Multinational enterprises and economic growth

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Abstract

The paper develops a theoretical model of economic growth with multinational enterprises. Foreign direct investment (FDI) between developed countries and between developed and developing country is considered. The work was inspired by empirical studies that find a significant relationship between economic growth, FDI and human capital of the recipient country. The results imply that there are two threshold levels of human capital. The first lower threshold can explain the concentration of FDI flows. The second higher threshold can explain why in some countries FDI does not have growth promoting effect.

1 Introduction

Multinational enterprise (MNE), which is a driving force of globalization, has attracted considerable attention of the public. It is many people’s favorite devil created to transform the world into a homogenous culture dominated by a few corporations, who undermine the democratic principles, rob poor nations and makes the rich richer. For economists MNE is more an angel than a devil. MNEs generate foreign direct investment (FDI) flows which are the most stable form of private capital flows during financial crisis. However the most important feature of FDI is that it is a composite bundle of capital and technology. MNE is not just a channel of capital flows but a promoter of efficient technologies and of the best management practices across the world. Nevertheless the positive effect of MNEs depends on the host country. Stiglitz (2002) notes that countries which benefited from FDI flows kept abuses of MNE in ”check”. It is not just industrial polices that determine the effectiveness of FDI, the most important element is human capital of the host country.
MNE is not a recent phenomenon\(^1\) but the forces that drive its activities are changing. If before MNE was searching for natural resources, now it searches for high human capital. In the past the human capital was relatively homogenous and MNE was exploiting advantage in natural resources of the host country. The recent wave of multinationals, however, has been directed towards countries with high human capital. The main reason for such a change is that new technology needs skilled labor to operate efficiently and human capital is much more immobile than other factors of production. Falling costs of transportation and communication make cross-country transfer of physical capital and of technology significantly easier than it was before. The falling cost of transportation could also contribute to the cross-country transfer of human capital, but technological advance is coupled with the development of the legal system which creates artificial barriers to cross-country human capital movement and offsets many advantages that technological development offers to human capital mobility. This is where globalization stands today: It reduces natural constraints while creates artificial ones. This inefficiency is effectively exploited by modern multinationals\(^2\) and it is no surprise that the last decade of the 20th century has seen tremendous surge in FDI flows.

General equilibrium theory of MNE that builds on Helpman (1984), Ethier (1986) and Horstmann and Markusen (1987) focuses on the trade patterns and does not consider growth effects associated with MNE activity. Helpman (1993) studies growth effects of various forms of technological transfer. He also analyses FDI in the North-South model but assumes that technological change is exogenous. Walz (1997) examines effects of various industrial policies when there are active MNE and notes that policies that promote FDI flows also promote international growth. In his model high skilled labor is mobile and how human capital endowment can affect FDI flows and growth is unclear. The models\(^3\) incorporating MNE always imply that FDI flows have positive effects on growth. Whereas the empirical literature does not always support this positive relationship. Aitken and Harrison (1999) note that many of these relationships might be spurious because

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\(^1\)Baldwin (1999) identifies years 1870-1914 as the period of major expansion of MNE activities.

\(^2\)as well as by human traffickers.

\(^3\)In the unpublished paper Baldwin, Braconier, and Forslid (2001) construct endogenous growth model with MNE where they show that FDI always has unambiguous positive effect.
FDI is attracted to the most productive industries and regions. They find that for Venezuela FDI has insignificant effect on aggregate output. They also state that FDI is attracted to the regions where there is high skilled labor. Balasubramanyam, Salisu, and Sapsford (1999) find that human capital has especially important influence on FDI growth relationship. Borensztein, Gregorio, and Lee (1998) and Nyatepe-Coo (1998) find that the positive relationship between FDI and growth holds only when a host country has crossed a minimum threshold level of human capital.

In this paper I construct a growth model in which human capital complements FDI’s effect on growth. In the model endogenously emerges the threshold level of human capital below which FDI has no or negative effect on the growth of the host economy. The model also exhibits a second, lower threshold of human capital below which the host country is not interesting for MNE. This feature of the model explains the concentration of the FDI flows. It is a stylized fact that most FDI outflows originate from developed countries and FDI inflows with high human capital. The paper is not restricted to the North-South case. FDI between two developed counties is also analyzed. This is very important for the model because most FDI flows goes to developed countries.

The paper is organized as follows. Section 2 construct the basic model and studies its properties in the closed economy. Section 3 considers FDI flows between two developed counters. Section 4 analyzes FDI flows from a large North country to a small South country. Section 4 concludes.

2 Closed economy

This section develops basic model suited to study the emergence of MNE in open economy. I show that the model has the unique balanced growth path and exhibits transitional dynamics. I also derive some properties that will be used to analyze growth path in the open economy.

The basic model is modified version of the quality improvement growth model of Aghion and Howitt (1992). The economy consists of households, producers, and a bank. Households are homogenous, they work, save and consume. There are two types of producers, final goods producers and inter-

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4 According to Baldwin (1999) in 1914 the division of FDI inflows between developing and developed nations was 63% to developing nations, in 1960 — 32% and in 1996 — 28%.
mediate goods producers. The final goods are only consumable goods and can be produced using intermediate inputs. Intermediate goods are produced by heterogenous monopolists who have headquarters and plants. The head-quarter conducts research and development and holds product-specific patent for a limited period of time. The plant produces an intermediate good and sells it the monopolized sector of market. The bank pools risks and provides households with the risk-free return. The bank gives risky credit to the firm’s headquarter to finance product-specific research and development; after that it gives risk free credit to firm’s plant to finance the production. Below I describe the model formally.

2.1 Households

An infinitely lived representative household maximizes its lifetime utility

$$\max \{c_t, s_t\} \sum_{t=0}^{\infty} \beta^t u(c_t)$$

subject to the household’s budget constraint

$$c_t + s_{t+1} = w_t H + (r_t - \delta)s_t$$

where $c_t$ is consumption at time period $t$, $s_t$ is the household’s assets at time period $t - 1$ giving the the risk free gross return $r_t$ in time period $t$. $H$ is the human capital stock of the household and $w_t$ is its rental price at time period $t$. $\delta$ is the depreciation rate.

Let $\lambda_t$ denote the shadow price of period $t$ savings. First order conditions give

$$\beta^t u'(c_t) = \lambda_t$$

$$\lambda_t = (r_{t+1} - \delta)\lambda_{t+1}$$

Euler equation is

$$u'(c_t) = \beta(r_{t+1} - \delta)u'(c_{t+1})$$

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5Although in closed economy prolongation of the credit line always takes place and this timing is not important, in the open economy it will make crucial difference.

6Here $r_t$ is interest that the bank offers and the depreciation happens when the household’s assets are used in production, but for the sake of simplicity I keep this term in the household’s budget constraint.
2.2 Production sector

The final goods are produced using Ethier production function

\[ Y_t = H_t^{1-\alpha} \int_0^1 x_t(i)^{\alpha} di \]  

(6)

where \( Y_t \) is output of the consumption good and \( H_t \) is the human capital employed. \( x_t(i) \) is the input of the intermediate good of type \( i \) at time \( t \). The number of product varieties is constant and normalized to one.

The final goods sector is competitive and indirect demand for the intermediate good\(^7\) is

\[ p(x) = \alpha \left( \frac{H}{x} \right)^{1-\alpha} \]  

(7)

Demand for the intermediate good is

\[ x(p) = H \left( \frac{\alpha}{p} \right)^{\frac{1}{1-\alpha}} \]  

(8)

\( x \) units of intermediate goods can be produced using \( \frac{x}{A^{1/\alpha}} \) units of capital\(^8\). The profit of the intermediate good producer is

\[ \pi = p(x)x - r \frac{x}{A^{1-\alpha}} = \alpha H^{1-\alpha} x^\alpha - r \frac{x}{A^{1-\alpha}} \]  

(9)

where \( r \) is gross interest.

Profit maximization implies

\[ x = H \alpha \frac{2}{1-\alpha} A^{\frac{1}{1-\alpha}} \left( \frac{1}{r} \right)^{\frac{1}{1-\alpha}} \]  

(10)

Monopolist markups price at

\[ p = \frac{r}{\alpha A^{1-\alpha}} \]  

(11)

The net revenue is

\[ \pi = HA \left( \frac{1}{r} \right)^{\frac{2}{1-\alpha}} \frac{1 - \alpha}{\alpha} A^{\frac{2-\alpha}{1-\alpha}} \]  

(12)

\(^7\)to avoid cumbersome expressions I do not write time subscripts and product indexes unless there is ambiguity.

\(^8\)For more intuitive cost function \( c(x) = \frac{x}{A} \) the main findings are still valid.
Using (6) and (10) we write the final goods output as

\[ Y_t = H \left( \frac{1}{r_t} \right)^{\frac{\alpha}{1-\alpha}} \alpha^{\frac{2\alpha}{1-\alpha}} \int_0^1 A_t(i) di \]  

(13)

Effective wage is

\[ w_t = (1 - \alpha) \left( \frac{1}{r_t} \right)^{\frac{\alpha}{1-\alpha}} \alpha^{\frac{2\alpha}{1-\alpha}} \int_0^1 A_t(i) di \]  

(14)

2.3 Research, development and banking

Justification for the existence of monopolists is the unique product-specific technology \( A_t(i) \) that the intermediate goods producer owns. The monopolistic firm lasts for one period; in the next period \( t + 1 \) a new monopolist having better technology \( A_{t+1}(i) > A_t(i) \) enters the market of intermediate good \( i \) and pushes out of the market the monopolist with obsolete technology \( A_t(i) \).9

Technology can be updated only after conducting research and development. Research and development is characterized by initial cost which is proportional to the current profits \( \pi_t(i) \) in the sector10. If the future monopolist entering the sector \( i \) invests fraction \( \mu_{t+1}(i) \) of \( \pi_t(i) \) in research and development, then the gross growth rate of the product-specific technology is

\[ \frac{A_{t+1}(i)}{A_t(i)} = z_t(i)[1 + \mu_t(i)] \]  

(15)

where \( z_t(i) \) is a realization of the research productivity shock \( Z \) which is i.i.d. across sectors and across time11.

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9I do not consider the possibility of limiting pricing.

10This assumption is useful to avoid complicated dynamics and is similar to Redding (1996) where the research cost is a fixed fraction of the current output. The main difference is that here research cost is divisible.

11There are several restrictions that must be made on the random variable \( Z \) to make the model well-behaved. First we must require that \( Z \leq 1 \) otherwise we will have that a product specific technology (15) improves without research investment when \( \mu = 0 \). This restriction, conversely can cause (15) to drop below one. To avoid the second problem we have to impose a lower bound on \( Z \) such that it will be consistent with the equilibrium behavior of the model. All these problems come from the unusual function of the growth rate in (15) for the more usual function \( \frac{A}{A} = 1 + z\mu, Z > 0 \) is sufficient to guarantee that the model is be-well behaved but to operate with this function analytically is more difficult.
In a period $t$ a monopolistic firm issues shares to finance research and development. The next period’s entire profit goes to the shareholders. Return on a share of the firm $i$ is

$$R_t(i) = \frac{\pi_t(i)}{\mu_t(i)\pi_{t-1}(i)} = z_t(i)\left(1 + \frac{\mu_t(i)}{\mu_t(i)}\right)\left(\frac{r_{t-1}}{r_t}\right)^{\alpha} = z_t(i)\left(1 + \frac{1}{\mu_t(i)}\right)\left(\frac{r_{t-1}}{r_t}\right)^{\alpha}$$

(16)

The expected return on a share in the sector $i$ is

$$E\{R_t(i)\} = E\{Z\} \left(1 + \frac{1}{\mu_t(i)}\right)\left(\frac{r_{t-1}}{r_t}\right)^{\alpha}$$

(17)

In equilibrium the expected return on the shares of every firm will be the same. Therefore $\mu_t(i) = \mu_t$ is the same across sectors. The portfolio of shares is held by the bank, who is the only source of finance for firms. The bank finances only one firm in each sector. The bank’s portfolio of risky assets has the risk-free return equal to

$$r_t = \int_0^1 R_t(i)di = E\{Z\} \left(1 + \frac{1}{\mu_t^2}\right)\left(\frac{r_{t-1}}{r_t}\right)^{\alpha}$$

(18)

Note that the risk-free return equals the expected return on a share in each sector. If $r_t = \text{const}$ (this will be consistent with the steady state of the model), then

$$r = E\{Z\} \left(1 + \frac{1}{\mu}\right)$$

(19)

### 2.4 Equilibrium dynamics and balanced growth path

Because random variable $Z$ is $i.i.d.$ across sectors we can write the following

$$\int_0^1 A_{t+1}(i)di = \int_0^1 z(i)[1 + \mu_{t+1}(i)]A_t(i)di = E\{Z\}[1 + \mu_{t+1}] \int_0^1 A_t(i)di$$

(20)

From (13) we can write the growth rate of the final output

$$g_t = \frac{Y_{t+1}}{Y_t} = E\{Z\}(1 + \mu_{t+1})\left(\frac{r_t}{r_{t+1}}\right)^{\alpha}$$

(21)

Note that the total assets in period $t$, $s_{t+1}$ is divided between production and research sectors. Capital going to the production is $K_{t+1}$ and the capital
going to research is $I_{t+1}$. From our assumption of the cost function $c(x) = \frac{x}{A^{1-\alpha}}$ we have

$$K_{t+1} = \int_0^1 A_{t+1}(i)^{1-\frac{\alpha}{\alpha}} x_{t+1}(i) di = H\alpha^{\frac{2}{1-\alpha}} \left( \frac{1}{r_{t+1}} \right)^{\frac{1}{1-\alpha}} \int_0^1 A_{t+1}(i) di$$

(22)

Capital invested in the improvement of good $i$ is

$$I_{t+1} = \mu_{t+1} \int_0^1 \pi_t(i) di = \mu_{t+1} H \left( \frac{1}{r_t} \right)^{\frac{\alpha}{1-\alpha}} \left( \frac{1 - \alpha}{\alpha} \right) \frac{1}{\alpha} \int_0^1 A_t(i) di$$

(23)

Adding these two expressions and using (20) gives

$$s_{t+1} = \left[ E\{Z\} [1 + \mu_{t+1}] \left( \frac{1}{r_{t+1}} \right)^{\frac{1}{1-\alpha}} + \mu_{t+1} \left( \frac{1}{r_t} \right)^{\frac{\alpha}{1-\alpha}} \frac{1 - \alpha}{\alpha} \right] H\alpha^{\frac{2}{1-\alpha}} \int_0^1 A_t(i) di$$

(24)

From (18) we have

$$r_{t+1} = \left[ E\{Z\} \left( 1 + \frac{1}{\mu_{t+1}} \right) \right]^{1-\alpha} r_t^\alpha$$

(25)

which we can substitute in the previous expression to get

$$s_{t+1} = \left[ \mu_{t+1} \left( \frac{1}{r_t} \right)^{\frac{\alpha}{1-\alpha}} + \mu_{t+1} \left( \frac{1}{r_t} \right)^{\frac{\alpha}{1-\alpha}} \frac{1 - \alpha}{\alpha} \right] H\alpha^{\frac{2}{1-\alpha}} \int_0^1 A_t(i) di$$

(26)

$$s_{t+1} = \mu_{t+1} H\alpha^{\frac{1+\alpha}{1-\alpha}} \left( \frac{1}{r_t} \right)^{\frac{\alpha}{1-\alpha}} \int_0^1 A_t(i) di = \mu_{t+1} \alpha Y_t$$

(27)

We can use this result and the household’s budget constraint (2) to get

$$s_{t+1} = \frac{c_t - \delta s_t}{1 - \frac{1}{\alpha \mu_{t+1}}}$$

(28)

Also note that (27) implies that the growth rate of the savings is

$$\frac{s_{t+2}}{s_{t+1}} = \frac{\mu_{t+2}}{\mu_{t+1}} \frac{Y_{t+1}}{Y_t} = \frac{\mu_{t+2}}{\mu_{t+1}} E\{Z\} (1 + \mu_{t+1}) \left( \frac{r_t}{r_{t+1}} \right)^{\frac{\alpha}{1-\alpha}}$$

(29)
We can use this result in (18) to get
\[
rt+1 = E\{Z\} \left( 1 + \frac{1}{\mu_{t+1}} \right) \frac{s_{t+2} \mu_{t+1}}{s_{t+1} \mu_{t+2}} \frac{1}{E\{Z\}(1 + \mu_{t+1})} \tag{30}
\]
\[
rt+1 = \frac{s_{t+2}}{s_{t+1} \mu_{t+2}} \frac{1}{1 + \mu_{t+1}} \tag{31}
\]
Assuming CRRA utility function
\[
u(c) = \frac{c^{1-\theta} - 1}{1 - \theta} \tag{32}
\]
Euler equation implies that
\[
\left( \frac{ct+1}{ct} \right)^{\theta} = \beta(r_{t+1} - \delta) \tag{33}
\]

**Transformation** Let \(\tilde{c}_t := \frac{c_t}{s_t}, \tilde{s}_{t+1} := \frac{s_{t+1}}{s_t} \) and \(\tilde{y}_t := \frac{Y_t}{s_t}\). Note that because the final goods sector is competitive and is characterized by Cobb-Douglas production technology the following result \(rt s_t = \alpha Y_t\) holds\(^{12}\). Therefore \(\tilde{y}_t = \frac{\alpha}{\delta}\). From (31) we get \(\tilde{s}_{t+1} = rt \mu_{t+1}\). If we divide the household’s budget constraint \(c_t + s_{t+1} = Y_t - \delta s_t\) by \(s_t\) we get
\[
\tilde{c}_t + rt \mu_{t+1} = \frac{r_t}{\alpha} - \delta \tag{34}
\]
or
\[
\mu_{t+1} = \frac{\frac{r_t}{\alpha} - \delta - \tilde{c}_t}{rt} \tag{35}
\]

Note that \(\frac{r_{t+1}}{r_t} = \frac{s_{t+1}}{s_t} = \frac{\tilde{s}_{t+1}}{\tilde{s}_{t+1}} = \frac{s_{t+1} \mu_{t+1}}{s_t} = \frac{\tilde{s}_{t+1} \mu_{t+1}}{\tilde{s}_t} = \tilde{s}_{t+1} rt \mu_{t+1}\) Euler equation (33) gives
\[
\tilde{c}_{t+1} = \tilde{c}_t \left[ \frac{\beta(r_{t+1} - \delta)}{rt \mu_{t+1}} \right] \tag{36}
\]
From (25) we get another equation
\[
rt+1 = \left[ E\{Z\} \left( 1 + \frac{1}{\mu_{t+1}} \right) \right]^{1-\alpha} r_t^{\alpha} = \left[ E\{Z\} \left( 1 + \frac{r_t}{\frac{\alpha}{\alpha} - \delta - \tilde{c}_t} \right) \right]^{1-\alpha} r_t^{\alpha} \tag{37}
\]
\(^{12}\)This result can also be derived from (27) and (31).
We can use it in (36) to obtain
\[
\tilde{c}_{t+1} = \tilde{c}_t \left[ \beta \left( \frac{\beta}{r_t - \delta - \tilde{c}_t} \right)^{1-\alpha} \right]^{1/\gamma}
\] (38)

(37) and (38) characterize the dynamics of the economy. Numerical solutions show that the system exhibits a saddle path stability.

Balanced growth path (BGP) can be found from
\[
\begin{align*}
g^\theta &= \beta(r - \delta) \\
r &= \mathbb{E}\{Z\} \left(1 + \frac{1}{\mu}\right) \\
g &= \mathbb{E}\{Z\}(1 + \mu)
\end{align*}
\] (39)

After some substitutions we arrive at
\[
[E\{Z\}(1 + \mu)]^\theta - \beta \left[ \mathbb{E}\{Z\} - \delta + \frac{\mathbb{E}\{Z\}}{\mu} \right] = 0
\] (40)

LHS is strictly monotonically increasing from $-\infty$ to $\infty$ over $\mu \in (0, \infty)$, so the equation has unique solution $\mu^*$. From it we derive $g^*$, the unique BGP of the economy.

Initialization  To initialize system (37) and (38) at $t = 0$ we need to know households’ assets $s_0$ and the distribution of technology $A_0(i)$ across firms. From these two we can find the initial $r_0$ using the following identity
\[
r_t = \frac{\tilde{s}_{t+1}}{\tilde{\mu}_{t+1}} = \frac{s_{t+1}}{s_t} \frac{1}{\mu_{t+1}} = \frac{\alpha Y_t}{s_t} H \left( \frac{1}{r_t} \right)^{\frac{\alpha}{1-\alpha}} \int_0^1 A_t(i)di
\] (41)

Solving the equation gives
\[
r_t = \left[ \frac{H}{s_t} \int_0^1 A_t(i)di \right]^{1-\alpha} \alpha^{1+\alpha}
\] (42)

2.5 Analysis of the steady state growth rate

In general the growth rate cannot be expressed analytically for any $\theta$ so I will formulate a simple lemma which will be useful to learn the properties of
the BGP in this and in the next sections. We write the following system of
equations

\[
\begin{align*}
g &= f + a\varphi(\mu) \\
r &= d + b\frac{\varphi(\mu)}{\mu} \\
g^\theta &= \beta r
\end{align*}
\]  

(43)

**Lemma.** If \(\varphi(\mu)\) is a continuous increasing function and \(\psi(\mu) = \frac{\varphi(\mu)}{\mu}\) a
decreasing function, then an increase in \(a, b, d\) or in \(f\) will lead to a rise in \(g\).

**Proof:** Inverse of \(\varphi()\) is increasing function \(\varphi^{-1}()\). From the system we have

\[\Phi = g^\theta - \beta d - \beta b\varphi^{-1}\left(\psi\left(\frac{g - f}{a}\right)\right) = 0\]  

(44)

we have that \(\frac{\partial \Phi}{\partial g} > 0, \frac{\partial \Phi}{\partial a} < 0, \frac{\partial \Phi}{\partial b} < 0, \frac{\partial \Phi}{\partial d} < 0\) and \(\frac{\partial \Phi}{\partial f} < 0\). From the implicit function theorem we get \(\frac{dg}{da} > 0, \frac{dg}{db} > 0, \frac{dg}{dd} > 0\) and \(\frac{dg}{df} > 0\).

**Proposition 1.** The growth rate is increasing in \(E\{Z\}\).

**Proof:** The function \(\varphi(\mu) = 1 + \mu\) satisfies conditions for the lemma. If we substitute \(a = b = E\{Z\}\) and \(f = d = 0\) we can say that the growth rate is increasing in \(E\{Z\}\).

### 3 Foreign direct investment in two developed countries

This section models the emergence of multinationals in a symmetric two
country model and compares growth rates of closed and open economies.
To simplify the analysis, assume that \(Z\) can have only two values \(z_l < z_h\).
Assume PDF

\[f_Z(x) = \begin{cases} 
  p & \text{if } x = z_l \\
  1 - p & \text{if } x = z_h
\end{cases}\]  

(45)

The gross return in the closed economy is

\[r = E\{R\} = E\{Z\}\left(1 + \frac{1}{\mu}\right) = [z_lp + z_h(1 - p)]\left(1 + \frac{1}{\mu}\right)\]  

(46)
The growth rate in the closed economy is

\[ g = E\{Z\}(1 + \mu) = [zp + zh(1 - p)](1 + \mu) \tag{47} \]

Consider two similar economies A and B each with the properties described in the previous section. In addition, assume that intermediate good producers can become MNE and set up production both domestically and abroad. There is no additional sunk cost associated with multinational activity; all that is required is to have technology superior to what the foreign firm has.

Consider what happens on the example of one sector. Let the realization of productivity shocks be \( z_A \) and \( z_B \) in countries A and B respectively. If \( z_A = z_B \) both monopolists produce domestically. Otherwise the monopolist having superior technological shock \( \max\{z_A, z_B\} \) becomes MNE, produces in both countries and earns profit \( \pi_A + \pi_B = 2\pi \). The intermediate good producer whose market was invaded by the MNE goes bankrupt and shareholders get zero net return\(^{13}\). What happens in the sector of the country A is summarized in the following table.

<table>
<thead>
<tr>
<th>Event</th>
<th>Probability</th>
<th>( R )</th>
<th>( \frac{A'}{A} )</th>
</tr>
</thead>
<tbody>
<tr>
<td>( Z_A = Z_B = z_l )</td>
<td>( p^2 )</td>
<td>( z_l \left( 1 + \frac{1}{\mu} \right) )</td>
<td>( z_l(1 + \mu) )</td>
</tr>
<tr>
<td>( Z_A = Z_B = z_h )</td>
<td>( (1 - p)^2 )</td>
<td>( z_h \left( 1 + \frac{1}{\mu} \right) )</td>
<td>( z_h(1 + \mu) )</td>
</tr>
<tr>
<td>( Z_A &lt; Z_B = z_h )</td>
<td>( p(1 - p) )</td>
<td>( 1 )</td>
<td>( z_h(1 + \mu) )</td>
</tr>
<tr>
<td>( Z_A &gt; Z_B = z_l )</td>
<td>( (1 - p)p )</td>
<td>( 2z_h \left( 1 + \frac{1}{\mu} \right) )</td>
<td>( z_h(1 + \mu) )</td>
</tr>
</tbody>
</table>

From this table we can express interest rate and growth rate. The gross return in the open economy with FDI is

\[ r = E\{R\} = p - p^2 + [zp^2 + zh(1 - p^2)] \left( 1 + \frac{1}{\mu} \right) \tag{48} \]

The growth rate in the open economy with FDI is

\[ g = E \left\{ \frac{A'}{A} \right\} = [(zp^2 + zh(1 - p^2))(1 + \mu) \tag{49} \]

**Proposition 2.** The open economy with FDI has a higher growth rate than the closed economy.

\(^{13}\)It is assumed that the research cost can be recovered.
Proof: $p - p^2 > 0$, $zp^2 + zh(1 - p^2) > zp + zh(1 - p)$ and $zp^2 + zh(1 - p^2) > zp + zh(1 - p)$. Lemma implies that the BGP in the open economy with FDI is higher than in the closed economy.

4 Foreign direct investment in less developed country

This section considers two asymmetric countries. The first is a large developed country and the second is a small less developed country (LDC). The developed country is large enough\(^{14}\) to be influenced by the process in the LDC and the interest rate $r_N$ in the developed country stays unchanged. I assume that product-specific technologies in every sector of the developed country are significantly higher than in LDC\(^{15}\).

Consider FDI in one sector. If technology in LDC is $A$, to import technology $A_{MNE} > A$ in the next period MNE must incur cost $\xi(A_{MNE} - A)$ where $\xi$ is some positive constant. This can be viewed as the cost of adopting the foreign technology.

MNE can set up a plant and import a better technology to LDC if the discounted profit from the plant is higher or equal to the cost:

$$\frac{\pi}{r_N} \geq \xi(A_{MNE} - A) \quad (50)$$

$$A_{MNE}H\left(\frac{1}{r_N}\right)^{\frac{\alpha}{1-\alpha}} \frac{1 - \alpha}{\alpha} \frac{1}{1 - \alpha} \geq r_N\xi(A_{MNE} - A) \quad (51)$$

If we assume that there are many potential MNEs in the North and there is free entry, then MNE will import the new technology until (51) will hold with equality, from which we will get the growth rate of the product specific technology brought by the MNE:

$$\gamma_{MNE} = \frac{A_{MNE}}{A} = \frac{H\left(\frac{1}{r_N}\right)^\frac{\alpha}{1-\alpha} \frac{1 - \alpha}{\alpha} \frac{1}{1 - \alpha}}{r_N\xi} + 1 \quad (52)$$

\(^{14}\)Alternatively we can assume that there are many symmetric developed countries.

\(^{15}\)As it will be shown this assumption implies that MNE can come in every sector of LDC. If we assume that some sectors have already caught up with developed countries or assume that the entry in some sectors are restricted there will not be BGP until LDC catches up with the developed country in every sector.
This means that the growth rate of the technology brought by the MNE is proportional to the human capital stock of LDC. But the role of human capital doesn’t end here; it determines not only the growth rate of the foreign technology but gives an entry condition for MNE. MNE will not enter LDC if its human capital is so low that it satisfies the following condition

$$\gamma_{MNE} \leq z_l (1 + \mu_{closed})$$  \hspace{1cm} (53)

where $\mu_{closed}$ is a research and development decision in the closed economy. This inequality means MNE does not enters LDC’s market even if a domestic firm experiences the lowest shock. This inequality determines the threshold level of the human capital $H_{entry}$ below which the country is not attractive for MNE.

If the country possesses human capital greater than $H_{entry}$ the MNE may enter the domestic market, which affects research and development decision $\mu$. It will be lower than $\mu_{closed}$ because the expected profits of the domestic firm are lower when there is the threat that MNE may enter the domestic market.

I assume that if the domestic firm has the highest shock, MNE cannot enter and the following always holds

$$\gamma_{MNE} \leq z_h (1 + \mu)$$  \hspace{1cm} (54)

This may seem an artificial assumption when we have a binary distribution, but when we have many mass points or continuum distribution one can always argue that there is some probability of very high shock. If this assumption does not hold then domestic firms will never do research and never produce anything (except for final goods sector). This implies that there is no saving technology for LDC and households cannot attain intratemporal optimization. The assumption guarantees that this never happens.

What happens in the sector of the host country is summarized in the following table.

<table>
<thead>
<tr>
<th>Event</th>
<th>Probability</th>
<th>$R$</th>
<th>$\frac{A'}{A}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$Z = z_l$</td>
<td>$p$</td>
<td>$1$</td>
<td>$\gamma_{MNE}$</td>
</tr>
<tr>
<td>$Z = z_h$</td>
<td>$1 - p$</td>
<td>$z_h \left(1 + \frac{1}{\mu}\right)$</td>
<td>$z_h (1 + \mu)$</td>
</tr>
</tbody>
</table>

The gross return rate in the LDC is

$$r = E\{R\} = p + (1 - p)z_h \left(1 + \frac{1}{\mu}\right)$$  \hspace{1cm} (55)
The growth rate in the LDC is

\[ g = E \left\{ \frac{A'}{A} \right\} = p\gamma_{MNE} + (1 - p)z_h(1 + \mu) \quad (56) \]

If we use the lemma to compare these two equations with (46) and (47) it is ambiguous whether opening the economy for MNE will have the positive effect on the economic growth of LDC. What we can say for sure is that after MNE is established, the growth rate increases when the rate at which MNE brings technology \( \gamma_{MNE} \) increases (This result follows from the lemma). This combined with (52) implies that the growth rate increases with the human capital of the country. Note that in the closed economy the human capital does not affect the growth rate of the economy.

Let’s see what happens to the growth rate when the economy moves from closed to open. Suppose that human capital is at the level that just satisfies an entry condition (54) with equality. This implies that if \( \mu \) stays the same then (56) is equal to (47) but (55) is smaller then (46). To satisfy the Euler equation \( g^\theta = \beta(r - \delta) \) in the equilibrium \( \mu \) decreases and the following inequality holds \( \mu < \mu_{closed} \). This raises the interest rate \( r \) but decreases the growth rate \( g \). Therefore we get the result that if the human capital stock is just above the threshold where MNE decides to enter \( H_{entry} \) the BGP in the LDC will drop discontinuously to the lower level.

After this drop any increase in human capital will be growth promoting and eventually the BGP of the open economy can exceed the BGP of the closed economy. This determines another threshold level of human capital \( H_{growth} \) after which the opening benefits the growth rate of LDC. Figure 1 summarizes the relation between human capital stock and BGP of the less developed economy.

5 Concluding remarks

This paper developed a theoretical model of economic growth with multinational enterprises. The work was inspired by empirical studies that find a significant relationship between economic growth, FDI and human capital of the recipient country. The results imply that there are two threshold levels of human capital. The first lower threshold can explain the concentration of FDI flows. The second higher threshold can explain why in some countries FDI does not have growth promoting effect.
The paper considered two types of FDI flows: one between the developed and less developed economy where vertical integration persists and the other between two symmetric developed economies where horizontal integration takes place. The two models stand very close to each other. The main difference is the assumption that the developed country has higher human capital than the less developed country, it is not specified how human capital is affected by economic growth. If we specify this relationship, the two models can be unified. While specification of such relationships is not a problem,\textsuperscript{16} analyzing the model becomes more complicated. We will not have BGP for the less developed economy even if we maintain an assumption that it is very small. This unbalanced growth will be maintained until LDC catches up with frontier technologies of the developed country.

The model can be extended by incorporating more complicated industrial structures. For example, we can allow monopolistic competition between intermediate goods producers. The paper assumes that FDI is the only way to transfer the technology across countries but other ways of technology transfer are not ruled out.

\textsuperscript{16}The easiest way is to assume learning by doing $H_t = \int_0^1 A_t(i)di$, note that it will double the growth rate of the closed economy.

Figure 1: Dependence of the growth rate on human capital
diffusions can be incorporated\(^\text{17}\). Although the model is not particularly suited to study trade patterns, nevertheless we can incorporate trade in the model.

References


Baldwin, R. E., 1999, Two waves of globalisation: Superficial similarities, fundamental differences, NBER working paper 6904.


\(^{17}\)The preliminary derivations that are not presented in this paper suggest that in some cases FDI has much stronger positive effect on growth then costless transfer of technology across countries.


