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Optimal policy for FDI incentives: An auction theory approach

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Abstract:

A multinational corporation's (MNC) entry into a host country brings benefits to the economy of that country, some direct (such as increasing production and employment) and some indirect (such as productivity spin-off). Governments that view MNCs as engines for growth and regional development have begun to encourage the flow of foreign investment into their country in hopes of increased local employment, market production and export capacity. MNCs consider first the maximization of profit when selecting a site to establish their subsidiaries. An MNC examines possible investment sites and indicates those that are best fitted for the investment. The countries that remain at this stage are similar in terms of their economic characteristics, and they compete with each other for receiving the foreign investment.

In this paper we use tools from auction theory to analyze the competition between host countries and MNCs and investigate the existence of Nash equilibrium strategies. The characteristics of this equilibrium are considered and assessed.

We developed a general model for examining the incentive competition between two countries and then apply it for several subgroups according to the number of MNCs and the availability of information. It turns out that the characteristics of the equilibrium depend on the number of MNCs as well as on the structure of their contribution to the host country economy.

***Key words**: FDI, multinational corporations, FDI incentives, auction theory.*

***JEL Classification**: F21, F23.*

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1. Introduction

A multinational corporation's (MNC) entry into a host country is accompanied by many benefits for that country's economy, some direct (such as increasing production and employment) and some indirect (such as productivity spin-off). Many governments that view MNCs as an engine for growth and regional development, with the possibility of expanding local employment as well as the market's production and export capacity, have begun to encourage the flow of foreign investment into their country. The considerations of an MNC for choosing a site to establish a subsidiary are mostly concerned with the maximization of profit. In the first stage, the MNC examines possible investment sites and designates those that are suitable for the investment. In the second stage, the MNC chooses the site that maximizes its profits, where the level of profit is affected by the incentives offered by the host country. The countries remaining at this stage are similar in terms of their economic characteristics, and they compete with each other for the foreign investment by offering attractive incentives.

In this paper, we use tools from auction theory to analyze the competition among the home country (HC) and the MNCs and investigate the existence of Nash equilibrium strategies. The characteristics of this equilibrium are presented and assessed.

We developed a general model for examining the incentive competition between two HCs. Then, we extend the basic model and apply it to several subgroups according to the number of MNCs and the availability of information. It turns out that the characteristics of the equilibrium depend on the number of MNCs, as well as on the structure of their contribution to the host country economy.

The structure of the paper is as follows: The following section provides a brief review of the relevant literature. The third section presents the considerations of an MNC when determining an optimal location for its subsidiary and the considerations of a government that uses FDI incentives. Section four discusses several models of incentives competition. In section five models of incomplete information are discussed. A brief summary of the main results is presented in the last section.

2. Background

The establishment of a subsidiary by an MNC may increase the HC's GDP in various ways: increasing employment, transfer of new technology, access to world markets, access to the MNC's R&D, and so on. The benefit to the HC is higher when there are productivity and technological spillovers. Chuang and Lin (1999), Driffield (2001), and Lipsey and Sjoholm (2001) found that technology spillovers exist in the UK, Taiwan and Indonesia and contribute to the economic growth of these economies (see also Dimelis and Louri, 2002). However, Konings (2000) showed that in several countries (e.g., Bulgaria and Rumania), the FDI may have a negative impact on the economy.

The current location theory (see, for example, Dunning, 1993; Globerman and Shapiro, 1999; Shapiro and Globerman, 2001) asserts that the MNC optimal location is determined in a two-stage process. In the first stage, a short list is prepared of potential locations that are characterized by a stable economy, big markets, high and growing income per capita, modern infrastructure and good trading conditions with other countries. In the second stage, the MNC assesses the financial conditions in each of these locations, including the following variables: corporate tax rates, factors prices, labor costs and so on. In this stage, countries that are on the short list compete for the FDI by offering grants, tax reductions, and subsidies for various factors of production. For example, INTEL received a 300 million dollar grant from the government of Costa Rica, which was instrumental in persuading the company to choose that country for its new plant. Canon Company chose Vietnam for its new subsidiary after the Vietnamese government offered a reduction in tax rates for 10 years (see Bjorvatn and Eckel, 2006).

A situation where countries with similar characteristics compete for FDI by offering incentives is called incentives competition. This competition affects the allocation of benefits between the host country and the MNC. Oman (2000) asserted that the MNC's share is close to one. Blomstrom and Kokko (2003) even proposed that "rules of game" be imposed to prevent this outcome and to leave a larger share of the benefits in the host country. Other studies emphasized the advantage of competition among countries. For example, Barros and Cabral (2000) showed that when countries differ in their size and unemployment rates, subsidy competition leads to optimal FDI location. Similar results can be found in Bjorvatn and Eckel (2006), who show that incentives competition may cause the MNC to locate its subsidiary in the country that has the highest benefits of FDI.

In our paper, we investigate the incentives competition by applying models of auction theory, and then we present characteristics of the equilibrium strategies.

3. Considerations of the MNC and the HC

The problem of an MNC is to decide where to locate its subsidiary. Let $\pi_{ij\tau}$ denote the expected profits of an MNC *j* in a country *i* at time τ. Let t_i denote the corporate tax rate in country *i*. The net present value of the expected stream of profit if I_{ij} is invested in the subsidiary, which is located in country *i* is:

(1) $$NPV_{ij} = \sum_{\tau=1}^{n} \frac{(1-t_i)\cdot \pi_{ij\tau}}{(1+k)^{\tau}} - I_{ij},$$

where *k* is the MNC discount rate.

Under the assumption that only one subsidiary can be established, the MNC should choose the optimal location, that is, the country that maximizes the present value of the profit per unit of investment:

(2) $$PI_{ij} = \frac{\sum_{\tau=1}^{n} \frac{(1-t_i)\cdot \pi_{ij\tau}}{(1+k_{ij})^{\tau}} + G_{ij}}{I_{ij}},$$

where G_{ij} is the grant offered by country *i* to MNC *j*. G_{ij} is a decision variable of country *i*.

When the HC competes for an MNC, it considers the benefits that can be derived from the MNC's activities in the country. We can classify these benefits into two kinds: direct benefits (DB), such as wages paid to workers who where previously unemployed and corporate taxes paid by the MNC to the HC's government, and indirect benefits (IDB), such as spillovers of new technologies, and so on. The total benefits country *i* derives from the *j* MNC, $TB_{ij\tau}$, at time τ is:

(3) $$TB_{ij\tau} = DB_{ij\tau} + IDB_{ij\tau}$$

Let r_i represent the discount rate of country *i*. Then, the present value of the benefits due to establishing a subsidiary by MNC *j*, R_{ij} is:

(4) $$R_{ij} = \sum_{\tau=1}^{n} \frac{TB_{ij\tau}}{(1+r_{ij})^{\tau}}$$

The grant, G_{ij}, is paid by the HC to the MNC, and therefore the net present value of the benefits of HC is:

(5) $$NB_{ij} = R_{ij} - G_{ij}$$

The HC's goal is to maximize this value, subject to the condition that $NB_{ij} > 0$.

As we noted before, the profitability for the HC and for the MNC depends on future outcomes. The quality of the estimated level of profits depends on the availability of information on the future expected values of the cash flows stemming from the project.

Complete information enables us to predict the accurate future cash flow of the project. In this case, both the MNC and the HC are indifferent to the type of incentives (a grant or tax relief) when both types prove to have the same net present value. Under incomplete information, the importance of an incentive scheme increases. Usually, the host country prefers tax relief that minimizes its risk, but the MNC prefers grants so that possible changes in future tax schemes can be avoided. Both cases are considered in our paper.

4. Models of Incentives Competition under Complete Information

We assume that the HC and the MNC have complete information and can make an accurate prediction of the future value of cash flows from the MNC's investment in the HC. In addition, we assume that the tax rate is constant for the project's lifetime and that the only way to provide FDI incentives is by offering the MNC a grant. We consider the incentives competition to be an auction where each HC offers a grant and the MNC chooses the country that provides it with the highest net present value of profits. The grant is paid only if the subsidiary is actually established. Therefore, we can apply models of first-price auction.

We deal with the following types of situations:

- Two countries compete for a single MNC.
- Two countries compete for two MNCs.
- There are homogenous and nonhomogenous countries.

4.1 Two Homogenous Countries Compete for One MNC

Two HC_i $(i=1,2)$ compete for an investment of one MNC, where R_i represents the value of total net benefits of host country i $(R_1=R_2)$. When a HC offers a grant (G_i), its net benefits are: $NBi=Ri\text{-}Gi$. Each country can offer a specific amount of the grant from a list of possible grants G_{ij} $(j=1,\dots,M)$, such that $G_{i1}<G_{i2}\dots<G_{iM}$. When the two countries are economically homogenous, it means that that the MNC's after-tax cash flows $\tilde{\imath}t_i \cdot \square_i$ are the same in both countries. The MNC that wishes to maximize its *PI* (the present value of the profits per unit of investment) will choose the host country that pays the higher grant.[1]

We look for the dominant strategy of HC_i in terms of the grant (G_i) to be offered.

Proposition 1.

For each HC strategy $x:\{G_i=R_i\}$ dominates strategy $y:\{G_i>R_i\}$.

Proof:

Let us assume that HC_2 uses strategy $y:\{G_2>R_2\}$. What would be the best strategy x for country one?

$$\begin{Bmatrix} NB_1(x,y)=(G_1-R_1)=0 & if \quad G_1<G_2 \\ NB_1(x,y)=(G_1-R_1)<0 & if \quad G_1=G_2 \\ NB_1(x,y)=(G_1-R_1)<0 & if \quad G_1>G_2 \end{Bmatrix}$$

[1] Since we assume complete information, the competition between HCs can be described as either grant competition or tax relief competition.

When HC_1's grant is smaller then that of HC_2, the MNC chooses to invest in HC_2. In this case, $NB_1=0$. For all other cases, $NB_1<0$: if HC_1 will pay $G_1=G_2>R_2=R_1$, then HC_1 will win with the probability of ½, and NB_1 will be negative. If $G_1>G_2>R_2=R_1$, then HC_1 will win, but NB_1 will be negative.

Proposition 2.

When $R_1=R_2$, strategy $x:\{G_i=R_i\}$ dominates strategy $y:\{G_i<R_i\}$.

Proof:

For simplicity we assume that $G_{1m}=G_{2m}$ for each m. Table 1 presents the NB for each country for all possible grants:

Table 1. Net benefits of each country that faces a single MNC (assuming homogenous countries)

	G_{21}	G_{22}	…….	G_{2M}
G_{11}	$\frac{1}{2}(R_i-G_{i1})$	$0\ ;R_2-G_{22}$	…….	$0\ ;R_2-G_{2M}$
G_{12}	$R_1-G_{12};\ 0$	$\frac{1}{2}(R_i-G_{i2})$	…….	$0\ ;R_2-G_{2M}$
$\vdots$	$\vdots$	$\vdots$	$\ddots$	$\vdots$
G_{1M}	$R_1-G_{1M};\ 0$	$R_1-G_{1M};\ 0$	…….	$\frac{1}{2}(R_i-G_{iM})$

The equilibrium strategies are: $G_1=R_1$ and $G_2=R_2$. As $R_1=R_2$, the MNC is indifferent between the two HCs. Therefore, we can summarize it in the following proposition:

Proposition .3

When $R_1=R_2$, strategy $x:\{G_i=R_i\}$ is Nash equilibrium.

Proof: For homogenous HCs in equilibrium, both HCs use the same strategies $\{G_i=R_i\}$ where all the HC's benefits are transferred to the MNC.

Usually, an HC has budgetary constraints on the value of the grant. Note that imposing budgetary constraints on the grants is way for coordination between the HCs. Let assume that Y_i is the maximum amount of the grant that can be offered by HC_i. There are several possibilities:

- $Y_1 \geq R_1\ and\ \ Y_2 \geq R_2$: In this case, the budgetary constraints are not effective, so there is no change in the equilibrium.
- $Y_1 \geq R_1\ and\ \ Y_2 < R_2$: In this case, the equilibrium strategies are such that HC_2 offers Y_2 (lower than R_2) and HC_1 offers Y_2+□ and wins the MNC. In this case, the surplus of HC_1 *is* R_1-(Y_2+□) > 0.
- $Y_1 < R_1\ and\ \ Y_2 < R_2\ \ and\ Y_1 > Y_2$: In this case, the equilibrium strategies are such that HC_2 offers Y_2, and HC_1 offers Y_2+□ and wins the MNC. In this case, HC_1's surplus is R_1-(Y_2+□) > 0.

The above model explains why some countries make their grant policy vague. Each HC determines its optimal grant by using information on the other HC's constraint. Secrecy can induce the HC with the higher budget constraint to make errors and lose the MNC's investment.

4.2 Incentives Competition when Countries Differ

Let us consider the case where the two HCs differ with respect to their FDI benefits. The difference may stem from different spillovers from the MNC to the HC, different unemployment rates, and so on. We investigate the impact of this difference on the characteristics of the equilibrium.

As in the previous sections, two HCs are competing for a subsidiary of one MNC, such that $R_1 > R2$. Each HC offers a grant (G_i), which can be chosen from a list of M possible levels such that: $G_{i1} < G_{i2} .... < G_{iM}$. We assume that if there are the same yearly after-tax cash flows $\tilde{\imath} t_i \cdot$ □$_i$ in both countries, then the MNC would prefer the country that offers the higher grant.

The dominant strategy for each HC_i can be considered according to the following propositions:

Proposition 4.

The highest grant that HC_i offers is less then R_i.

Proof:

See Proposition 1's proof.

Proposition 5.

If HC_2 uses strategy $y:\{G_2=R_2\}$ then HC_1's dominant strategy is $x: \{G_1=R_2+$□□.

Proof:

For HC_2 strategy $y:\{G_2=R_2\}$, The net benefit of country one depends on G_1 as follows:

$$\begin{Bmatrix} NB_1(x,y) = \frac{1}{2}(R_1 - G_2) & if \quad G_1 = G_2 \\ NB_1(x,y) = (R_1 - G_2) & if \quad G_1 > G_2 \\ NB_1(x,y) = 0 & if \quad G_1 < G_2 \end{Bmatrix}$$

Note, that if HC_1 offers $G_1=G_2$, it will win the MNC investment with probability of ½, and the expected added value is as described above. Since $R_1 > R_2$, it is worth it for HC_1 to offer a higher grant value $(G_1 > G_2)$ and to win the MNC investment.

Proposition 6.

The strategy of HC_2 $y:\{G_2=R_2\}$ and HC_1 $x:\{G_1=R_2+$□□ are equilibrium strategies.

Proof:

For HC_1 strategy $x:\{G_1=R_2+$□□, the changes in HC_2's net benefit as a result of changing its strategy $y:\{G_2=R_2\}$ are:

$$\begin{Bmatrix} NB_2(x,y)=0 & if \quad G_2 = R_2 \\ NB_2(x,y)=0 & if \quad G_2 < R_2 \end{Bmatrix}$$

When HC_1 offers a grant such that $G_1= R_2+$□, HC_2 does not gain by offering the same grant (proposition 4), as the expected benefits of HC_2 are negative. On the other hand, HC_2 does not gain by offering a grant smaller than R_2. Therefore, the equilibrium strategies are: y:{$G_2=R_2$} and x:{$G_1=R_2+$□□.

In this section, we have shown that, when there are two different HCs and one MNC, the HC with the higher benefit wins the MNC investment. This HC pays a grant amount that is equal to the benefits of the other country. Thus, part of the HC's benefits remains in the HC.

Note, if budgetary constraints are relevant, then the HC with the higher constraint wins the MNC's investment–not necessarily the HC with the higher benefits. Thus, we can conclude that budgetary constraints may cause inefficiency.

4.3 Two Countries and Two MNCs

Assume that there are two HC_i's *(i=1,2)* and two MNCs. If there is no MNC investing at HC_i, the benefits of this HC_i is zero $(R_{i0}=0)$. If one MNC invests at HC_i, the benefits are R_{i1}, and if both MNCs invest in HC_i the total benefits are R_{i2}. We assume decreasing marginal benefits when the number of subsidiaries increases ($R_{i1} > \frac{R_{i2}}{2}$), and, if the MNCs are similar, the offered grant by HC_i is the same for both HCs. The net benefits of HC_i are: $NB_i = R_{ij} - j \cdot G_i$ (where $j=0,1,2$ and count the number of MNCs that invest in HC_i).

Table 2**. Net benefits matrix for two countries and two MNCs**

	G_{21}	G_{22}	....	G_{2M}
G_{11}	$\frac{1}{4}(R_{i2} - 2 \cdot G_{i1}) + \frac{1}{2}(R_{i1} - G_{i1}) + \frac{1}{4} \cdot 0$	$0 \;; R_{22} - 2 \cdot G_{22}$	....	$0 \;; R_{22} - 2 \cdot G_{2M}$
G_{12}	$R_{12} - 2 \cdot G_{12};\; 0$	$\frac{1}{4}(R_{i2} - 2 \cdot G_{i2}) + \frac{1}{2}(R_{i1} - G_{i2}) + \frac{1}{4} \cdot 0$	....	$0 \;; R_{22} - 2 \cdot G_{2M}$

⋮	⋮	⋮	⋱	⋮
G_{1M}	$R_{12}-2\cdot G_{1M};\ 0$	$R_{12}-2\cdot G_{1M};\ 0$	…….	$\frac{1}{4}\left(R_{i2}-2\cdot G_{iM}\right)$ $+\frac{1}{2}\left(R_{i1}-G_{iM}\right)$ $+\frac{1}{4}\cdot 0$

Table 2 presents the net benefits for each HC. Each HC can offer the MNCs a grant of G_{im} $(m=1,2\ldots M)$. The various types of grants are ordered by their size $(G_{i1}<G_{i2}\ldots.<G_{iM})$ and $G_{1m}=G_{2m}$ for each m . For example: if HC_1 offers G_{14} and HC_2 offers G_{23}, both MNCs will invest at HC_1 and net benefits for HC_1 are $NB_1=R_{12}-2\cdot G_{14}$. If HC_1 offers G_{13} and HC_2 offers $G_{23,}$ then the outcome is as follows: the probability that both MNCs invest at HC_1 is ¼; the probability is ½ that one MNC invests in HC_1 and ¼ that there is no investment at HC_1. The expected net benefits for HC_1 in this case are:

$$\frac{1}{4}\left(R_{12}-2\cdot G_{13}\right)+\frac{1}{2}\left(R_{11}-G_{13}\right)+\frac{1}{4}\cdot 0.$$

If HC_1 offers G_{12} and HC_2 offers G_{23}, both MNCs will invest at HC_2 and net benefits for HC_1 is zero.

We will show that each HC gains by increasing its grant up to a specific limit G_{Max}.

Proposition 8.

Equilibrium exists for every pair of grants $(G_1=G_2)$ that satisfies: $G_{Min}\le G_i\le G_{Max}$ where:

$$G_{Min}=\frac{3}{4}\cdot R_{i2}-\frac{1}{2}\cdot R_{i1}-\frac{1}{4}\cdot 0$$

and

$$G_{Max}=\frac{1}{4}\cdot R_{i2}+\frac{1}{2}\cdot R_{i1}-\frac{3}{4}\cdot 0\,.$$

Proof:

The lower boundary: Let us assume that HC_2 offers $G_2<G_{Min}$; HC_1 can offer $G_1<G_2$. In this case, HC_2 wins and both MNCs invest in HC_2 and NB_1 (HC_1's net benefit) equal to 0.

If HC_1 offers $G_1=G_2$, then, with probability ¼, both MNCs invest in HC_1; with probability ½, one MNC invests in HC_1; and with probability ¼ there is no investment in HC_1. The expected net benefit for HC_1, in this case is:

$$NB_1(G_1 = G_2) = \frac{1}{4}(R_{12} - 2G_2) + \frac{1}{2}(R_{11} - G_2) + \frac{1}{4}\cdot 0 = \frac{1}{4}R_{12} + \frac{1}{2}R_{11} - G_2 + \frac{1}{4}\cdot 0 .$$

However, HC_1 can offer $G_1=G_2+\varepsilon<G_{Min}$. In this case, both MNCs invest in HC_1, and $NB_1(G_1 = G_2 + \varepsilon) = R_{12} - 2(G_2 + \varepsilon)$.

It turns out that:

$$NB_1(G_1 = G_2) > 0$$

and that

$$NB_1(G_2 = G_1 + \varepsilon) > NB_1(G_2 = G_1) > 0 .$$

If HC_2 offers $G_2<G_{Min}$ then HC_1 gains by setting $G_1=G_2+\varepsilon<G_{Min}$. Therefore, any grants below G_{Min} are not in equilibrium.

The middle range: Let us assume that HC_2 offers a grant such that $G_{Max}>G_2>G_{Min}$. Now there are three possibilities for HC_1:

1. HC_1 can offer $G_1<G_2$. In this case HC_2 wins both subsidiaries and NB_1 (HC_1's net benefit) is equal to 0.
2. HC_1 can offer $G_1=G_2$. In this case, there is a lottery (with a probability of ¼ that both MNCs invest in HC_1; a probability of ½ that one MNC invests in HC_1 and ¼ that there is no investment in HC_1). The expected net benefit for HC_1 is:

$$NB_1 = \frac{1}{4}(R_{12} - 2G_2) + \frac{1}{2}(R_{11} - G_2) + \frac{1}{4}\cdot 0 = \frac{1}{4}R_{12} + \frac{1}{2}R_{11} - G_2 + \frac{1}{4}\cdot 0 .$$

3. HC_1 can offer $G_1=G_2+\varepsilon>G_2$. In this case, both MNCs invest in HC_1 and the net benefit is: $NB_1 = R_{12} - 2(G_2 + \varepsilon)$.

Simple calculations reveal that:

- If $G_2<G_{Max}$, then offering $G_1=G_2$ provides HC_1 with a higher *NB* than it can get by choosing $G_1<G_2$.
- If $G_2<G_{Max}$, then offering $G_1=G_2$ provides HC_1 with a higher *NB* than it can get by choosing $G_1=(G_2 + \varepsilon)$.

Therefore, equilibrium exists for any pair of grants $(G_1=G_2)$ that satisfies: $G_{Min} \le G_i \le G_{Max}$.

The upper boundary: HC will not offer $G>G_{Max}$.

Explanation: If HC_2 offers G_2 that is greater than G_{Max} and if $G_1>G_2$, then both MNCs invest in HC_1, and its expected net benefit is:

$$NB_1 = R_{12} - 2(G_{Max} + \varepsilon) = R_{12} - 2 \cdot \left(\frac{1}{4} R_{12} + \frac{1}{2} R_{11} - \frac{3}{4} \cdot 0 + \varepsilon \right) = \frac{1}{2} R_{12} - R_{11} - 2\varepsilon < 0$$

If $G_1=G_2$ then a lottery occurs and:

$$NB_1 = \frac{1}{4} R_{12} + \frac{1}{2} R_{11} - (G_{Max} + \varepsilon) = \frac{1}{4} R_{12} + \frac{1}{2} R_{11} - \left(\frac{1}{4} \cdot R_{12} + \frac{1}{2} \cdot R_{11} + \varepsilon \right) < \tilde{0}$$

Since, in both cases, NB_i is negative, HC never offers a G which is above G_{Max}.

To summarize, we showed that:

- When an HC offers $G<G_{Min}$ the other HC gains by increasing its grant.
- HC will never offer $G>G_{Max}$.
- Any G such that $G_{Max}>G>G_{Min}$ is an equilibrium if both HCs offer this grant.
- The lower boundary and the upper boundary of the equilibrium strategies can be derived from the following argument: Each HC may give up an MNC investment and then its NB is 0. On the other hand, a country may increase its grant offer and can attract the investment of both MNCs. In this case the NB equals R_{i2}-$2 \cdot G_i$. Then $G_1=G_2$ is an equilibrium if:

$$\frac{1}{4}(R_{i2} - 2 \cdot G_i) + \frac{1}{2}(R_{i1} - G_i) + \frac{1}{4} \cdot 0 \geq max\{0, R_{i2} - 2G_i\}.$$

- This inequality provides us with the two boundaries. The lower boundary is:

$$G_{Min} = \frac{3}{4} \cdot R_{i2} - \frac{1}{2} \cdot R_{i1} - \frac{1}{4} \cdot 0,$$

- and the upper boundary is:

$$G_{Max} = \frac{1}{4} \cdot R_{i2} + \frac{1}{2} \cdot R_{i1} - \frac{3}{4} \cdot 0.$$

- Note that $G_1=G_2$, such that $G_{Max}>G_i>G_{Min}$, is an equilibrium, but each HC may suffer ex-post loss. The equilibrium strategies ensure that the expected net benefit is positive. But, if an HC paid a high grant and won both MNCs, then the total amount of the grants may be higher than the total net benefits of the HC, which are derived from the entrance of the two MNCs. This outcome may explain why in most countries there is no automatic system of offering grants for all possible MNC projects.

4.4 The Number of MNCs Is Large

We have shown in the previous sections that the power of the HCs increases as the number of MNCs rises. When the number of HCs is high and there are only a few MNCs, the HCs compete for the FDI in order to gain its benefits. Each HC is willing to offer the MNC a large share of the benefits rather than remain with no FDI. On the other hand, when the number of MNCs is large, each HC knows that one of these MNCs will eventually invest there even if the incentive is low or there are no incentives at all. Furthermore, an HC may set constraints on FDI, such as licensing. An MNC may prefer to pay the HC the license rather than cancel its investment plan and lose any potential profits. Such an HC gains all the benefits of the FDI as well as part of the MNC's profits.

5. Incomplete Information of Benefits

In the previous sections, under the assumption of complete information, all the participants in the incentives competition know the value of all the variables. In this section, we introduce a model with incomplete information. Specifically, each country knows its own benefit, *R*, but has no precise information on the competitor's *R*. Similarly, the MNC knows its own expected profits, but does not know each country's R_i.

For simplicity's sake, we assume that each R_i is uniformly distributed on the [0,1] range, and this information is available to all the participants.

5.1 The Case of Two HCs and One MNC

We assume that R_i denotes the net benefit for HC_i $(i=1,2)$, and that it is uniformly distributed $(R_i \sim U[0,1])$. Each HC_i offers a grant that depends on its own R_i: $G_i = f(R_i)$. We also assume symmetric grant function such that if $R_i = R_j$ then $G_i = G_j$.

HC_i consideration

HC_i's net benefit is:

$$NB_i(G_i, G_j, R_i) = \begin{pmatrix} R_i - G_i & if \;\; G_i > G_j \\ \frac{1}{2}(R_i - G_i) & if \;\; G_i = G_j \\ 0 & if \;\; G_i < G_j \end{pmatrix}$$

Note that we actually ignore the case where $G_1 = G_2$, as a continuous density function is assumed.

The two HCs use the same grant function, $f_1(R) = f_2(R)$ due to the symmetry between HC_1 and HC_2. The optimal grant policy of HC_1 is the one that maximizes its expected net benefit:

$$\underset{G}{MAX}\left(R_1 - G\right)\cdot \Pr\left(G > f\left(R_2\right)\right),$$

and due to the uniform distribution the abject function can be written as:

$$\underset{f}{MAX}\left(R_1 - G_1\right)\cdot f^{-1}(G_1)$$

f^{-1} is defined as the inverse of $G_i = f(R_i)$.

Equilibrium exists when f satisfies (see Krishna, 2002):

$$G_1 = \frac{1}{2}\cdot R_1 .$$

Let us show that the strategy: “each HC suggests a grant that is equal to half of the MNC net benefit” is equilibrium. Assume that $G_2 = \frac{1}{2}\cdot R_2$. In this case, HC_1 acts as follows:

$$\underset{G_1}{MAX}\left(R_1 - G_1\right)\cdot Pr\left(G_1 > \frac{1}{2}\cdot R_2\right) = \underset{G_1}{MAX}\left(R_1 - G_1\right)\cdot \Pr\left(2\cdot G_1 > R_2\right) =$$
$$\underset{G_1}{MAX}\left(R_1 - G_1\right)\cdot 2\cdot G_1$$

First-order condition for maximum is:

$$2\cdot R_1 - 4\cdot G_1 = 0,$$

and therefore,

$$G_1 = \frac{1}{2}\cdot R_1 .$$

When HC_2 uses $f_2=½$, then HC_1 uses $f_1=½$ as well. Because of symmetry, if HC_1 uses $f_1=½$, then HC_2 uses $f_2=½$ as well. Therefore, equilibrium exists when each HC offers a grant that is half of its net benefit.

5.2 The Case of Several HCs and One MNC Under Incomplete Information

There are several symmetric HC_i $(i=1,2\ldots N)$ and one MNC, assuming incomplete information such that each HC knows its own net benefit (R_i) but the other *R*s are unknown except their distribution function. An HC's considerations are:

$$NB_i(G_1, G_2, G_3, \ldots, G_N, R_i) = \begin{pmatrix} R_i - G_i & if \;\; G_i > \max_{i \neq j} G_j \\ \frac{1}{2}(R_i - G_i) & if \;\; G_i = \max_{i \neq j} G_j \\ 0 & if \;\; G_i < \max_{i \neq j} G_j \end{pmatrix}$$

Thus, the object function is:

$$\underset{G}{MAX}\left(R_i - G_i\right)\cdot \Pr\left(G_i > \max_{i \neq j} \; f_j\left(R_j\right)\right)$$

and the equilibrium strategies are (see Krishna, 2002):

$$f_i\left(R_i\right) = \frac{N-1}{N}\cdot R_i \text{ for each } HC_i.$$

We can see that as the number of HCs increases, the offered grant increases as well. The reason for this is that the probability of winning the MNC's investment decreases as the number of HCs increases, and each HC compensates by raising its grant. Therefore, when the number of HCs is large, the *G* approaches *R*, and the HC's net benefit decreases.

In summary, this section investigates cases of incentives competition under incomplete information. When one MNC faces two HCs, equilibrium exists when each HC offers a grant that is equal to half its benefits. In equilibrium, the subsidiary will be established in the HC where its contribution to the economy is higher. The HC enjoys half of the benefits of the FDI.

An increase in the number of potential HCs increases the grant offered by each HC as well. Therefore, more intense incentives competition increases the share of the HC's benefits.

6. Summary and Conclusions

This paper investigated incentives competition in cases where there is complete information on the HC's benefits as well as the MNC's profits. Each country tries to attract FDI by offering the MNC an incentive. We applied models of auction theory to this problem, presented the optimal strategies for each HC, and characterized the Nash equilibrium strategies.

There are two main questions regarding the equilibrium of the incentives competition:

1. What is the portion of an HC's benefits that is spent on FDI incentives?
2. Is the global allocation of investment optimal? That is, should FDI go first to HCs with higher productivity, and only when the size of the FDI is large should the low productivity HCs get their share of the investment?

The main results are as follows. When there is one MNC and two (identical) HCs competing for an investment, at equilibrium, each HC offers an incentive that is equal to its total benefit derived from the FDI. This is the only case where our results coincided with those of Blomstrom and Kokko (2003), who argued that a set of rules is required to limit the level of incentives and to let each MNC gain a major part of the FDI benefits.

If there is a constraint on the amount of the incentives (due to a budget shortage or global regulation), the incentives competition leads to an equilibrium where a larger share of the benefits remains in the HC, but it can also lead to inefficiency where the new subsidiary is located in the less productive HC. This finding supports Bjorvatn and Eckel (2006), who argued that competition between HCs improves the efficiency in the allocation of FDI in HCs.

When the two HCs differ with respect to their benefits, the HC with the higher benefit wins the race and can offer incentives that are equal to the other HC's lower benefit.

When the HCs face several MNCs, and under the assumption of diminishing benefits, the equilibrium of the incentives competition consists of a range of possible incentives. In this case, it is possible that the actual value of the incentives is greater than the total benefits of the HC.

Thus, we have shown that under complete information the characteristics of the incentives competition equilibrium depend on the number of participants in the game, which is the number of HCs that compete for FDI as well as the number of MNCs who are looking for investment location.

Couples of models are analyzed under the assumption of incomplete information. When one MNC faces two HCs, equilibrium exists when each HC offers a grant that is equal to half the benefits, and the subsidiary will be established in the HC where its contribution to the economy is higher. An increase in the number of potential HCs increases the grant offered by each HC as well. Therefore, more intense incentives competition increases the share of the MNC's benefits.

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