola@newcastle.edu.au, [c]beibei588588@foxmail.com

*Corresponding author

Keywords: Human capital, FDI, Economic growth, Theoretical explanation.

Abstract. In the foreign direct investment (FDI) literature, human capital is regarded as an important factor in augmenting FDI effects on economic growth in host counties. To test for this hypothesis, we develop an endogenous growth model that incorporates human capital development and learning-by-doing effects for examining the impact of FDI on the growth of the host economy. The theoretical explanation indicates that both the industrial and locational human capital augments FDI-growth effects.

Introduction

Despite many studies having examined the impact of inward FDI on economic growth, the empirical evidence remains inconclusive [1]. Trying to explore why this happens, some examined absorptive capability of the host country, more specifically, the level of local human capital (HC) to augment FDI effects. Nevertheless, the results are still unconvincing. Smeets [2] argued that the inconclusiveness of the empirical findings is due to inadequate development of the theoretical framework linking FDI and growth. To overcome this difficulty on the theoretical front, this paper attempts to develop a theoretical model for studying FDI effects on growth through human capital augmentation and learning-by-doing activities.

Differentiation of the Theoretical Model

Romer's [3] knowledge-driven growth theory provides the foundation on which an endogenous model is developed to explore the impact of inward FDI on economic growth through human capital augmentation. Consider two sectors, research and production, and two countries, foreign and host. The host economy produces a single homogeneous final-good and that production occurs under perfect competition.

$$Y_t = A_t L_{Yt}^{\alpha} \int_0^N x(i)^{1-\alpha} di, \; 0 < \alpha < 1 \tag{1}$$

where Y denotes the output at time t, A denotes the exogenous state of the domestic 'environment', L denotes the amount of human capital employed in production, and α is the output elasticity of human capital. The state of the 'environment' consists of factors such as public knowledge development, which influence the general level of productivity of the economy. Following Borensztein et al. [4], this study assumes that physical capital is a vector of intermediate inputs, denoted by *x(i)*. Capital accumulation is through the expansion of inputs in the production of the final-good. Domestic firms produce n varieties of intermediate inputs, and foreign firms, which take the FDI mode to enter the host country, produce n^* varieties. Therefore, the total number of varieties of intermediate inputs used in the production of the final-good is: $N = n + n^*$, meaning that FDI increases the varieties of capital goods available in the host economy. This is termed by Borensztein et al. [4] as ‘physical capital deepening’.

It is assumed that the intermediate inputs are ‘invented’ by the research sector and each innovation represents one variety. That is, N varieties of intermediate inputs represent N number of innovations [5]. Taking a variation of the specification by Lai et al. [5], the innovations, invented by domestic and foreign firms, are computed by:

$$N = n + n^* = f[\theta A_t,\ \theta_f A_{ft} f(I_t)]H_R \qquad (2)[1]$$

where H_R is the labor force employed in the research sector and θ the productivity parameter. The expression, $\theta_f A_{ft} f(I_t)$, represents the innovations contributed by foreign firms, in which A_{ft} is the knowledge level of the foreign country channeled through FDI inflows denoted by $f(I_t)$ and θ_f is the host economy’s absorptive capability of foreign knowledge including the utilization efficiency of foreign capital. Based on Borensztein et al. [4] and Lai et al.[5], this study further analyzes the impact of inward FDI on human capital augmentation. Specifically, assume that human capital development of the host country is measured by the following function:

$$L_{Yt} = f(\varphi H_R H_Y, n + n^*) \qquad (3)$$

where H_Y is the labor force employed in the production sector, and growth of human capital is influenced by the interaction between H_Y and H_R, given that increased connections between production workers and researchers would raise possibilities of knowledge flow from the research to production sectors. φ is the learning parameter that influences assimilation of knowledge from researchers. $f(n+n^*)$ accounts for the impact of domestic and foreign technological progress on human capital accumulation, meaning that workers assimilate knowledge and translate it through new innovations into final-good production. Substituting N from Equation (2) into (3) gives:

$$L_{Yt} = f\{[\varphi H_Y, \theta A_t, \theta_f A_{ft} f(I_t)]H_R\} \qquad (4)$$

Next, this study extends Borensztein et al.’s [4] and Lai et al.’s [5] models through incorporating the concept of learning-by-doing into the examination of the impact of FDI on the production of intermediate inputs. FDI inflows can yield a spillover effect on productivity updating through bringing physical and knowledge resources to support domestic firms’ learning-by-doing activities in production. Assume that the learning-by-doing effect takes place at time t in the production process and this leads to a reduction of the cost of producing an intermediate input. For simplicity, this study further assumes that the reduced cost due to learning-by-doing is a constant percentage of the production cost, denoted by ε .[2]

This framework utilizes the equalization of wage rates between the research sector and production sector to obtain new market equilibrium after FDI inflows. Following Lai et al. [5], assume that in a perfect competition market, human capital can move freely between the research sector and production sector. Thus an equilibrium condition is reached if the wages paid to both sectors are equal.

$$W_{H_Y} = W_{H_R} \qquad (5)$$

and

[1] Assume that FDI is the only channel through which foreign firms impact on the economy.

[2] The specification of ε in this study is based on Aghion and Howitt [6].

$$W_{H_Y} = \alpha Y_t / L_{Yt} = \alpha A_t L_{Yt}^{\alpha} \int_0^N x(i)^{1-\alpha} di / L_{Yt} = \alpha A_t N \bar{x}^{1-\alpha} L_{Yt}^{\alpha} / L_{Yt} \tag{6}$$

$$W_{H_R} = P_r \theta A_t \tag{7}$$

$$P_r = [P(i) - 1] x(i)/r \tag{8}$$

$$P(i) = A_t (1-\alpha) L_{Yt}{}^{\alpha} x(i)^{-\alpha} \qquad (9)^3$$

where W_{H_Y} and W_{H_R} denote wages paid to workers in the production sector and research sector, respectively. $\bar{x} = (\int_0^N x(i) di / N)^{1-\alpha}$ is the average value of *x(i)*. An intermediate-input producer buys innovations made by research firms and pays them for patents at the price P_r. *p(i)* is the price of intermediate inputs which are produced by specialized firms in the production sector and rented to a final-good producer. *r* is the constant interest rate in a steady-state economy.

Differing from Lai et al. [5], human capital denoted by L_{Yt}, instead of the labor force denoted by H_Y, is used in Eq. (6) and (8) to account for the impact of FDI on worker's productivity improvement, namely, human capital augmentation. Using L_{Yt} also accounts for the impact of an improvement in the labor force on wage rates. After productivity has been improved, workers can increase their outputs and also will ask employers to raise their wages. Moreover, FDI inflows are not only helping for the labor forces' productivity improvement, but also capable of increasing competitions for employment of workers. As a result, competitions between employers will raise wage rates. For simplicity, this model assumes that the wage rates in both the production sector and research sector are fixed over time, while the changes of wages due to productivity improvement is reflected by the changes of the human capital.

This study extends Lai et al. [5] through incorporating the impact of learning- by-doing on production-cost reduction into differentiation of the market equilibrium. Under the condition of free entry into the production sector, producers of intermediate inputs are price takers. Once an intermediate input is innovated, a constant marginal cost of producing this input is spent at each period of time, which ensures that intermediate inputs depreciate fully at the end of a useful life. To examine the impact of FDI on the long-run economic growth of the host country, assume it is a steady state. If the marginal cost is assumed to be 1, profits for producing the intermediate input will be discounted at the rate $e^{-r(s-t)}$ between periods *t* and *s*:

$$\pi(i)_t = \int_t^{\infty} [p(i)x(i) - 1 \times (1-\varepsilon)x(i)] e^{-r(s-t)} ds \tag{10}$$

where $\pi(i)$ denotes profits of producing *x(i)*, $\varepsilon < 1$ is the portion of reduced costs due to learning-by-doing effect. Thus, the profit maximization problem of Eq. (10) is:

$$Max \pi(i)_t = Max[P(i)x(i) - x(i)(1-\varepsilon)] \tag{11}$$

To obtain the optimality condition of the production of intermediate inputs, differentiating Eq. (11) gives

$$\frac{\partial}{\partial x(i)} [P(i)x(i) - x(i)(1-\varepsilon)] = 0 \tag{12}$$

Substituting Eq. (9) for $P(i)$ into Eq. (12) gives

3 See Lai et al.[5] for the derivation from Eq. (6) to (9), similar to Borensztein et al.[4].

$$\frac{\partial}{\partial x(i)}[A_t L_{Yt}{}^{\alpha}(1-\alpha)x(i)^{1-\alpha} - x(i)(1-\varepsilon)] = 0$$
$$\Rightarrow A_t L_{Yt}^{\alpha}(1-\alpha)^2 x(i)^{-\alpha} - (1-\varepsilon) = 0$$

Rearranging the equation obtains

$$x(i) = A_t^{1/\alpha} L_{Yt}(1-\alpha)^{2/\alpha}/(1-\varepsilon)^{1/\alpha} \tag{13}$$

Substituting Eq. (13) for *x(i)* into Eq. (11) obtains the price paid to intermediate inputs which accounts for the learning-by-doing effect:

$$P(i) = (1-\varepsilon)/(1-\alpha) \tag{14}$$

Furthermore, substituting Eq. (14) for $P(i)$ into Eq. (8) obtains the price paid to patents in the research sector.

$$P_r = \frac{1}{r}(\frac{1-\varepsilon}{1-\alpha} - 1)x(i) = \frac{1}{r}(\frac{\alpha-\varepsilon}{1-\alpha})x(i) \tag{15}$$

Assume that all intermediate inputs are used symmetrically in the production of the final-good, so $\bar{x} = x(i)$. Substituting Eq. (13) for *x(i)* into Eq. (6) yields

$$W_{H_Y} = \alpha A_t^{1/\alpha} N[(1-\alpha)^{2/\alpha}/(1-\varepsilon)^{1/\alpha}]^{1-\alpha} \tag{16}$$

Substituting Eq. (16) for W_{H_Y}, Eq. (15) for P_r, and Eq. (7) for W_{H_R} into Eq. (5):

$$\frac{\theta A_t}{r}(\frac{\alpha-\varepsilon}{1-\alpha})A_t^{1/\alpha} L_{Yt}^{\alpha}(1-\alpha)^{2/\alpha}/(1-\varepsilon)^{1/\alpha} = \alpha A_t^{1/\alpha} N[(1-\alpha)^{2/\alpha}/(1-\varepsilon)^{1/\alpha}]^{1-\alpha}$$
$$\Rightarrow r = \theta A_t L_{Yt}(\alpha-\varepsilon)/\alpha N(1-\alpha)(1-\varepsilon) \tag{17}$$

in which $N = (1+\tau)\,n$ where $\tau = n^*/n$.

Substituting $n = \theta H_R A_t$ into Eq. (17) yields

$$r = (\frac{L_{Yt}}{H_R(1+\tau)})(\alpha-\varepsilon)/\alpha(1-\alpha)(1-\varepsilon) \tag{18}$$

Assume that individuals try to maximize the following standard inter-temporal utility function

$$U_t = \int_0^{\infty} \frac{C_s^{1-\sigma}}{1-\sigma} e^{-\rho(s-t)} ds \tag{19}$$

where C denotes consumption of the final good, while p is the pure rate of time preference and $1/\sigma$ is the inter-temporal elasticity of substitution. Given that a rate of return on investment in production and research is equal to the constant interest rate in a steady state, a common growth rate, denoted by g, of the host economy is obtained

$$g = g_c = C_{t+1}/C_t = (r-\rho)/\sigma \tag{20}$$

Substituting Eq. (18) for r into Eq. (20) yields

$$g = \frac{1}{\sigma}\{[(\frac{L_{Yt}}{H_R(1+\tau)})(\frac{(\alpha-\varepsilon)}{\alpha(1-\alpha)(1-\varepsilon)})] - \rho\} \tag{21}$$

Furthermore, substituting Eq.(4) for L_{Yt} into Eq.(21) obtains a steady-state growth rate after incorporating the impact of FDI on human capital augmentation:

$$g = \frac{1}{\sigma}\{[(\frac{f(\varphi H_Y, \theta A_t, \theta_f A_{ft} f(I_t))}{(1+\tau)})(\frac{(\alpha-\varepsilon)}{\alpha(1-\alpha)(1-\varepsilon)})] - \rho\} \tag{22}$$

where $\tau = n^*/n$, σ is the time preference parameter, ρ is the substitution elasticity.

The Theoretical Explanation

After the entry of foreign firms, the market of the host country needs to make adjustments and ultimately reaches a new equilibrium. After that, a new growth rate of the host economy is reached. As Equation (22) indicates, there are at least three aspects of factors which are capable of influencing economic growth. Domestic knowledge development denoted by A_t is the first factor being able to stimulate human capital growth, supporting the generally held view that development of the domestic knowledge pool is capable of promoting economic growth [3].

FDI inflow is another factor and, indicated by Equation (22), has two offsetting effects on economic growth. The expression $A_{ft} f(I_t)$ illustrates a positive impact of FDI, but an increase in the ratio between the innovations invented by foreign firms and those by domestic firms, denoted by τ, is negatively associated with economic growth. This implies that on one hand FDI inflows are capable of yielding spillover effects on domestic workers' productivity updating and human capital accumulation through serving as a channel of transferring foreign capital and knowledge to the host country. On the other hand, the reliance on foreign technologies may discourage domestic firms to invest in high-cost R&D [7] and this consequently retards long-run economic growth.

Equation (22) indicates that there are two levels of human capital in affecting economic growth. First, the human capital level in a location, denoted by H_Y, is detected to be positively related to economic growth. Meanwhile, the quality of local human capital, denoted by φ, θ and θ_f, is growth-enhancing too through affecting the absorptive capability for both domestic and foreign knowledge. Second, the level of industrial human capital, denoted by α and ε, is growth-affecting. At one hand, an increase in the proportion of human capital input in the production would accelerate economic growth. At the other hand, the learning effect of human capital helps the economy to sustain growth, implying that an improvement in the learning of workers [6]. In short, Equation (22) suggests that human capital is capable of augmenting the impact of FDI on economic growth through affecting absorptive and learning capabilities of foreign knowledge.

Acknowledgement

This research was financially supported by Graduate Education Innovation Project of Guangdong University of Foreign Studies [17GWYJSCX-07].

References

[1] W.S. Liu, F. Agbola, Regional analysis of the impact of inward foreign direct investment on economic growth in the Chinese electronic industry. Appl. Econ. 46 (2014) 2576-92.

[2] R. Smeets, Collecting the pieces of the FDI knowledge spillovers puzzle. World Bank Reser. Obse. 23 (2008) 107-138.

[3] P.M. Romer, Endogenous technological change. J. Poli. Econ. 98 (1990) S71-102.

[4] E. Borensztein, J. De Gregorio, J.W. Lee, How does foreign direct investment affect economic growth? J. Int. Econ. 45 (1998) 115-135.

[5] M.Y. Lai, S.J. Peng, Q. Bao, Technology spillovers, absorptive capacity and economic growth. Chin. Eco. Rev. 17 (2006) 300-320.

[6] P. Aghion, P. Howitt, Endogenous Growth Theory, The MIT Press, 1998.

[7] N. Salike, Role of human capital on regional distribution of FDI in China: new evidences. Chin. Econ. Rev. 37(2016) 66-84.