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Huu Thanh Tam Nguyen*, Manh Hung Nguyen†, Aditya Goenka‡

Abstract

This paper investigates the effect of foreign direct investment (FDI) on the welfare of the host country through the process of corporate tax rate determination. Based on a theoretical model that allows for the entry of heterogenous multinational firms, we show that the impact of FDI on government revenue will depend on the competition effect and the technological spillovers. We argue that the competition effect reduces production of domestic firms and thereby lowers the level of corporate tax revenue while the technological spillovers can have positive or negative welfare effects depending on the absorptive capacity of local firms. The degree to which FDI contribute to government revenue in the host country depends also on the demand creation effect and technological transfer cost.

Keywords: FDI, corporate tax revenue.

Codes JEL: F15, F23

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1 Introduction

While FDI is widely considered to be beneficial for the host country because this investment is thought to provide new growth opportunities, there is a concern that a high net inflows of FDI may decline the welfare of a developing country where a sufficient absorptive capability of the advanced technologies is not available. The reason is that the welfare of the host country depends on the impact of FDI on corporate tax revenue and labour income generated by the investment. The purpose of this paper is to investigate the degree to which FDI contributes to corporate tax revenue in the host via the rates of corporate income taxes and others important factors as competition effect, demand creation effect, technological transfer cost and technological spillovers.

The entry of multinational firms (MNFs) could lead to two opposing impacts on the development of the host country. On the one hand, MNFs are seen as catalyst of development by promoting industrial development (Markusen and Venables, 1999), creating backward linkages with the rest of the host economy (Lin and Saggi, 2005, 2007; Nguyen and Minda, 2012), generating positive technological spillovers (Blomstrom and Persson, 1983; Kokko, 1996; Zhou et al, 2002; Sinani and Meyer, 2004). On the other hand, these firms may hurt the development of the host country by lowering the production of domestic firms (Nguyen et al., 2010), reducing total factor productivity (Haddad and Harrison, 1993; Barrios and Strobl, 2002) or crowding out domestic investment (Boreinszten et al., 1996).

The purpose of this paper is to examine how foreign direct investment (FDI) affect the level of corporate tax revenue by developing a simple model that considers the impacts of a entry of MNFs. We argue that these MNFs transfers technology to the host country and create technological spillovers. Furthermore, they also generate linkages with the rest of the host economy by using the inputs produced locally. In the model, there are two types of industries, a supporting industry producing inputs and a final industry producing final goods. The production of final goods by domestic firms and MNFs requires some inputs that are produced by local suppliers (supporting firms). The degree of corporate tax revenue is determined by tax on final goods and that on inputs. The model contrasts the market equilibrium under the autarkic economy and that under the FDI economy

where MNFs start to produce in the host country.

In comparison to the autarkic economy, the entry of MNFs in the final industry has two kinds of impacts. First, such entry affects the production of domestic firms via competition effect and technological spillovers (called also intra-industrial effects). The competition effect reduces production of domestic firms and thereby, lowers the degree of corporate tax revenue while the technological spillovers could be positive and negative. Secondly, MNFs create inter-industrial effects including two opposite effects. On the one hand, by lowering the production of domestic firms in the final industry relative to the autarkic economy, MNFs shrink the degree of backward linkages and hence, reduce the level of corporate tax revenue (competition effect). On the other hand, these firms generate backward linkages by sourcing local inputs and thereby enhance corporate tax revenue.

The remainder of the paper is organized as follows. The next section presents the model while section 3 analyzes different impacts of FDI on corporate tax revenue. Section 4 concludes.

2 The model

In the following, we develop a model of corporate taxation with heterogenous multinational firms in an open economy in order to explain the impacts of FDI to government revenue on the host country.

We consider a host developing country having two types of industries, a supporting industry A and a final industry B . The supporting industry produces intermediate goods (inputs) which will supply the final industry while the final industry produces final goods in order to serve final consumers. Otherwise, by assumption, foreign firms (also called multinational firms - MNFs, or m and denoted by $f = 1\dots$), if there are any, could only enter in the final industry B .

There are some domestic firms (also called national firms, or d and denoted by $j = 1\dots$) which produce final good. These firms and foreign competitors (if there are any) choose their output level in a Cournot fashion. In other words, each firm determines its output by taking as given the output levels of its rivals. At a given date t , the inverse demand

function in final industry is given by:

$$p_t^B = S_t^B - Q_t^B \quad (1)$$

where p_t^B , S_t^B and Q_t^B are the price, the market size and the total consumption of final goods, respectively, at the moment t .

Like Lin and Saggi (2005) and Nguyen et al. (2010), we assume that the production of final goods needs inputs supplied by the supporting industry A and labor. For each unit of final good produced, domestic firms required γ^B units of inputs and multinational firms need γ^e units of input. The units of labor required to transfer inputs into final goods are not identical. Therefore, the corresponding marginal labor cost is not similar. At a given date t , denoted $c_{j,t}^B$ and $c_{f,t}^B$, the marginal labor cost of a given domestic firm j and that of a given foreign firm f .

In the supporting industry, there are some domestic suppliers (also called supporting firms, or a and denoted by $i = 1\dots$). For producing one unit of input, a given supporting firm i needs λ_i units of labor and the corresponding marginal cost at a given date t is denoted by $c_{i,t}^A$.

On the other hand, the government applies a tax on products. At a given time t , the unit tax in the final industry and the supporting industry is fixed by τ_t^A and τ_t^B , respectively. Then, the level of corporate tax revenue (CTR) at time t is given by

$$CTR_t = \tau_t^B Q_t^B + \tau_t^A Q_t^A \quad (2)$$

where Q_t^B and Q_t^A represent the total consumption of final goods and that of inputs at time t , respectively.

To establish a benchmark for our analysis, the model has two stages. At the date t_0 (an autarkic economy), there has not been any foreign firm who invests in the final industry. Foreign firms begin to invest in this country after the date t_1 (a FDI economy). We will determine whenever these entries have some influences on the degree of corporate tax revenue.

2.1 Autarkic economy

Under the autarkic economy, we assume that the corporate tax is high. Therefore, there has not been any foreign firm located in the host country. Then, domestic firms compete

with each other buying inputs from domestic supporting firms. Let denote n_0^B be the number of domestic firms in the industry B . Hence, the inverse demand function (1) in the economy is given by:

$$p_0^B = S_0^B - \sum_{j=1}^{n_0^B} q_{j,0}^B \quad (3)$$

where $q_{j,0}^B$ represents the output level produced by a given domestic firm j , $j = 1 \dots n_0^B$ and $\sum_{j=1}^{n_0^B} q_{j,0}^B$ indicates the aggregate output of all domestic firms.

Let denote p_0^A be the price of inputs under the autarkic economy. Taking this price as given, the maximization program of a typical domestic firm, d , is determined by

$$\max_{q_{j,0}^B} \Pi_{j,0}^B = p_0^B q_{j,0}^B - (c_i^B + \gamma^B p_0^A + \tau_0^B) q_{j,0}^B$$

The first-order condition for this problem is given by

$$p_0^B + \frac{\partial p_0^B}{\partial q_{j,0}^B} q_{j,0}^B - (c_i^B + \gamma^B p_0^A + \tau_0^B) = 0 \quad (4)$$

Using the linear demand function specified in equation (3), we have the Cournot-Nash equilibrium in the final industry under the autarkic economy

$$q_{j,0}^B = \frac{S_0^B + \sum_{h=1}^{n_0^B} (c_{h,0}^B + \gamma^B p_0^A + \tau_0^B) - (n_0^B + 1) (c_{j,0}^B + \gamma^B p_0^A + \tau_0^B)}{1 + n_0^B} \quad (5)$$

Summing the above equation, the price of input in this economy is determined by

$$p_0^A = \frac{\sum_{j=1}^{n_0^B} [S_0^B - (c_{j,0}^B + \tau_0^B)]}{\gamma^B n_0^B} - \frac{(1 + n_0^B)}{\gamma^B n_0^B} \sum_{j=1}^{n_0^B} q_{j,0}^B \quad (6)$$

Under the autarkic economy, inputs are only required by domestic firms. Therefore, if n_0^A is the number of domestic suppliers in the industry A , backward linkages are linked by

$$\sum_{i=1}^{n_0^A} q_{i,0}^A = \gamma^B \sum_{j=1}^{n_0^B} q_{j,0}^B$$

where $q_{i,0}^A$ presents the input level produced by a given supporting firms i , $i = 1 \dots n_0^A$.

Using equation (6), the linear inverse demand function for inputs is given by

$$p_0^A = \frac{\sum_{j=1}^{n_0^B} [S_0^B - (c_j^B + \tau_0^B)]}{\gamma^B n_0^B} - \frac{(1 + n_0^B)}{(\gamma^B)^2 n_0^B} \sum_{i=1}^{n_0^A} q_{i,0}^A \quad (7)$$

Like the final industry, a typical supporting firm, a , competes with its domestic rivals in a Cournot fashion. Hence, this firm chooses its input level $q_{i,0}^A$ to maximize its profit

$$\max_{q_{i,0}^A} \Pi_{i,0}^A = p_0^A q_{i,0}^A - (c_i^A + \tau_0^A) q_{i,0}^A$$

The first-order condition for this problem is given by

$$p_0^A + \frac{\partial p_0^A}{\partial q_{i,0}^A} q_{i,0}^A - (c_i^A + \tau_0^A) = 0 \quad (8)$$

Using the above equation and the linear demand function for inputs given in equation (13), the equilibrium output of a typical domestic supplier equals

$$q_{j,0}^A = \frac{\gamma \sum_{j=1}^{n_0^B} [S_0^B - (c_{j,0}^B + \tau_0^B)] + (\gamma^B)^2 n_0^B \sum_{h=1}^{n_0^A} (c_{h,0}^A + \tau_0^A)}{(1 + n_0^A)(1 + n_0^B)} - \frac{(\gamma^B)^2 n_0^B (n_0^A + 1) (c_{i,0}^A + \tau_0^A)}{(1 + n_0^A)(1 + n_0^B)} \quad (9)$$

and the price of inputs in equation (7) becomes

$$p_0^A = \frac{\sum_{j=1}^{n_0^B} [S_0^B - (c_{j,0}^B + \tau_0^B)] + \gamma^B n_0^B \sum_{i=1}^{n_0^A} (c_{i,0}^A + \tau_0^A)}{\gamma^B n_0^B (1 + n_0^A)} \quad (10)$$

Using the price of inputs given in the above equation, the total level of final goods and that of inputs consumed in this economy is determined by

$$\begin{aligned} \sum_{i=1}^{n_0^A} q_{i,0}^A &= \gamma^B \frac{n_0^A \sum_{j=1}^{n_0^B} [S_0^B - (c_{j,0}^B + \tau_0^B)] - \gamma^B n_0^B \sum_{i=1}^{n_0^A} (c_{i,0}^A + \tau_0^A)}{(1 + n_0^A)(1 + n_0^B)} \\ \sum_{j=1}^{n_0^B} q_{j,0}^B &= \frac{n_0^A \sum_{j=1}^{n_0^B} [S_0^B - (c_{j,0}^B + \tau_0^B)] - \gamma^B n_0^B \sum_{i=1}^{n_0^A} (c_{i,0}^A + \tau_0^A)}{(1 + n_0^A)(1 + n_0^B)} \end{aligned} \quad (11)$$

Hence, given equation (2), the degree of corporate tax revenue under the autarkic economy is determined by

$$\begin{aligned} CTR_0 &= \tau_0^B \sum_{j=1}^{n_0^B} q_{j,0}^B + \tau_0^A \sum_{i=1}^{n_0^A} q_{i,0}^A \\ &= (\tau_0^B + \gamma^B \tau_0^A) \frac{n_0^A \sum_{j=1}^{n_0^B} (S_0^B - c_{j,0}^B - \tau_0^B) - \gamma^B n_0^B \sum_{i=1}^{n_0^A} (c_{i,0}^A + \tau_0^A)}{(1 + n_0^B)(1 + n_0^A)} \end{aligned} \quad (12)$$

Remark 1 *The level of corporate tax revenue under the autarkic economy increases in the market size (S_0^B) while it decreases in a typical supplier' labor marginal cost (c_i^A) as well as in a typical domestic firm' labor marginal cost (c_j^B).*

Remark 2 From equation (12), we also note that the degree of corporate tax revenue under the autarkic economy is not a monotonic function in tax on products. It is an increasing function in tax on final good and in tax on input when those ones do not reach a critical threshold ($\tau_0^B < \tau_0^{B*}$ and $\tau_0^A < \tau_0^{A*}$) while it becomes a decreasing function whenever taxes are high enough ($\tau_0^B > \tau_0^{B*}$ and $\tau_0^A > \tau_0^{A*}$) where

$$\begin{aligned}\tau_0^{B*} &= \frac{n_0^A \sum_{j=1}^{n_0^B} (S_0^B - c_{j,0}^B) - \gamma^B n_0^B \sum_{i=0}^{n_0^A} c_{i,0}^A}{2n_0^A n_0^B} - \gamma^B \tau_0^A \\ \tau_0^{A*} &= \frac{n_0^A \sum_{j=1}^{n_0^B} (S_0^B - c_{j,0}^B) - \gamma^B n_0^B \sum_{i=0}^{n_0^A} c_{i,0}^A}{2\gamma^B n_0^A n_0^B} - \frac{\tau_0^B}{\gamma^B}\end{aligned}\quad (13)$$

Solving the above equations, the optimal tax on final goods (τ_0^{B*}) and the optimal tax on inputs (τ_0^{A*}) in this economy (that allows a maximal level of corporate tax revenue) are determined by

$$\tau_0^{B*} + \gamma^B \tau_0^{A*} = \frac{n_0^A \sum_{j=1}^{n_0^B} (S_0^B - c_j^B) - \gamma^B n_0^B \sum_{i=0}^{n_0^A} c_{i,0}^A}{2n_0^A n_0^B} \quad (14)$$

Applying the above optimal taxes in the final and the supporting industries, the optimal level of corporate tax revenue can be written as

$$CTR_0^* = \frac{\left[n_0^A \sum_{j=1}^{n_0^B} (S_0^B - c_j^B) - \gamma^B n_0^B \sum_{i=0}^{n_0^A} c_{i,0}^A \right]^2}{4n_0^A n_0^B (1 + n_0^B) (1 + n_0^A)} \quad (15)$$

Remark 3 Using the optimal taxes, the level of corporate tax revenue under the autarkic economy becomes an increasing function in a typical supplier' labor marginal cost (c_i^A) as well as in a typical domestic firm' labor marginal cost (c_j^B).

In what follows, we are next interested in the market competition under the FDI economy where some foreign firms entry into the host country.

2.2 FDI economy

In order to attract the location of FDI, the government of the host country decides to decrease the corporate tax from τ_0^B to τ_1^B in the final industry ($\tau_0^B > \tau_1^B$). Thanks to this policy, under the FDI economy, some foreign firms whose the headquarter is located in some home developed countries may enter into the final industry. The number of entry is

given by n_1^e . As Saggi and Lin (2005, 2007) mentioned, we suppose that while producing the final goods in the host country, these foreign firms use inputs locally produced. On the other hand, as Nguyen et al. (2010) and Nguyen and Minda (2012) underlined, we assume that the entry of MNFs may have an influence on domestic firms. Some of them will exit to the industry while some new domestic firms will entry. Denoted n_1^B , the final number of domestic firms under the FDI economy. Therefore, if $n_1^B > n_1^0$ then there is a net entry of domestic firms and *vice versa*. The linear demand function for final goods given in equation (1) becomes

$$p_1^B = S_1^B - \sum_{j=1}^{n_1^B} q_{j,1}^B - \sum_{f=1}^{n_1^e} q_{f,1}^B \quad (16)$$

where $q_{j,1}^B$ and $q_{f,1}^B$ represent, respectively, the output level produced by a given domestic firm j , $j = 1 \dots n_1^B$ and that of a given foreign firm f , $f = 1 \dots n_1^e$. $\sum_{j=1}^{n_1^B} q_{j,1}^B$ and $\sum_{f=1}^{n_1^e} q_{f,1}^B$ indicate, respectively, the aggregate output of all domestic firms and that of all foreign firms.

While producing in a host country less developed than their home country, we assume that foreign firms will transfer their technology to the production affiliate (Minda and Nguyen, 2012). For a typical MNF, m , the unit cost of this transfer is denoted by g_f . Otherwise, the transfer leads some technological spillovers to domestic firms. As Meyer and Sinani (2009), these spillovers could be positive or negative depending upon the development level of the host country. Let denote θ_j be the degree of technological spillovers for each unit of final good produced by a typical domestic firm, d . Then, when $\theta_j > 0$, a typical domestic firm gains from technological transfer while whenever $\theta_j < 0$, it losses from this transfer.

Let denote p_1^A be the price of inputs under the FDI economy. Hence, the unit production costs of a typical firm are summarized in table 1 below.

Table 1: **Production costs under the FDI economy**

	Labor cost	Price of inputs	Transfer cost	Tech. Spillovers	Corporate tax
Domestic firm j	$c_{j,1}^B$	$\gamma^B p_1^A$	-	θ_j	τ_1^B
Supporting firm i	$c_{i,1}^A$	-	-	-	τ_1^A
Foreign firm f	$c_{f,1}^B$	$\gamma^e p_1^A$	g_f	-	τ_1^B

Considering the price of inputs (p_1^A) and the output levels of its competitor as given, a typical domestic firm, d , and a typical MNF, m , choose their production levels in order to maximize their profit. The maximization program is given by

$$\begin{aligned}\max_{q_{j,1}^B} \Pi_{j,1}^B &= p_1^B q_{j,1}^B - (c_{j,1}^B + \gamma^B p_1^A - \theta_j + \tau_1^B) q_{j,1}^B \\ \max_{q_{f,1}^B} \Pi_{f,1}^B &= p_1^B q_{f,1}^B - (c_{f,1}^B + \gamma^e p_1^A + g_f + \tau_1^B) q_{f,1}^B\end{aligned}$$

The first-order conditions for the problem are written as

$$\begin{aligned}p_1^B + \frac{\partial p_1^B}{\partial q_{j,1}^B} q_{j,1}^B - (c_{j,1}^B + \gamma^B p_1^A - \theta_j + \tau_1^B) &= 0 \\ p_1^B + \frac{\partial p_1^B}{\partial q_{f,1}^B} q_{f,1}^B - (c_{f,1}^B + \gamma^e p_1^A + g_f + \tau_1^B) &= 0\end{aligned}\tag{17}$$

Solving the above equations, the output level of a typical MNF equals

$$q_{f,1}^B = \Psi_{f,1}^B - \gamma^e p_1^A - \tau_1^B - \sum_{h=1}^{n_1^B} q_{h,1}^B - \sum_{h=1}^{n_1^e} q_{h,1}^B\tag{18}$$

while that of a typical domestic firm equals

$$q_{j,1}^B = \Psi_{j,1}^B - \gamma^B p_1^A - \tau_1^B - \sum_{h=1}^{n_1^B} q_{h,1}^B - \sum_{h=1}^{n_1^e} q_{h,1}^B\tag{19}$$

where $\sum_{h=1}^{n_1^B} q_{h,1}^B$ and $\sum_{h=1}^{n_1^e} q_{h,1}^B$ indicate the total level of final goods produced by all domestic firms and those of MNFs, respectively, and

$$\begin{aligned}\Psi_{f,1}^B &= S_1^B - (c_{f,1}^B + g_f) \\ \Psi_{j,1}^B &= S_1^B - (c_{j,1}^B - \theta_j) \\ \sum_{h=1}^{n_1^B} q_{h,1}^B &= \frac{(1 + n_1^e) \sum_{j=1}^{n_1^B} [S_1^B - (c_{j,1}^B + \gamma^B p_1^A - \theta_j + \tau_1^B)]}{1 + n_1^B + n_1^e} \\ &\quad - \frac{n_1^B \sum_{f=1}^{n_1^e} [S_1^B - (c_{f,1}^B + \gamma^e p_1^A + g_f + \tau_1^B)]}{1 + n_1^B + n_1^e} \\ \sum_{h=1}^{n_1^e} q_{h,1}^B &= \frac{(1 + n_1^B) \sum_{f=1}^{n_1^e} [S_1^B - (c_{f,1}^B + \gamma^e p_1^A + g_f + \tau_1^B)]}{1 + n_1^B + n_1^e} \\ &\quad - \frac{n_1^e \sum_{j=1}^{n_1^B} [S_1^B - (c_{j,1}^B + \gamma^B p_1^A - \theta_j + \tau_1^B)]}{1 + n_1^B + n_1^e}\end{aligned}$$

Under the FDI economy, inputs are required both by domestic firms and MNFs. Hence, the derived demand for inputs is given by

$$\begin{aligned}
Q_1^A &= \gamma^B \sum_{j=1}^{n_1^B} q_{j,1}^B + \gamma^e \sum_{f=1}^{n_1^e} q_{f,1}^B \\
&= \gamma^B \frac{(1 + n_1^e) \sum_{j=1}^{n_1^B} (\Psi_{j,1}^B - \gamma^B p_1^A - \tau_1^B) - n_1^B \sum_{f=1}^{n_1^e} (\Psi_{f,1}^B - \gamma^e p_1^A - \tau_1^B)}{1 + n_1^B + n_1^e} \\
&\quad + \gamma^e \frac{(1 + n_1^B) \sum_{f=1}^{n_1^e} (\Psi_{f,1}^B - \gamma^e p_1^A - \tau_1^B) - n_1^e \sum_{j=1}^{n_1^B} (\Psi_{j,1}^B - \gamma^B p_1^A - \tau_1^B)}{1 + n_1^B + n_1^e}
\end{aligned} \tag{20}$$

where Q_1^A is the total demand for inputs under the FDI economy.

We consider that due to change in demand for inputs, the number of supporting firms also changes. Let n_1^A be the final number of domestic suppliers in the supporting industry. So whenever $n_1^A > n_1^0$, there is a net entry of suppliers into the industry and *vice versa*. Let denote $q_{i,1}^A$, $i = 1 \dots n_1^A$, be the production level of a typical supplier, a , we have

$$Q_1^A = \sum_{i=1}^{n_1^A} q_{i,1}^A$$

To ease exposition, for the rest of the paper, assume that $\gamma^B = \gamma^e = \gamma$. That means for each unit of final goods produced, a typical MNF, m , and a typical domestic firm, d , use the same quantity of inputs. Then, using equation (20), the linear demand function for inputs can be written as

$$p_1^A = \frac{\sum_{j=1}^{n_1^B} (\Psi_{j,1}^B - \tau_1^B) + \sum_{f=1}^{n_1^e} (\Psi_{f,1}^B - \tau_1^B)}{\gamma (n_1^B + n_1^e)} - \frac{1 + n_1^B + n_1^e}{\gamma^2 (n_1^B + n_1^e)} \sum_{i=1}^{n_1^A} q_{i,1}^A \tag{21}$$

Given the linear demand function for inputs in the above equation and the output level of its competitors, a typical supplier, s , maximizes its profit in a Cournot fashion. The maximization program is written as

$$\max_{q_{i,t}^A} = p_1^A q_{i,1}^A - (c_{i,1}^A + \tau_1^A) q_{i,1}^A$$

The first-order condition for the problem is determined by

$$p_1^A + \frac{\partial p_1^A}{\partial q_{i,1}^A} q_{i,1}^A - (c_{i,1}^A + \tau_1^A) = 0 \tag{22}$$

Solving the above equation by taking into account equation (21), the output level of a typical domestic suppliers at the equilibrium equals

$$q_{i,1}^A = \frac{\sum_{j=1}^{n_1^B} (\Psi_{j,1}^B - \tau_1^B) + \sum_{f=1}^{n_1^e} (\Psi_{f,1}^B - \tau_1^B)}{\gamma (n_1^B + n_1^e)} - (c_{i,1}^A + \tau_1^A) - \sum_{h=1}^{n_1^A} q_{h,1}^A \quad (23)$$

where $\sum_{h=1}^{n_1^A} q_{h,1}^A$ represents the total level of inputs consumed under the FDI economy, and

$$\sum_{h=1}^{n_1^A} q_{h,1}^A = \frac{\gamma n_1^A \left[\sum_{j=1}^{n_1^B} (\Psi_{j,1}^B - \tau_1^B) + \sum_{f=1}^{n_1^e} (\Psi_{f,1}^B - \tau_1^B) \right] - \gamma^2 (n_1^B + n_1^e) \sum_{h=1}^{n_1^A} (c_{h,1}^A + \tau_1^A)}{(1 + n_1^B + n_1^e) (1 + n_1^A)}$$

Hence, the price of input described in equation (21) can be written as

$$p_1^A = \frac{\sum_{j=1}^{n_1^B} (\Psi_{j,1}^B - \tau_1^B) + \sum_{f=1}^{n_1^e} (\Psi_{f,1}^B - \tau_1^B) + \gamma (n_1^B + n_1^e) \sum_{i=1}^{n_1^A} (c_{i,1}^A + \tau_1^A)}{\gamma (n_1^B + n_1^e) (1 + n_1^A)}$$

As before, the degree of corporate tax revenue under the FDI economy is defined by

$$\begin{aligned} CTR_1 &= \tau_1^B \left(\sum_{j=1}^{n_1^B} q_{j,1}^B + \sum_{f=1}^{n_1^e} q_{f,1}^e \right) + \tau_1^A \sum_{i=1}^{n_1^A} q_{i,1}^A \quad (24) \\ &= (\tau_1^B + \gamma \tau_1^A) \frac{n_1^A \left[\sum_{j=1}^{n_1^B} (\Psi_{j,1}^B - \tau_1^B) + \sum_{f=1}^{n_1^e} (\Psi_{f,1}^B - \tau_1^B) \right]}{(1 + n_1^B + n_1^e) (1 + n_1^A)} \\ &\quad - (\tau_1^B + \gamma \tau_1^A) \frac{\gamma (n_1^B + n_1^e) \sum_{i=1}^{n_1^A} (c_{i,1}^A + \tau_1^A)}{(1 + n_1^B + n_1^e) (1 + n_1^A)} \end{aligned}$$

Remark 4 *The degree of corporate tax revenue under the FDI economy increases in the unit technological transfer cost (g_f) of a typical MNF. Otherwise, the technological spillovers to a typical domestic firms (θ_j) has an ambiguous influence on this degree. It is a decreasing function when $\theta_j < 0$ and it becomes an increasing function when $\theta_j > 0$.*

As Minda and Nguyen (2012) underline, the technological transfer cost may be represented as the development gap between the home country of a typical MNF and the host country. Therefore, the more host country is less developed than the home one, the less local government could benefit from the entry of MNFs into the host country to enhance its budget revenue. Otherwise, since the sign of the technological spillovers enjoyed by a typical domestic firm (θ_j) is not determined, the net impacts of technological spillovers ($\sum_{j=1}^{n_1^B} \theta_j$) on the level of corporate tax revenue is unclear.

Remark 5 *The level of corporate tax revenue under the FDI economy is not a monotonic function in the taxes on products. It increases in tax on final goods and that in tax on inputs when those ones do not reach a critical threshold ($\tau_1^B < \tau_1^{B*}$ and $\tau_1^A < \tau_1^{A*}$) while it decreases in those taxes whenever they are high enough ($\tau_1^B > \tau_1^{B*}$ and $\tau_1^A > \tau_1^{A*}$) where*

$$\begin{aligned}\tau_1^{B*} &= \frac{n_1^A \left(\sum_{j=1}^{n_1^B} \Psi_{j,1}^B + \sum_{f=1}^{n_1^e} \Psi_{f,1}^B \right) - \gamma (n_1^B + n_1^e) \sum_{i=1}^{n_1^A} c_{i,1}^A}{2 (n_1^B + n_1^e) n_1^A} - \gamma \tau_1^A \\ \tau_1^{A*} &= \frac{n_1^A \left(\sum_{j=1}^{n_1^B} \Psi_{j,1}^B + \sum_{f=1}^{n_1^e} \Psi_{f,1}^B \right) - \gamma (n_1^B + n_1^e) \sum_{i=1}^{n_1^A} c_{i,1}^A}{2\gamma (n_1^B + n_1^e) n_1^A} - \frac{\tau_1^B}{\gamma}\end{aligned}\quad (25)$$

Solving equation (25), the optimal tax on final good and that on input under the FDI economy are defined by

$$\tau_1^{B*} + \gamma \tau_1^{A*} = \frac{n_1^A \left(\sum_{j=1}^{n_1^B} \Psi_{j,1}^B + \sum_{f=1}^{n_1^e} \Psi_{f,1}^B \right) - \gamma (n_1^B + n_1^e) \sum_{i=1}^{n_1^A} c_{i,1}^A}{2 (n_1^B + n_1^e) n_1^A}$$

Using the above optimal taxes, the maximal degree of corporate tax revenue is given by

$$CTR_1^* = \frac{\left[n_1^A \left(\sum_{j=1}^{n_1^B} \Psi_{j,1}^B + \sum_{f=1}^{n_1^e} \Psi_{f,1}^B \right) - \gamma (n_1^B + n_1^e) \sum_{i=1}^{n_1^A} c_{i,1}^A \right]^2}{2 (n_1^B + n_1^e) n_1^A (1 + n_1^B + n_1^e) (1 + n_1^A)} \quad (26)$$

Remark 6 *Applying the optimal taxes, the level of corporate tax revenue under the FDI economy becomes an increasing function in the unit technological transfer cost (g_f) of a typical MNF.*

In the following section, we examine how the entry of MNFs influences the degree of corporate tax revenue in the host country.

3 Impacts of FDI on government revenue

Relative to the autarkic economy, the entry of MNFs into the host country under the FDI economy may have some conflicting impacts on the final industry as well as on the supporting industry (Nguyen, 2011). Therefore, the net impact of FDI on the level of corporate tax revenue is ambiguous.

Regarding to the final industry, such entry lowers the production of domestic firms or leads to a net exit of them, due to a competition effect (Markusen et Venables, 1999;

Nguyen et al., 2010). MNFs also create technological spillovers (θ_j) and whenever they are positive ($\theta_j > 0$), these firms have a positive effect on the output level of the corresponding typical domestic firm. Otherwise, positive technological spillovers, shrinking the unit production cost, may allow a net entry of domestic firms in the industry.

As for the supporting industry, FDI decrease the demand for inputs, that leads a net exit of suppliers or a fewer production of each them, because the output level of a typical domestic firm falls relative to the autarkic economy or there is a net exit of those firms. On the other hand, MNFs also source inputs locally, thereby creating supplemental demand for inputs (Rodriguez-Clare, 1996; Lin and Saggi, 2005). That is a direct demand creation. Furthermore, MNFs also generate an indirect demand for inputs by rising the output level of a typical domestic firm or by driving a net entry of domestic firms (Nguyen and Minda, 2012). Demand creation effect could allow a net entry of suppliers or a higher production level of a typical supplier.

Taking into account all above effects, FDI affects the degree of corporate tax revenue through the competition effect, the technological spillovers and the demand creation effect. The competition effect lowers the degree of corporate tax revenue while it increases in the demand creation effect and the technological spillovers affect it uncertainly. We explore below the conditions under which MNFs create a net positive effect on the degree of corporate tax revenue as well as the conditions under which the net effect becomes negative.

3.1 The one-firm economy

Like Lin and Saggi (2005, 2007) and Minda and Nguyen (2012), we set that there is only one supplier ($n_1^A = n_0^A = 1$), one domestic firm ($n_1^B = n_0^B = 1$) and one MNF ($n_1^e = 1$). Let denote, $c_{j,t}^B = c_t^B$, $c_{i,t}^A = c_t^A$, $c_{f,t}^B = c_t^F$, $g_f = g$ and $\theta_j = \theta$. Hence, the degree of corporate tax revenue under the autarkic economy, given in equation (12), can be written by

$$CTR_0 = (\tau_0^B + \gamma\tau_0^A) \frac{(S_0^B - c_0^B - \tau_0^B) - \gamma(c_0^A + \tau_0^A)}{4} \quad (27)$$

and that under the FDI economy, given in equation (24) is defined as

$$\begin{aligned} CTR_1 &= (\tau_1^B + \gamma\tau_1^A) \frac{\left[(\Psi_{j,1}^B - \tau_1^B) + (\Psi_{j,1}^B - \tau_1^B) \right] - 2\gamma(c_1^A + \tau_1^A)}{6} \\ &= \frac{(\tau_1^B + \gamma\tau_1^A)}{6} \left[(S_1^B + \theta - c_1^B - \tau_1^B) + (S_1^B - c_1^F - g - \tau_1^B) - 2\gamma(c_1^A + \tau_1^A) \right] \end{aligned} \quad (28)$$

Let denote ΔCTR , the difference in the level of corporate tax revenue between the FDI economy and the autarkic one ($\Delta CTR = CTR_1 - CTR_0$). Examining the sign of ΔCTR yields the fundamental results of the model.

We notice that

$$\Delta CTR \geq 0 \text{ iff } \theta \geq \theta^* = \frac{1}{2\lambda^T} \left[\left(2(\lambda^T)^2 - 3 \right) T + 3\Gamma_0 \right] - \Gamma_1 \quad (29)$$

where

$$\begin{aligned} T &= \tau_0^B + \gamma\tau_0^A \\ \lambda^T &= \frac{\tau_1^B + \gamma\tau_1^A}{\tau_0^B + \gamma\tau_0^A} \\ \Gamma_0 &= (S_0^B - c_0^B - \tau_0^B) \\ \Gamma_1 &= 2S_1^B - c_1^B - c_1^F - g - 2\gamma c_1^A \end{aligned}$$

Hence, the function $\theta^*(\Gamma_1)$ indicates all situations in which the entry of MNFs has no effect on the level of corporate tax revenue. We therefore can state.

Proposition 1 *The entry of MNF boosts corporate tax revenue in the host country iff the level of technological spillovers up to a critical threshold (i.e., $\theta > \theta^*$).*

Whenever technological spillovers are small, the demand creation effect is weak and thereby, it could not move out the strong competition effect generated by MNF. As a result, its entry damages the level of corporate tax revenue. Inversely, if the technological spillovers are large enough, the opposite happens: the competition effect is carried out and FDI enhances the degree of corporate tax revenue. Our result is similar to various works in the literature on FDI (see e.g., Blomstrom and Kokko, 1998; Gorg and Greenaway, 2004; Sinani and Meyer, 2009; Nguyen et al., 2010; Nguyen, 2012), since the entry of MNFs into the host country improves its economy iff the degree of technological spillovers are high enough.

Since $\theta^*(S_1^B)$ decreases in S_1^B , it implies that the higher local market size is, the more likely it is that the entry of MNF raises the level of corporate tax revenue. This occurs because using equation (1), a large market size means a high demand for final goods and thereby, the competition effect generated by the entry of MNF is rather weak while the demand creation effect is rather high.

As for the technological transfer cost (g), we notice that $\Delta CTR \geq 0$ iff

$$g \leq g^* = \left(2S_1^B - c_1^B + \theta - c_1^F - 2\gamma c_1^A\right) - \frac{1}{2\lambda^T} [2(\lambda^T)^2 T + 3\Gamma_0] \quad (30)$$

We therefore can state.

Proposition 2 *The entry of MNF enhances the level of corporate tax revenue in the host country iff the technological transfer cost falls below a critical threshold (i.e., $g < g^*$). Under the assumption that the technological transfer cost relates to the development gap between the home and the host countries, this means FDI raises the degree of corporate tax revenue iff the development level of the host country is high enough.*

If the technological transfer cost is small, the demand creation effect is strong whereas the competition effect created by the entry of MNF is weak. Consequently, FDI raises the level of corporate tax revenue. The opposite appears whenever the technological transfer cost is large. In this case, the demand creation is weak and dominated by the competition effect.

As $g^*(S_1^B)$ increases in the market size (S_1^B), a low development level of the host country may be partly offset by its large market size. The result is due to the fact that a low development level leads to a strong competition effect while a large market size implies a high demand creation effect.

Let denote ΔCTR^A be the evolution in the level of corporate tax revenue from the supporting industry between the FDI economy and the autarkic one. The evolution is

determined by

$$\begin{aligned}\Delta CTR^A &= \tau_1^A q_{i,1}^A - \tau_0^A q_{i,0}^A \\ &= \gamma \tau_1^A \frac{\left[\left(\Psi_{j,1}^B - \tau_1^B \right) + \left(\Psi_{f,1}^B - \tau_1^B \right) \right] - 2\gamma \left(c_1^A + \tau_1^A \right)}{6} \\ &\quad - \gamma \tau_0^A \frac{\left(S_0^B - c_0^B - \tau_0^B \right) - \gamma^B \left(c_0^A + \tau_0^A \right)}{4}\end{aligned}$$

We notice that

$$\Delta CTR^A \geq 0 \text{ iff } \theta \geq \theta_A^* = \frac{1}{2\lambda^A} \left[\left(2\lambda^T \lambda^A - 3 \right) T + 3\Gamma_0 \right] - \Gamma_1$$

where $\lambda^A = \frac{\tau_1^A}{\tau_0^A}$. Then, the function $\theta_A^*(\Gamma_1)$ indicates all solutions allowing the no impact of FDI on the degree of corporate tax revenue from the supporting industry.

Let denote ΔCTR_j^B be the difference in the degree of corporate tax revenue from the one-domestic firm between the FDI economy and the autarkic economy. It can be written as

$$\Delta CTR_j^B = \tau_1^B q_{j,1}^B - \tau_0^B q_{j,0}^B$$

We notice that

$$\Delta CTR_j^B \geq 0 \text{ iff } \theta \geq \theta_B^* = \frac{1}{7\lambda^B} \left[\left(2\lambda^T \lambda^B - 3 \right) T + 3\Gamma_0 \right] + \frac{6}{7} \left(c_1^F + g - c_1^B \right) - \frac{\Gamma_1}{7}$$

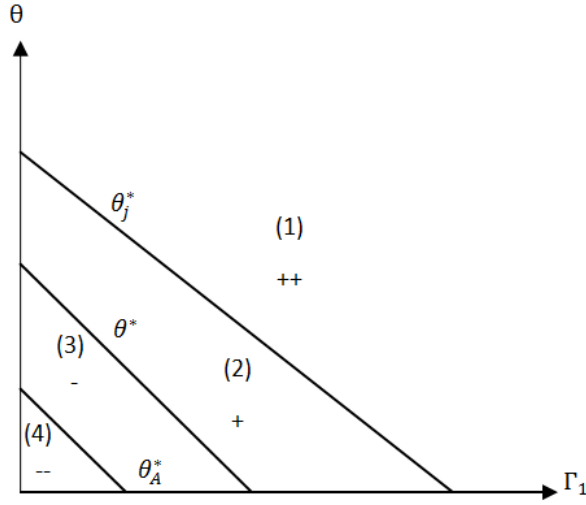
where $\lambda^B = \frac{\tau_1^B}{\tau_0^B}$. Then, the function $\theta_B^*(\Gamma_1)$ presents all solutions in which FDI has not any impact on the degree of corporate tax revenue from domestic firms.

Let denote ΔCTR_f^B be the evolution in the level of corporate tax revenue from the one-MNF between the FDI economy and the autarkic one. Hence, $\Delta CTR_f^B = q_{f,1}^B > 0$. Since, $\Delta CTR_f^B > 0$, the sign of ΔCTR is determined by that of ΔCTR^A and that of ΔCTR_j^B

Given the functions $\theta^*(\Gamma_1)$, $\theta_A^*(\Gamma_1)$ and $\theta_B^*(\Gamma_1)$, the figure 1 shows different possible impacts of FDI on the level of corporate tax revenue.

In area 1, the entry of MNFs into the host country raises greatly the degree of corporate tax revenue relative to the autarkic economy thanks to two positive effects. First, such entry creates an important degree of technological spillovers in the final industry while the

Figure 1: Impacts of FDI on corporate tax revenue - One firm economy



competition effect is weak. Therefore, FDI increases the output level of the one-domestic firm. Hence, the level of tax revenue from it improves compared with the autarkic economy. Second, this entry also generates a high level of demand for input and thereby increases the production level of the one-supplier. This boosts the degree of tax revenue from the supporting industry.

The opposite happens in area 4. Under the FDI economy, the level of corporate tax revenue decreases considerably, owing to two negative effects. On the one hand, in the final industry, the competition effect is strong while the degree of technological spillovers is weak. Therefore, FDI lowers the output level of the one-domestic firm that leads to a lower level of corporate tax revenue from it. On the other hand, in the supporting industry, the smaller output level of the one-domestic firm causes the demand for inputs to decline (a competition effect). Moreover, this decline is so strong that it moves out the increase in the demand for inputs created by the one-MNF (a weak demand creation effect versus a strong competition effect). Therefore, FDI lowers the production level of the one-supplier and then the level of corporate tax revenue shrinks relative to the autarkic economy.

In cases 2 and 3, FDI affects the degree of corporate tax revenue by two conflicting ways. On the one hand, in the supporting industry, the competition effect is offset by the demand creation effect. Thereby, such investment raises the level of tax revenue from

the one-supplier vis-a-vis the autarkic economy. On the other hand, the entry of MNFs shrinks the degree of tax revenue from the one-domestic firm because the competition effect is relatively strong while the level of technological spillovers is weak. Therefore, the net impact of such entry on the degree of corporate tax revenue is ambiguous. In area 2, the lower level of tax revenue from the one-domestic firm is entirely offset by the greater level of tax revenue from the one-supplier et that from the one-MNF. Hence, FDI enhances the degree of corporate tax revenue. The opposite occurs in area 3: the decline in tax revenue from the one-domestic firm is relatively high so that it dominates the increase in tax revenue from the one-supplier and that from the one-MNF. As a result, the entry of MNFs hurts the level of corporate tax revenue.

3.2 The identical-firms economy

In what following, we consider that domestic firms in the final industry are identical and suppliers in the supporting industry are identical. Foreign firms investing in the host country are also identical. We have then

$$\begin{aligned}
c_{j,t}^B &= c_{k,t}^B \text{ for } \forall j, k = 1, \dots, n_t^B, t = 1, 2 \\
\theta_j &= \theta_k \\
c_{i,t}^A &= c_{h,t}^A \text{ for } \forall i, h = 1, \dots, n_t^A, t = 1, 2 \\
c_{f,1}^B &= c_{f',1}^B \text{ for } \forall f, f' = 1, \dots, n_1^e \\
g_f &= g_{f'}
\end{aligned}$$

Let denote $c_{j,t}^B = c_t^B$, $\theta_j = \theta$, $q_{j,t}^B = q_t^B$; $c_{i,t}^A = c_t^A$, $q_{i,t}^A = q_t^A$; $c_{f,1}^B = c_1^e$, $g_f = g$, $q_{f,1}^B = q_1^e$. Otherwise, to make simpler the presentation, we set $\tau_0^B = \tau_0^A = \tau_0$ and $\tau_1^B = \tau_1^A = \tau_1$.

The level of corporate tax revenue under the FDI economy can be rewritten as

$$\begin{aligned}
CTR_1 &= \tau_1 \left(n_1^B q_1^B + n_1^e q_1^e \right) + \tau_1 n_1^A q_1^A & (31) \\
&= \tau_1 (1 + \gamma) n_1^A \left[\frac{n_1^B \left(S_1^B - (c_1^B - \theta + \tau_1) \right) + n_1^e \left(S_1^B - (c_1^e + g + \tau_1) \right)}{(n_1^A + 1) (n_1^B + n_1^e + 1)} \right] \\
&\quad - \tau_1 (1 + \gamma) n_1^A \left[\frac{\gamma \left(n_1^B + n_1^e \right) \left(c_1^A + \tau_1 \right)}{(n_1^A + 1) (n_1^B + n_1^e + 1)} \right]
\end{aligned}$$

and that under the autarkic economy can be explained as

$$\begin{aligned}
CTR_0 &= \tau_0 n_0^B q_0^B + \tau_0 n_0^A q_0^A & (32) \\
&= \tau_0 (1 + \gamma) n_0^A n_0^B \frac{S_0^B - (c_0^B + \tau_0) - (c_0^A + \tau_0)}{(n_0^A + 1)(n_0^B + 1)}
\end{aligned}$$

Let denote $n_0^B q_0^B = \overline{Q}_0^B$, $n_0^A q_0^A = \overline{Q}_0^A$ and $CTR_0 = \overline{CTR}_0$. Figures (3), (4) respectively represent the total output level produced by domestic firms in the final in the final industry and that produced by suppliers in the supporting industry. Otherwise, the level of corporate tax revenue of the host country is shown in figure (5). The initial situation (situation under the autarkic economy) of the host country is at point E_0 where the total output level of domestic firm is given by \overline{Q}_0^B , the total output level of suppliers is \overline{Q}_0^A and the degree of corporate tax revenue is \overline{CTR}_0 .

Let denote ΔCTR , ΔQ^B and ΔQ^A be respectively the evolution in the degree of corporate tax revenue, the evolution in the total output level of the final industry and of the supporting industry

$$\begin{aligned}
\Delta CTR &= CTR_1 - CTR_0 \\
\Delta Q^B &= (n_1^B q_1^B + n_1^e q_1^e) - n_0^B q_0^B \\
\Delta Q^A &= n_1^A q_1^A - n_0^A q_0^A
\end{aligned}$$

We notice that

$$\begin{aligned}
\Delta CTR \geq 0 \text{ iff } \theta &\geq \hat{\theta} = \frac{\tau_0}{\tau_1} \frac{\Delta_1}{n_1^B} - \frac{\Delta_2}{n_1^B} + \frac{n_1^e}{n_1^B} (c_1^e + g) + c_1^B \\
\text{or } g < \hat{g} &= \frac{\Delta_2}{n_1^e} - \frac{n_1^B}{n_1^e} (c_1^B - \theta) - c_1^e - \frac{\tau_0}{\tau_1} \frac{\Delta_1}{n_1^e}
\end{aligned}$$

where

$$\begin{aligned}
\Delta_1 &= \frac{n_0^A (n_1^A + 1) n_0^B (n_1^B + n_1^e + 1)}{n_1^A (n_0^A + 1) (n_0^B + 1)} [S_0^B - (c_0^B + \tau_0) - \gamma (c_0^A + \tau_0)] > 0 \\
\Delta_2 &= (n_1^B + n_1^e) [S_1^B - \tau_1 - \gamma (c_1^A + \tau_1)] > 0
\end{aligned}$$

The result shows that the entry of MNFs into the host country increases the level of corporate tax revenue if and only if the technological spillovers is high enough and/or the

technological transfer cost is small enough. Let denote $\hat{\theta} = \mathcal{F}(\Delta_1)$, then the function $\mathcal{F}(\Delta_1)$ represents all situations where the entry of MNFs into the host country has not any influence on the level of corporate tax revenue.

Under the FDI economy, the total output level of suppliers is greater than that under the autarkic economy whenever $\Delta Q^A \geq 0$. That happens iff

$$\begin{aligned}\theta &\geq \hat{\theta}^A = \frac{\Delta_1}{n_1^B} - \frac{\Delta_2}{n_1^B} + \frac{n_1^e}{n_1^B} (c_1^e + g) + c_1^B \\ g &\leq \hat{g}^A = \frac{\Delta_2}{n_1^e} - \frac{n_1^B}{n_1^e} (c_1^B - \theta) - c_1^e - \frac{\Delta_1}{n_1^e}\end{aligned}$$

That means the degree of technological spillovers is sufficiently high and/or the technological transfer cost is low enough. Since $\tau_0 > \tau_1$ and $\frac{\Delta_1}{n_1^B}, \frac{\Delta_1}{n_1^e} > 0$, so $\hat{\theta}^A < \hat{\theta}$ and $\hat{g}^A > \hat{g}$. Let denote $\hat{\theta}^A = \mathcal{G}(\Delta_1)$, then the function $\mathcal{G}(\Delta_1)$ represents all cases where the aggregate output level of suppliers under the FDI economy is equivalent to that under the autarkic economy.

In the final industry, let denote ρ be the market shares of domestic firms ($0 < \rho < 1$), hence

$$n_1^B q_1^B = \rho n_1^A \frac{(n_1^B + n_1^e) [S_1^B - \tau_1 - \gamma (c_1^A + \tau_1)] - n_1^e (c_1^e + g) - n_1^B (c_1^B - \theta)}{(n_1^A + 1) (n_1^B + n_1^e + 1)}$$

The entry of MNFs has no effect on the aggregate output level of domestic firms since

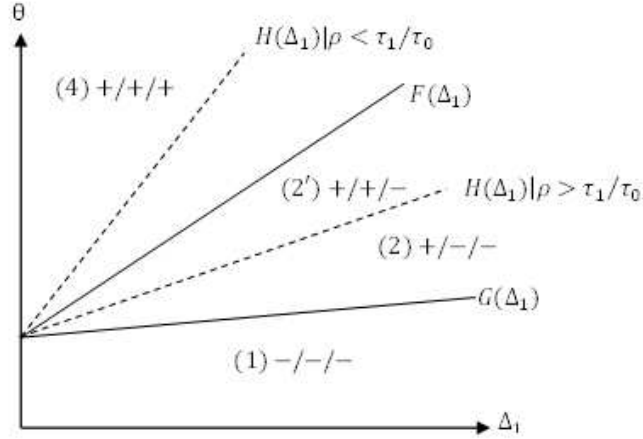
$$\begin{aligned}\theta &= \hat{\theta}^B = \frac{1}{\rho} \frac{\Delta_1}{n_1^B} - \frac{\Delta_2}{n_1^B} + \frac{n_1^e}{n_1^B} (c_1^e + g) + c_1^B \\ g &= \hat{g}^B = \frac{\Delta_2}{n_1^e} - \frac{n_1^B}{n_1^e} (c_1^B - \theta) - c_1^e - \frac{1}{\rho} \frac{\Delta_1}{n_1^e}\end{aligned}$$

Hence, this entry has a positive impact ($\Delta Q^B \geq 0$) whenever the degree of technological spillovers reaches a critical threshold ($\theta \geq \hat{\theta}^B$) or the technological transfer cost is low enough ($g \leq \hat{g}^B$). Given that $0 < \rho < 1$ and $\frac{\Delta_1}{n_1^B}, \frac{\Delta_1}{n_1^e} > 0$, we have $\hat{\theta}^A < \hat{\theta}^B$ and $\hat{g}^A > \hat{g}^B$. Let denote $\hat{\theta}^B = \mathcal{H}(\Delta_1)$, then the function $\mathcal{H}(\Delta_1)$ shows all situation in which the entry of MNFs into the host country has no impact on the total output level of domestic firms.

Given the functions $\mathcal{F}(\Delta_1)$, $\mathcal{G}(\Delta_1)$ and $\mathcal{H}(\Delta_1)$, figure 2 shows different effects of FDI on the degree of corporate tax revenue. Since $\hat{\theta}^A < \hat{\theta}^B$ and $\hat{\theta}^A < \hat{\theta}$, $\mathcal{G}(\Delta_1)$ is below $\mathcal{F}(\Delta_1)$ and $\mathcal{H}(\Delta_1)$. Otherwise, $\mathcal{F}(\Delta_1)$ is above $\mathcal{H}(\Delta_1)$ when $\frac{\tau_1}{\tau_0} < \rho$ and $\mathcal{F}(\Delta_1)$ is below $\mathcal{H}(\Delta_1)$ if $\mathcal{H}(\Delta_1)$ when $\frac{\tau_1}{\tau_0} > \rho$. Otherwise, let denote $(x/x/x)$ be respectively the sign of ΔQ^A ,

ΔQ^B and ΔCTR . For exemple, (+/ - /+) indicates that $\Delta Q^A > 0$, $\Delta Q^B < 0$ and $\Delta CTR > 0$.

Figure 2: Impacts of FDI on corporate tax revenue - Identical firms economy

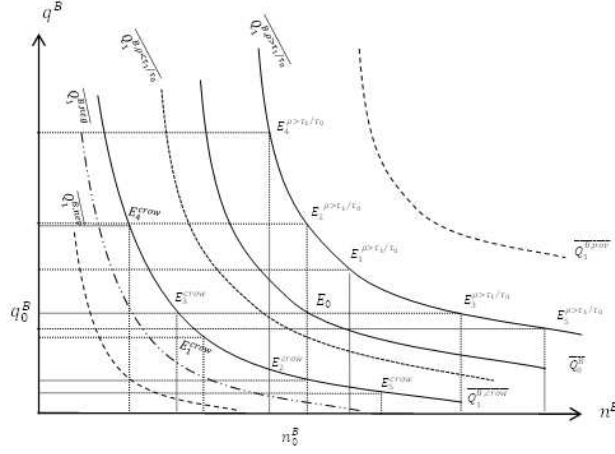


Cas 1 *The 100% crowding-out effect* - $\theta = \hat{\theta}^A$

Under the FDI economy, the production of MNFs in the host country replaces that of domestic firms in an exactly offsetting way, $n_1^B q_1^B + n_1^e q_1^e = \overline{Q_0^B}$. The host country is then in the line $\mathcal{G}(\Delta_1)$.

In the final industry, the total output level of domestic firms decreases and by the way, in figure (3), the curve $\overline{Q_0^B}$ moves to $\overline{Q_1^{B,crow}}$, $\overline{Q_1^{B,crow}} < \overline{Q_0^B}$. There are five possible equilibriums in the industry. At the point E_2^{crow} , the entry of MNFs has not any impact on the number of domestic firms, $n_1^B = n_0^B$. However, each of them has a smaller output level, $q_1^B < q_0^B$. The opposite way happens at the point E_3^{crow} : the production level of each domestic firm remains the same as that under the autarkic economy, but there is a net exit of domestic firms, $q_1^B = q_0^B$ and $n_1^B < n_0^B$. The equilibrium at the point E_3^{crow} is also shown by Markusen and Venables (1999). At the point E_5^{crow} , there are more domestic firms but each of them has a smaller production level and conversely, we have less domestic firms but a better production of each of them at E_4^{crow} . At the point E_1^{crow} , there are less domestic firms and each of them has a lower production level. In the supporting industry, the 100% crowding-out effect means that the direct demand creation effect is fully offset by the competition one. Therefore, there is not any net effect on the aggregate production

Figure 3: Equilibriums in the final industry



of the industry, $n_1^A q_1^A = \overline{Q_0^A}$. However, given the existence of technological transfer cost and that of technological spillovers, the entry of MNFs can lead to a reorganization in the supporting industry.

Less suppliers but better production: Whenever the technological spillover is high enough, $\hat{\theta}^A > \theta^{crow}$ or the technology transfer cost is low enough, $\hat{g}^A < g^{crow}$, we have $n_1^A < n_0^A$ and $q_1^A > q_0^A$ where

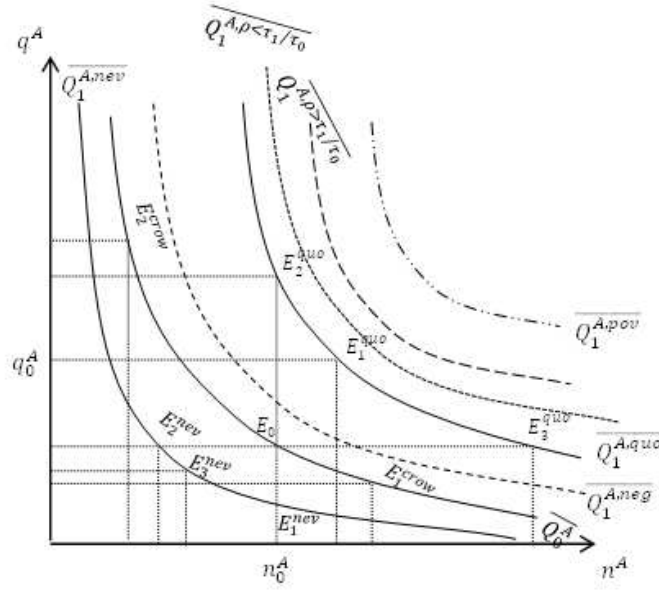
$$\begin{aligned} \theta^{crow} &= \frac{(n_1^B + n_1^e + 1) n_0^B [S_0^B - (c_0^B + \tau_0) - \gamma (c_0^A + \tau_0)]}{n_1^B (n_0^B + 1)} \\ &\quad - \frac{(n_1^B + n_1^e) [S_1^B - \tau_1 - \gamma (c_1^A + \tau_1)] + n_1^e (c_1^e + g)}{n_1^B} + c_1^B \\ g^{crow} &= \frac{(n_1^B + n_1^e) [S_1^B - \tau_1 - \gamma (c_1^A + \tau_1)] - n_1^B (c_1^B - \theta)}{n_1^e} - c_1^e \\ &\quad - \frac{(n_1^B + n_1^e + 1) n_0^B [S_0^B - (c_0^B + \tau_0) - \gamma (c_0^A + \tau_0)]}{n_1^B (n_0^B + 1)} \end{aligned}$$

Hence, under the FDI economy, there is a net exit of suppliers to the supporting industry. Nevertheless, those remaining in the industry have a greater production level. We are then at the point E_1^{crow} in the curve $\overline{Q_0^A}$ of figure (4). We notice that an increasing in the domestic market size (S_1^B) or a decreasing in the corporate tax (τ_1) under the FDI economy leads to a shift from E_1^{crow} to E_0 .

More suppliers but smaller production: In the opposite way, when the technolog-

ical spillovers are small, $\hat{\theta}^A < \theta^{crow}$ or the technological transfer cost is high, $\hat{g}^A > g^{crow}$, then $n_1^A > n_0^A$ and $q_1^A < q_0^A$. The result indicates that there is a net entry of suppliers into the supporting industry but each of them has a smaller production level. Hence, we are at the point E_2^{crow} in the curve $\overline{Q_0^A}$ of figure (4). Otherwise, a decreasing in the domestic market size (S_1^B) or an increasing in the corporate tax (τ_1) will lead to a shift from E_2^{crow} to E_0 .

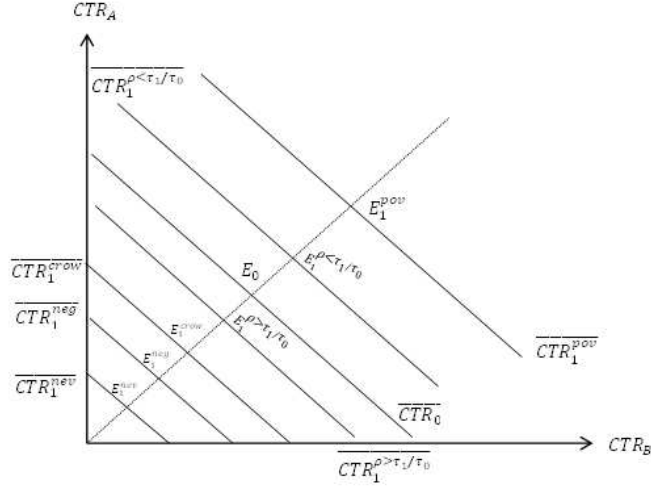
Figure 4: Equilibriums in the supporting industry



Relating to the corporate tax revenue of the host country, since $n_0^A q_0^A = n_1^A q_1^A$ and $\tau_0 > \tau_1$, we have $CTR_0 > CTR_1$. Hence, under the FDI economy, the degree of corporate tax revenue decreases in compared with the autarkic economy. This decline is caused by a lower aggregate production level of domestic firms and by a fewer unit tax ($\tau_0 > \tau_1$). In figure (5), the light $\overline{CTR_0}$ moves to $\overline{CTR^{crow}}$ and the new equilibrium is at the point E^{crow} .

Our results seem to coincide with several previous researches (Markusen et Venables, 1999; Nguyen et al., 2010; Nguyen and Minda, 2012). Nevertheless, our main contribution is to show the possibility that the entry of MNFs may lead to a reorganization in the final industry as well as in the supporting industry without an increasing or a drop in the aggregate production level in these industries.

Figure 5: Equilibriums in corporate tax revenue



Cas 2 *The three negative effects - $\theta < \theta^A$*

Whenever the degree of technological spillovers falls into a minimum threshold, $\theta < \theta^A$, the present of MNFs in the host country causes three negative effects. Hence, the host country is in area (1) of figure 2.

In the final industry, the aggregate output level of domestic firms is relatively smaller than that under the autarkic economy ($n_1^B q_1^B + n_1^e q_1^e < \overline{Q_0^B}$). Therefore, in figure 3, the curve $\overline{Q_0^B}$ moves to $\overline{Q_1^{B,nev}}$ that is below $\overline{Q_1^{B,crowd}}$. We also have five possible situations as the case of 100% crowding-out effect.

In the supporting industry, the total production level of suppliers decreases, $n_1^A q_1^A = \overline{Q_1^{A,nev}} < \overline{Q_0^A}$. In figure 4, the curve $\overline{Q_1^{A,nev}}$ is below $\overline{Q_0^A}$. In comparison to the 100% crowding-out effect, we have three other possible equilibriums. At the point E_1^{nev} , the number of suppliers is unchanged but each of them has a smaller output level. Inversely, at the point E_2^{nev} , its production level remains the same as that under the autarkic economy. However, there are less suppliers in the supporting industry. Moreover, at the point E_3^{nev} , there are less suppliers and their output level is smaller than that under the autarkic economy.

Related to the corporate tax revenue, since $\tau_0 > \tau_1$ and $n_1^A q_1^A < n_0^A q_0^A$, the degree of corporate tax revenue declines under the FDI economy. This decrease is caused by a smaller

unit tax level as well as by a lower production level in the final industry and that in the supporting one. In figure 5, the light \overline{CTR}_0 moves to \overline{CTR}^{nev} and the new equilibrium is at the point E^{nev} .

The three negative effects belongs to the host country in which domestic firms is much less powerful than the MNFs. Thereby, the location of the latter in the final industry may lead to net exit of domestic firms as well as a lower output level of each of them. In this industry, the competition effect is relatively stronger than the demand creation one and by the way, the total demand for input becomes much smaller than that under the autarkic economy. As for the supporting industry, the decline in demand for input causes a fewer production level and/or a net exit of suppliers. Whenever the production falls in the two industries and the unit tax is lower, the government has a smaller corporate tax revenue.

Cas 3 *The status quo effect - $\theta = \hat{\theta}$*

That is the case where the location of FDI in the final industry does not cause any impact on the level of corporate tax revenue ($\Delta CTR = 0$, $\theta = \hat{\theta}$). The host country is therefore in the curve $\mathcal{F}(\Delta_1 = 0)$ of figure 2 and in figure 5, it stays in the same situation as before (the point E).

The production of MNFs creates a high demand for inputs that it fully dominates the competition effect. Hence, in the supporting industry, the total production level is greater than that under the autarkic economy. In figure 4, the curve \overline{Q}_0^A shifts to the right and becomes $\overline{Q}_1^{A,quo}$. Relating to the 100% crowding-out effect, we have three more possible situations. First, that at the point E_1^{quo} where there are more supporting firms and each of them has a greater production level. Second, the suppliers are at the point E_2^{quo} from which the number of supporting firms remains the same but their own production level increases. Third, at the point E_3^{quo} , there are more suppliers and their own production level remains the same as that under the autarkic economy.

In the final industry, the aggregate industrial output level is higher than that under the autarkic economy, $n_1^B q_1^B + n_1^e q_1^e > n_0^B q_0^B$. However, the impact of FDI on the total production level of domestic firms is ambiguous and depends upon the relationship between ρ and $\frac{\tau_1}{\tau_0}$.

Cas 4 *The low tax effect*

Whenever the technological spillovers fall into a certain level, $\theta \in (\hat{\theta}^A, \hat{\theta})$, the entry of MNFs into the host country lowers the corporate tax revenue and enhances the aggregate production level of supporting firms. We are in area (2) or (2') of figure 2.

In area (2), we are in situation where $\rho > \frac{\tau_1}{\tau_0}$ and $\hat{\theta}^A < \theta$, that means $\hat{\theta} > \hat{\theta}^B$ and $\theta \in (\hat{\theta}^A, \hat{\theta}^B)$. Hence, in the final industry, the aggregate industrial output level is greater than that under the autarkic economy. However, the technological spillovers may not carry out the competition effect, $n_1^B q_1^B < n_0^B q_0^B$. Thereby, the location of FDI in the final industry shrinks the total output level of domestic firms. In figure 3, the curve $\overline{Q_0^B}$ moves slightly to the left and becomes $\overline{Q_1^{B,neg}}$ ($\overline{Q_1^{B,neg}}$ is above $\overline{Q_1^{B,nev}}$). We have the same situations as those in the curve $\overline{Q_1^{B,nev}}$. In the supporting industry, the total production level increases, but in a lower rate than that of the status quo effect. Therefore, in figure 4, the curve $\overline{Q_0^A}$ lifts to $\overline{Q_1^{A,neg}}$ that is below $\overline{Q_1^{A,quo}}$. In this position, we also have five possible equilibriums as those of the status quo effect. That means, relating to the autarkic economy, we can have : i) the same number of supporting firms but a better production of each of them, ii) the same production level but more suppliers, iii) less suppliers but a better unit production level, iv) a lower unit production level but more suppliers and v) more supporting firms and a greater unit production level.

On the other hand, in area (2'), we are in situation where $\rho > \frac{\tau_1}{\tau_0}$ and $\hat{\theta}^A < \theta$, that means $\hat{\theta} > \hat{\theta}^B$ and $\theta \in (\hat{\theta}^B, \hat{\theta})$. By the way, the degree of technological spillovers becomes stronger than the competition effect. Hence, the location of FDI in the final industry boosts the total output level of domestic firms, $n_1^B q_1^B > n_0^B q_0^B$. In figure 3, the curve $\overline{Q_0^B}$ shifts to the right and becomes $\overline{Q_1^{B,\rho > \tau_1/\tau_0}}$. In this position, there are five possible equilibriums. In comparison to the autarkic economy, we have: i) more domestic firms and a better unit output level (point $E_1^{\rho > \tau_1/\tau_0}$), ii) the same number of domestic firms but a higher unit output level (point $E_2^{\tau_1/\tau_0}$), iii) the same unit output level but more domestic firms (point $E_3^{\rho > \tau_1/\tau_0}$), iv) less domestic firms but a better production level of each of them (point $E_4^{\rho > \tau_1/\tau_0}$) and v) more domestic firms but smaller output level of each of them (point $E_5^{\rho > \tau_1/\tau_0}$).

In the supporting industry, the total production level increases in a higher rate than

that of the status quo case. Therefore, in figure 4, the curve $\overline{Q_0^A}$ moves to the right and becomes $\overline{Q_1^{A,\rho>\tau_1/\tau_0}}$ that is above the curve $\overline{Q_1^{A,quo}}$. As for the corporate tax revenue, its level is smaller than that under the autarkic economy. However, this decline is not caused by the entry of MNFs into the host country but rather by a strong decrease in unit tax level. In figure 5, the line $\overline{CTR_0}$ moves downwards and becomes $\overline{CTR_1^{\rho>\tau_1/\tau_0}}$ that is above the line $\overline{CTR_1^{crow}}$. Area (2') is related to host countries in which in order to attract the location of FDI, the local government is ready to provide a low tax (taxes holiday) that it shrinks the degree of its corporate tax revenue.

Cas 5 *The two positive effect - $\theta > \hat{\theta}$ and $\rho < \frac{\tau_1}{\tau_0}$*

When the degree of technological spillovers exceeds a critical threshold ($\theta > \hat{\theta}$) and the market shares of domestic firms is relatively small ($\rho < \frac{\tau_1}{\tau_0}$), the entry of MNFs into the host country enhances the level of corporate tax revenue as well as the aggregate production level of supporting firms. However, it lowers the total output level of domestic firms. The host country occurs then in area (3) of figure 2.

In the final industry, the competition effect is slightly stronger than the technological spillovers. In figure 3, the curve $\overline{Q_0^B}$ moves down to $\overline{Q_1^{B,\rho<\tau_1/\tau_0}}$ that is above $\overline{Q_1^{B,crow}}$. We have the same situations as those of the 100% crowding out effect case.

In the supporting industry, the decline in demand for inputs caused by a lower total domestic production is carried out by a strong demand for inputs created by the foreign production. In other words, the demand creation effect is stronger than the competition one. The total production level of suppliers increases and by the way in figure 4, the curve $\overline{Q_0^A}$ shifts up to $\overline{Q_1^{A,\rho<\tau_1/\tau_0}}$ that is above the curve $\overline{Q_1^{A,quo}}$. There are then five possible equilibriums as those of the status quo effect case. That means in comparison to the autarkic economy, we can have i) more supporting firms and a better production of each of them, ii) more suppliers but a lower unit production level, iii) the same suppliers but a higher unit production level, iv) the same unit level production but more suppliers and v) less suppliers and a better production of each of them.

As regards the corporate tax revenue, the line $\overline{CTR_0}$ lifts to $\overline{CTR_1^{\rho<\tau_1/\tau_0}}$ and the new equilibrium is at the point $E_1^{\rho<\tau_1/\tau_0}$.

Cas 6 *The complement and feedback effects*

In this case, the level of technological spillovers is relatively high and carried out the competition effect. In the supporting industry, the demand creation est much stronger than the competition one. Hence, the host country is in area (4) of figure 2 where the location of FDI in the final industry has three positive effects: i) a greater total production level of supporting firms, ii) a higher aggregate output level of domestic firms and iii) an increase in the degree of corporate tax revenu.

Area (4) seems to be related to two kinds of the host country, a low income developing country and a high income developed country.

In the first case, while investing in a low income developing country, MNFs transfer a international standard technology that they do not intend to protect. Therefore, the level of technological spillovers is high and such spillovers can be obtained by a demonstration chanel. Otherwise, these firms are likely to entry in another market segments than domestic ones and by the way, the competition effect is low. Technological spillovers completely dominate the competition effect and hence FDI boosts the aggregate output level of domestic firms. The growth in domestic production as well as the foreign production in the final industry create a very high demand for inputs. In the supporting industry, the competition effect is completely carried out by the demand creation one from which the total production level of suppliers is much greater than that under the autarkic economy. This increase can lower on the price of input that leads to a feedback effect on the final industry: a lower price of input enhances the production of domestic firms. In this situation, FDI acts as a catalyst for the local industrial development. This development allows a greater level of corporate tax revenu, whatever the declin in unit tax. Our findings seem to confirm different results in several previous empirical researches (Markusen and Venables, 1999; Jordaan, 2005; Wang and Yu, 2007; Meyer and Sinani, 2009)

In the second case, while investing in a high income economy, MNFs compete directly with domestic firms in the same or similar market segments and transfer advanced technology that they intend to protect. However, domestic is also powerful as their foreign competitors and then the competition effect is low. Furthermore, to remain competitive against MNFs, domestic firms have to enhance their own performance by investing in

humain capital or in R&D. Hence, in this case, technological spillovers are indirectly created by the entry of MNFs into the host country. In the final industry, the technological spillovers are much stronger than the competition effect from which the aggregate output level of domestic firms increases. In the supporting industry, the demand creation effect is relatively high and dominates the competition one that improves the total industrial production level. Moreover, this growth will shrink the price of inputs from where domestic firms may benefit to increase their own output level. Our results seem to support many previous findings in the literature (Liu et al., 2000; Haskel et al., 2007, Mayer and Sinani, 2009, ...)

4 Conclusion

This paper examines the implications of high net inflows foreign direct investment (FDI) characterized by number of entries of heterogenous multinational firms on corporate tax revenues' decline. We show that the impact of FDI on tax revenue will depend on the competition effect, demand creation effects, technology transfer cost and the technological spillovers. We argue that the competition effect reduces production of domestic firms and thereby, lowers the level of corporate tax revenue while the technological spillovers could be positive or negative due to the absorptive capacity of local firms. Local firms with strong absorptive capacity have the capability to make use of knowledge that they get to know. Local firms that lack this capability may be simply unable to catch up, and thus be crowded out by foreign investors increasing their market share. Our results generalize and support many theoretical models and empirical findings in the literature (Aitken, B.J, Harrison,A.E.,1999, Blomstrom and Kokko, 1998; Gorg and Greenaway, 2004; Sinani and Meyer, 2009). There are several interesting avenues for future research as endogenizing taxes in this framework. Studying the long run effects on the investment pattern in a dynamic model seems also fruitful. An empirical test in a developing country based on this theoretical framework will be our further research investment.

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