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# The influence on developing countries' foreign direct investment (FDI) policies imposed by incentives: A game analysis

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**When governments initiate incentive policies, they are concerned for the transnational corporations' foreign direct investment (FDI). All governments intend to attract FDI by incentive policies. On the other hand, transnational corporations determine their FDI based on the incentive policies implemented by the developing countries. Therefore, incentive policies affect FDI more than anything else. However, few researchers have studied the game between the interest groups within the host country, that is, the competition between various regions regarding how to attract FDI by incentive policies. Therefore, this study attempts to analyze the game between incentive policies and FDI by game theory and compare the contributions made by incentives. Secondly, this study intends to identify the negative effects of prisoner's dilemma caused by incentives. Finally, this study discusses the arrangements made by host countries regarding FDI and countermeasures and thereby presents options regarding the incentives to be adopted by governments.**

**Key words:** Transnational corporations, foreign direct investment (FDI), incentive policy, game theory.

## INTRODUCTION

Transnational corporations have increased their foreign direct investment (FDI) substantially in recent years. As a result, transnational corporations have sped up their internationalization process and amended their capital structures and investment methods ceaselessly. Transnational corporations' FDI accelerates the host countries' economic development tremendously. The host countries are increasingly aware of the transnational corporations' FDI affecting their economies. Therefore, many countries, including the developed nations, are competing against one another in order to attract transnational corporations' FDI (UNCTAD, 2010).

Transnational corporations' FDI not only builds capitals for host countries, but speeds up host countries' technical advancement (Caves, 1996). At the time that more and more countries have understood the role played by transnational corporations' FDI, investment barriers have been removed one after another. In the 1990s alone, 1000 FDI laws and regulations were amended – 94% were amended to attract FDI (UNCTAD, 2010). In an effort to remove investment barriers, many countries have

implemented incentives to attract FDI, including tax exemptions, government's pledges, equipment and component tariff reductions, as well as goal-oriented incentives, such as Research and Development (R&D) subsidy, employment and vocational training, and technical transfer.

Classic international trade theorems are short of the discussions on transnational corporations and FDI. Then, a large number of transnational corporations appeared in the last century. With the rapid FDI development, international trade scholars began to modify the traditional theorems in order to interpret FDI adequately (Kemp, 1966; Jones, 1967; Helpman, 1984). However, the transnational FDI theorems at that time, such as enterprise's competitive theory (Hymer, 1996; Kindleberger, 1969; Horst, 1971, 1973; Copithorne, 1971; Caves, 1974), internalization theory (Magee, 1977; Buckley and Casson, 1989; Krugman, 1986), product lifecycle theory (Vernon, 1966, 1979; Wells Jr., 1968), comparative advantage theory (Kojima, 1973, 1978, 1990), international production compromise theory integrated with enterprise

advantage theory, internalization theory and regional theory (Dunning, 1977, 1981, 1990) and the literatures regarding FDI-overflow effect (Caves, 1974; Blomstrom and Pererron, 1983; Haddad and Harrison, 1991; Kokko, 1974; Kokko et al., 1996, 1997; Ramstetter, 1998; Chung and Lin, 1999; Lai, 2000) were founded on the individual transnational corporation in which host countries were treated as the background and premise (Ho et al., 2003).

So far, no researcher has treated host country as endogenous decision-making subject. Instead, the host countries were treated as a background with fixed behaviors under which transnational corporations reached their investment decisions. Apparently, their analysis concentrated on the investors' behaviors and disregarded the host countries' behaviors, which is unable to describe the whole picture. Both host countries and transnational corporations are involved in FDI. Just like all transactions in the marketplace, FDI is a win-win process for both host countries and transnational corporations through Pareto equilibrium. However, a careful examination reveals a number of external issues throughout the transaction. Both players are subject to the decisions and behaviors made by each other; both players' revenues are subject to the decisions made by both players, too. Therefore, each player has to include its restrictions and other player's decisions into consideration. Revenue and decisions affect and depend on each other. Apparently, the host country and transnational corporations are involved in a game when they deal with FID.

In recent years, some scholars have analyzed the policies implemented by host countries for transnational corporations regarding FDI and the related benefits (Spencer, 1987; Levinsohn, 1989; Levy and Nolan, 1992; Prusa, 1990; Bartolini, 1995; Chen-Kuo, 2004, 2010). Since then, host countries' policies have been treated as an important factor for the analysis of transnational corporations' investment decisions. Nonetheless, their analysis concentrated on transnational corporations' FDI, instead of the roles played by host countries (Chen-Kuo, 2004). Up until now, few scholars have researched the game between interest groups competing against each other destructively in host countries, for example, blockading, boycotting and obstructing each other. Therefore, this study intends to concentrate on the afore stated game.

Economic policy analysis concentrates on government's interference with economy as well as the effects arising from government's interference. Faced with government's interference, players have to make a choice between their expected goals and benefits. Secondly, players respond to different policies by different strategies. Apparently, the policies activate games for the players. So far, United States and European scholars have applied monetary policies, financial policies and foreign trade policies to game theory comprehensively, but few scholars have included the host countries' regional economic policies into analysis. Therefore, this

study begins with the game activated by incentive policy, concentrating on the basic games activated by regional incentive policy, followed by the discussions and analysis of the incentive strategies designed for FDI, the game between regional incentives and FDI, the "prisoner's dilemma" resulted from the incentive policies designed for regional FDI, as well as the host countries' regional FDI and countermeasures.

### Basic models

This study implements regional incentives and FDI-oriented game models by game theory in order to analyze the contributions made by the FDI-oriented incentives and meanwhile, identify the negative impacts of "prisoner's dilemma" activated by the FDI-oriented incentives.

### REGIONAL FDI-ORIENTED INCENTIVE STRATEGIES AVAILABLE FOR THE GOVERNMENT

Assume three factors affecting the regional FDI-oriented incentive policies implemented by a government – to wit; incentive policies (financial incentives, monetary incentives, and price preference), manpower policy (human resources, technical and managerial human resources), and environment policy (regional politics, economy, society, laws, credits, infrastructure, market size, etc.). Three factors affect the pace, size and level of FDI inflow. Let  $p$ ,  $l$ , and  $b$  denote the costs for every 1 USD of FDI inflow  $w$  produced by incentive, manpower incentive and environment incentive, respectively. Therefore,  $c = p + l + b$  represents the costs of incentive for every US dollar attracted by FDI. Transnational corporations' investments enhance regional economic development. Meanwhile, transnational corporations profit from their investment in host countries. When  $w$  increases, the host country (or region) sees its  $R$  increase. The relationship is denoted by  $R(w)$  in which  $R'(w) > 0$  and  $R''(w) < 0$ , the more FDI in the region, the higher the economic benefits  $R$ . However, the growth slows down as  $w$  increases (MacDougall, 1960). When governments implement incentives to attract FDI, the net economic benefits  $\pi(w, p, l, b)$  satisfies the equation as follows:

$$\begin{aligned}\pi &= (w, p, l, b) = R(w) - (p + l + b)w \\ &= R(w) - cw\end{aligned}\quad (1)$$

When FDI inflow  $w$  is combined with three factors (incentive policy  $p$ , manpower policy  $l$  / environment policy  $b$ ), the three factors serve as key elements for FDI inflow and  $w$  serves as output function in Cobb-Douglas production function shown as Equation (2) as follows:

$$w = Ap^{\alpha}l^{\beta}b^{\gamma} \quad (2)$$

In Equation (2), parameter  $A$  denotes FDI inflow  $w$ 's dependence on incentive policy, manpower policy and environment policy, which determines transnational corporations' satisfaction of the investment environment in the host country (region). The satisfaction is treated as a function of time  $t$ , which fluctuates as time, FDI size and standard change. Within a fixed timeframe,  $A$  increases as administrative and technical innovation are upgraded by incentive policy, human resources and environment resources; and vice versa. Exponents  $\alpha$ ,  $\beta$  and  $\gamma$  denote the output elasticity of policy strength  $p$ , manpower quality  $l$  and environment strength  $b$  in relation to FDI inflow  $w$ , which means the contributions made by the incremental incentive policy, human resources and environment resources to FDI inflow. Therefore,  $\alpha$ ,  $\beta$  and  $\gamma$  are calculated by Equation (3) as follows:

$$\alpha = \frac{dw}{dp} \cdot \frac{p}{w}, \quad \beta = \frac{dw}{dl} \cdot \frac{l}{w}, \quad \gamma = \frac{dw}{db} \cdot \frac{b}{w} \quad (3)$$

When  $\alpha + \beta + \gamma > 1$ , FDI causes revenue to grow. When  $\alpha + \beta + \gamma = 1$ , revenue remains unchanged although FDI increases. When  $\alpha + \beta + \gamma < 1$ , FDI causes revenue to decrease. Apparently, when  $\alpha + \beta + \gamma > 1$ , FDI induce investment to grow, causes  $p$ ,  $l$  and  $b$  to increase by 1%, and thus triggers  $w$  to grow by  $(\alpha + \beta + \gamma) \%$  (larger than 1%). Therefore, the region has to maintain the incentives. When,  $\alpha + \beta + \gamma = 1$ ,  $w$  grows at the same pace as  $p$ ,  $l$  and  $b$ , at this time the region still has to maintain the incentives. When  $\alpha + \beta + \gamma < 1$ ,  $w$  grows slower than  $p$ ,  $l$  and  $b$ , at this time the incentives have lost efficiency; therefore the region has to reduce incentives, find out the reasons behind the deteriorating efficiency, and solve the problems in due course.

If the region modifies the incentive policy, upgrades human resources and environment resources to improve its investment climate, the additional incentive costs  $c$  satisfies the equation  $c = p + l + b$ . The region's government improves investment climate (to improve  $p$ ,  $l$  and  $b$ ) in order to maximize FDI inflow. An optimal model is therefore implemented for the decision-related issues:

$$\begin{aligned} \text{Max } w &= (p, l, b) = Ap^{\alpha}l^{\beta}b^{\gamma} \\ \text{s.t } c &= p + l + b \end{aligned} \quad (4)$$

The following are the first-order conditions for the optimization required by Model (4):

$$\begin{cases} \frac{\partial w}{\partial p} = \frac{\partial w}{\partial l} = \frac{\partial w}{\partial b} \\ c = p + l + b \end{cases} \quad (5)$$

Therefore:

$$\begin{cases} \frac{\alpha}{p} = \frac{\beta}{l} = \frac{\gamma}{b} \\ c = p + l + b \end{cases} \quad (6)$$

According to Equation (6), regional government's optimal incentive costs  $c^*$  and all incentive factors' motivation strengths ( $p^*$ ,  $l^*$  and  $b^*$ ) satisfy the following relationship:

$$p^* = \frac{\alpha}{\alpha + \beta + \gamma} c^*, \quad l^* = \frac{\beta}{\alpha + \beta + \gamma} c^*, \quad b^* = \frac{\gamma}{\alpha + \beta + \gamma} c^* \quad (7)$$

If regional government behaves flexibly and effectively in the FDI solicitation process, it can control the total incentive costs and all incentive factors' incentive strengths using the demands in various FDI development stages, meaning  $c^*$  can be adjusted by the regional government's optimal strength  $P^*$  based on its incentive policies. Therefore, other factors' incentive strengths can be determined by Equation (7). According to this analysis, incentive policy strength  $p$  is an appropriate criterion to examine the incentive required by regional FDI solicitation. Therefore, this study obtained  $P^*$  from model (4), and then acquired the values of incentive strengths using Equation (7).

### Analyzing regional incentives and FDI solicitation using game models

According to afore analysis, the relationship between incentive policy strength  $p$  and FDI inflow  $w$  can be found when incentives are launched to induce FDI; other incentives, such as  $l$  and  $b$ , can be obtained using Equation (7). Therefore, the net economic benefits (1) created by regional FDI are expressed by following equation:

$$\pi(w, p) = R(w) - \frac{\alpha + \beta + \gamma}{\alpha} pw \quad (8)$$

Assume the  $p$ ,  $l$  and  $b$  (inputs) created by regional incentive FDI and the regional FDI inflow  $w$  (outputs) constitute a production function with constant benefits, meaning  $\alpha + \beta + \gamma = 1$  in which  $\alpha$  denotes the ratio of incentive policy to FDI inflow  $w$ ,  $\beta$  denotes the ratio of human resources to FDI inflow  $w$ , and  $\gamma$  represents the ratio of environment to FDI inflow  $w$ , respectively. Assume  $p_0$ ,  $l_0$  and  $b_0$  represent the lower limits of  $p$ ,  $l$

and  $b$ . Let  $P = \frac{p}{\lambda}, L = \frac{l}{\lambda}, B = \frac{b}{\lambda}, \lambda = \min\{p_0, l_0, b_0\}$ .  
 Therefore,  $P \geq 1, L \geq 1, B \geq 1$ . Now, substitute  $p = \lambda P, l = \lambda L, b = \lambda B$  into Equation (2). Thus:

$$w = A(\lambda P)^\alpha (\lambda L)^\beta (\lambda B)^\gamma$$

$$= \lambda A P^\alpha L^\beta B^\gamma$$

$\lambda$  is a constant. Therefore,  $\lambda A$  is denoted by  $A$ , and  $w$  is denoted by following equation:

$$w = A P^\alpha L^\beta B^\gamma, P \geq 1, L \geq 1, B \geq 1$$

Based on the afore assumptions, regional incentives and FDI solicitation are considered a dynamic game model of complete information. Assume regional government announces incentive policy, all transnational corporations in that region watch the incentive policy strength closely before they decide their investment amounts. Amount zero means no transnational corporation in that region. Regional government takes the first move to launch incentive policy with incentive strength  $P$ . Transnational corporations determine their investment amounts  $w$  based on  $P$ . As soon as both sides reach equilibrium, the game is over. Based on the transnational corporations' reactions to the incentive policy strength, this analysis concludes that the transnational corporations adjust their strategies based on the relationship between  $w$  and  $P$  ( $w = A P^\alpha L^\beta B^\gamma, P \geq 1, L \geq 1, B \geq 1$ ). On the other hand, regional government finalizes its optimal strength  $P^*$  based on the transnational corporations' reactions in order to materialize the optimal economic benefits. Apparently, regional government reaches its decisions using the optimal models as follows:

$$Max \quad \pi = (w, P) = R(w) - \frac{\lambda}{\alpha} P w \tag{9}$$

$$s.t. \quad w = A P^\alpha L^\beta B^\gamma$$

In model (9),  $P \geq 1, L \geq 1, B \geq 1, w > 0, A > 0, \alpha > 0, \beta > 0, \gamma > 0, \alpha + \beta + \gamma = 1$

Using the optimization model (9), this study found  $P^*$  and  $w^*$  are the optimization values for  $P$ , and  $w$ , respectively. Both optimization values satisfy following relationship:

$$P^* = \frac{\alpha}{\lambda} R'(A P^\alpha L^\beta B^\gamma) \tag{10}$$

$$w^* = f(A, P, L, B, \alpha, \beta, \gamma) \tag{11}$$

From implicit Equations (10) and (11), this study found  $(P^*, w^*)$  are the sub-game perfect Nash equilibrium (SPNE) needed by regional government and FDI in the dynamic game model of complete information. Apparently,  $P^*$  and  $w^*$  are the multi-functions needed by  $A, P, L, B, \alpha, \beta$  and  $\gamma$ :

$$P^* = h(A, P, L, B, \alpha, \beta, \gamma) \tag{12}$$

$$w^* = k(A, P, L, B, \alpha, \beta, \gamma) \tag{13}$$

Game equilibrium: Regional government's optimal  $\lambda$

economic effect  $\pi^*(w^*, P^*) = R(w^*) - \alpha P^* w^*$ ; The optimal inflow  $w^*$  of regional FDI satisfies the following:

$$c^* = \frac{\alpha + \beta + \gamma}{\alpha} P^*$$

$$L^* = \frac{\beta}{\alpha + \beta + \gamma} c^*$$

$$B^* = \frac{\gamma}{\alpha + \beta + \gamma} c^*$$

$$w^* = A(P^*)^\alpha (L^*)^\beta (B^*)^\gamma \tag{14}$$

**Analysis of the contributions made by regional FDI incentives**

This study has examined the SPNE results stated earlier and identified the equilibrium between regional government's incentive policy strength  $P$  and transnational corporations' investment amounts  $w$ . Manpower resources and environment substitute each other when regional government attempts to attract FDI using incentive policy. In other words, manpower resources and environment facilitate the incentive policy to attract FDI. This relationship is manifested by the

$$\frac{\partial P^*}{\partial L}, \frac{\partial w^*}{\partial L}, \frac{\partial P^*}{\partial B}, \frac{\partial w^*}{\partial B}$$

values derived from  $(\frac{\partial P^*}{\partial L}, \frac{\partial w^*}{\partial L})$  and  $(\frac{\partial P^*}{\partial B}, \frac{\partial w^*}{\partial B})$ . Using Equations (10) and (11), this study has found the partial derivatives of  $L$  and  $B$  as follows:

$$\frac{\partial P^*}{\partial L} = \frac{\beta P^* w^* R''(w^*)}{L^* \left[ \frac{\lambda}{\alpha} P^* - \alpha w^* R''(w^*) \right]} \tag{15}$$

$$\frac{\partial P^*}{\partial B} = \frac{\gamma P^* w^* R''(w^*)}{L^* \left[ \frac{\lambda}{\alpha} P^* - \alpha w^* R''(w^*) \right]} \quad (16)$$

$$\frac{\partial w^*}{\partial L} = \frac{\beta w^*}{L^* \left[ 1 - \frac{\alpha^2}{\lambda} A \left[ \frac{\alpha}{\lambda} R'(w^*) \right]^{\alpha-1} R''(w^*) \right]} \quad (17)$$

$$\frac{\partial w^*}{\partial B} = \frac{\gamma w^*}{\beta^* \left[ 1 - \frac{\alpha^2}{\lambda} A \left[ \frac{\alpha}{\lambda} R'(w^*) \right]^{\alpha-1} R''(w^*) \right]} \quad (18)$$

With  $P^* > 0$ ,  $L^* > 0$ ,  $\beta^* > 0$ ,  $\alpha > 0$ ,  $\beta > 0$ ,  $\gamma > 0$ ; and  $R''(w^*) < 0, R'(w^*) > 0$ , this study has found the following. Using Equations (15) through (18):

$$\frac{\partial P^*}{\partial L} < 0, \frac{\partial w^*}{\partial L} > 0 \quad (19)$$

$$\frac{\partial P^*}{\partial B} < 0, \frac{\partial w^*}{\partial B} > 0 \quad (20)$$

According to Equations (19) and (20), when regional government implements incentive policy to attract FDI, the policy strength is subject to the influence imposed by human resources, environment and the level of development, which affect one another oppositely. In other words, when human resources (or environment) are improved, regional government can reduce its incentive policy strength and maintain the equilibrium at the same time. On the other hand, a higher level of human resources and environment facilitate FDI to attract more  $w$ . In other words, the higher quality of human resources (or the higher level of environment) facilitates FDI to attract more  $w$ . Therefore, human resources and environment facilitate incentive policies.

With  $L > 1$  and  $B > 1$ , this study has found the derivatives of  $\beta$  and  $\gamma$ . Similarly, this study has found the inequalities as follows:

$$\frac{\partial P^*}{\partial \beta} < 0, \frac{\partial w^*}{\partial \beta} > 0 \quad (21)$$

$$\frac{\partial P^*}{\partial \gamma} < 0, \frac{\partial w^*}{\partial \gamma} > 0 \quad (22)$$

According to Equations (21) and (22), when regional human resources (or environment) develop sufficiently, regional government's incentive policy strength and human resources (or environment) affects the output elasticity of FDI oppositely. When regional human resources (or environment) are further upgraded, regional government reduces its incentive policy strength. Meanwhile, the incentive policy continues to attract FDI.

### The prisoner dilemma created by the competition under incentive policy

According to previous analysis, incentive policy, human resources and environment attract FDI. Meanwhile, human resources and environment affect incentive policy to a large extent. If the host country (for example, Taiwan) is attracting FDI to all industries and the central government is no longer intervening in the regional FDI solicitation systems, all regional governments are therefore, free to implement their incentive strategies. In such case, all regional governments tend to launch FDI solicitation policies and provide all kinds of incentives in order to attract foreign investments. Thus, all regional governments compete against one another for foreign investments. Actually, transnational corporations gain regional benefits from incentive policies. As a result, the host country loses revenues. Therefore, this study discusses the dilemma caused by the competition using game theory.

Assume two regions (A and B) in a host country are competing against each other using incentive policies. If both players choose to cooperate (not to implement incentive policies), they obtain net economic benefit  $\pi_{01}$  and  $\pi_{02}$ , respectively. If both players choose not to cooperate (to implement incentive policies), they obtain net economic benefits  $\pi_{11}$  and  $\pi_{12}$ , respectively. When both regions compete against each other using incentive policies, they are faced with solicitation costs. Assume  $\pi_{0i} > \pi_{1i} (i=1,2)$ . If one player chooses to cooperate but the other player chooses not to cooperate (competition), the cooperative player obtains net economic benefits  $X_{0i} (i=1,2)$  and the uncooperative player obtains  $Y_{1i} (i=1,2)$ . When one player chooses to cooperate and other player chooses to compete, the uncooperative player attracts more foreign investments using its incentive policy. Thus, its net economic benefits increase dramatically. The cooperative player launches fewer incentive policies and thus losses its net economic benefits. Assume  $Y_{1i} > \pi_{0i} > \pi_{1i} > X_{0i} (i=1,2)$ , the strategies adopted by regions A and B are shown in Table 1.

In Table 1,  $(\pi_{11}, \pi_{12})$  represents the game results between both players using incentives to attract FDI. If both players cooperate, they reach Pareto equilibrium at  $(\pi_{01}, \pi_{02})$ . In other words, when central government lifts restrictions for incentives, all players act for their best interests and cause prisoner dilemma for their game. Thus, the group optimization is unlikely to come true. The

**Table 1.** The game between both players using incentive policies to attract FDI.

		A	
		Cooperate	Compete
B	Cooperate	$\pi_{01}, \pi_{02}$	$X_{01}, Y_{12}$
	Compete	$Y_{11}, X_{02}$	$\pi_{11}, \pi_{12}$

$$Y_{11} > \pi_{01} > \pi_{11} > X_{01} \quad (i=1,2).$$

competition causes the region to lose its interest and thus the national financial revenue decreases dramatically.

**Coordination and countermeasures between all regions of host country (Taiwan) using incentives to attract FDI**

It is important to reconcile the inconsistency between regional government’s goals and central government’s goals, balance the different levels of FDI inflows between all regions, and minimize the financial loss arising from FDI inflows. If host country maintains a low level of FDI, the issues stated earlier are far from urgent. If host country induces FDI substantially, these issues have to be solved in due course. Therefore, host country has to complete the following tasks in order to solve these issues permanently: If any region is short of human resources and infrastructure (for example, eastern Taiwan), the regional government does not have to compete against the regions full of human resources and infrastructure (for example, western Taiwan) for premium foreign investments. Premium foreign investments refer to the large transnational corporations possessing core competence and abilities to monopolize industries, or hi-tech industries producing “technical overflow effect” to upgrade the whole industry’s competitive edge, or hi-tech industries producing external effect to energize the industrial chain. Low-grade foreign investments, contrary to the premium foreign investments, contribute insignificantly to the industry’s value and lack the abilities to produce technical overflow effect.

This study has analyzed the host country’s FDI factors including incentive policies, human resources and environment. According to the analysis, premium foreign investments stress long-term development with emphasis on the human resources and environment of the host country, and treat incentive policies as the second important factor. However, low-grade foreign investments stress short-term interests and treat incentive policies as the most important factor. Based on the aforementioned discussions, this study lists the host country’s foreign investment policy, human resources and environment in various development stages in Table 2.

In Table 2, as far as foreign investment policy is concerned, eastern Taiwan is in a transitional period between stage 1 (featured by the incentive policy promulgated by

the host country) and stage 2 (featured by the regulatory policy promulgated by the host country) whereas western Taiwan is in a transitional period between stages 2 and 3 (featured by the enhanced industrial association policy promulgated by the host country). Apparently, eastern Taiwan is likely to attract FDI using incentive policy while western Taiwan is developing human resources and environment in order to attract foreign investments (stage 3). Therefore, eastern Taiwan is leading western Taiwan in terms of incentive policy. However, eastern Taiwan has just begun to improve its human resources and environment while western Taiwan has developed its human resources and environment sufficiently. Apparently, western Taiwan is leading eastern Taiwan in terms of human resources and environment. According to above analysis, premium FDI is likely to reach equilibrium in northern Taiwan because of the abundant human resources and superior environment in northern Taiwan (entrance, superior human resources and environment) whereas low-grade FDI is likely to be attracted by the incentive policy promulgated in eastern Taiwan (entrance, incentive policy). Table 3 shows the equilibrium derived from the game.

According to previous analysis and the game described by Table 3, western Taiwan is leading eastern Taiwan in terms of human resources and environment whereas eastern Taiwan is leading western Taiwan in terms of incentive policy. Assume western Taiwan is attracting FDI using its abundant human resources and environment. In other words,  $Q_2 > Q_1, Q_4 > Q_3$ . Premium FDI prefers human resources and environment while low-grade FDI prefers incentive policy. It is therefore reasonable to assume  $F_2 > F_4, F_3 > F_1$  and find  $(F_2, Q_2)$  as the equilibrium in western Taiwan. In other words, western Taiwan’s superior human resources and environment attract premium FDI. Eastern Taiwan has promulgated a number of incentive policies. In other words,  $Q_1 > Q_2, Q_3 > Q_4$ , and  $F_3 > F_1$ . Similarly, FDI finds  $(F_3, Q_3)$  as the equilibrium in eastern Taiwan. In other words, eastern Taiwan should strive to attract low-grade FDI for the time being instead of competing with western Taiwan using incentive policies to attract premium FDI. Furthermore, at the time western Taiwan continues to reduce incentive policies, eastern Taiwan should reduce its incentive policies and thereby moves to stages 2 and 3. In other words, eastern Taiwan should reduce its incentive policies in cooperation with western Taiwan and meanwhile improve its human resources and environment and thereby begins to attract premium foreign investments instead of the low-grade foreign investments. Thus, Taiwan can accelerate its regional development, regional industries and enterprises constructively using FDI.

In the long-run, all regions have to improve their human resources, environments, and meanwhile reduce their incentive policies in order to attract FDI in a positive and constructive manner. Therefore, western Taiwan should continue to improve its market size, FDI clusters,

**Table 2.** Investment factors of host country (Taiwan) in various development stages.

Development stage	Foreign investment policy	Human resources	Environment	Current stage
I	Incentive policy	Weaker	Inferior	Areas in eastern Taiwan
II	Regulatory policy	Developing	Developing	Eastern Taiwan (limited areas), western Taiwan
III	Enhanced industrial association policy	Matured	Perfect	Areas in western Taiwan

Source of data: This study.

**Table 3.** The game of investment decisions made by FDI between different regions.

Region FDI	Incentive policy	Human resources and environment
Premium FDI	$F_1, Q_1$	$F_2, Q_2$
Low-grade FDI	$F_3, Q_3$	$F_4, Q_4$

industrial clusters, human resources, urbanization, infrastructure, R&D technologies, scientific administration skills, and meanwhile reduce incentive policies using its superior human resources and environment.

Eastern Taiwan should learn from western Taiwan regarding FDI, especially western Taiwan's experiences in market, liberalization, technical innovations and scientific administrations. Thus, eastern Taiwan can upgrade its human resources and create a motivation system in order to attract FDI. Secondly, eastern Taiwan must not compete with western Taiwan using incentive policies. Instead, eastern Taiwan must reduce incentive policies and continue to upgrade human resources and environment in cooperation with western Taiwan. In the long-run, eastern Taiwan must improve its human resources and upgrade its environment in order to attract FDI. Thirdly, eastern Taiwan must continue to make best use of the central government's financial assistance in order to improve its human resources and upgrade its environment. Meanwhile, eastern Taiwan has to guide foreign investments into its infrastructure and meanwhile improve its human resources and upgrade environment using funds from all sources. Thus, eastern Taiwan can use FDI constructively: FDI inflows → improving human resources and upgrading environment → new FDI or attracting foreign investments from western Taiwan → improving human resources and upgrading environment once again.

Central government should act as a coordinator and motivator in order to help all regions attracting FDI. Transnational corporations make their investment decisions based on the incentive policies promulgated by the host country for various regions. If incentives vary from region to region and all regions are similar to one another in terms of human resources and environment,

transnational corporation are likely to invest in the regions having promulgated more incentive policies than other regions. If all regions are similar to one another in terms of incentives, transnational corporations are likely to make their investment decisions based on the human resources and environment of all regions. In an effort to minimize the loss arising from all regions using incentive policies to attract FDI, central government must combine its investment environment with its markets based on the incentive policies promulgated by the nearby countries and meanwhile restricts all regions from competing with one another using incentive policies. Moreover, central government must establish a system to motivate all regions maintaining the same incentive policy strength for FDI. Thus, the host country can retain FDI within all regions and meanwhile, motivate all regions to reduce their incentive policies jointly in order to minimize the financial loss for the host country. In an effort to optimize FDI scale and minimize incentive policy strength at the same time, central government must formulate its countermeasures based on the analysis stated hereunder with respect to the incentive policies promulgated for various regions:

i. As far as incentive policy is concerned, central government must restrict the uncooperative regions and support the cooperative regions at the same time. In an effort to encourage all regions cooperating with one another for a common goal, central government must formulate a reasonable incentive policy based on the changes of environment, and request all regions to comply with the standard promulgated by the central government. All regions choose either competition or cooperation when they are faced with the decision of using incentive policy or not. If central government

**Table 4.** FDI incentive policy's competitive game between various regions under the motivation system formulated by central government.

	<b>B</b>	
	<b>Cooperation</b>	<b>Competition</b>
<b>A</b>		
Cooperation	$\pi_{01}+R, \pi_{02}+R$	$X_{01}+R, Y_{12}-C$
Competition	$Y_{11}-C, X_{02}+R$	$\pi_{11}-C, \pi_{12}-C$

$$Y_{11} > \pi_{01} > \pi_{11} > X_{01} \quad (i=1,2).$$

provide financial assistance, such as loans, taxes and subsidy, to the regions having complied with the cooperative strategy promulgated by central government for a long period of time, all such regions increase their economic benefits R. Meanwhile, central government restrict the regions using competitive strategy and publicize the violating regions' incompliance, the violating regions increase their costs C. Thus, central government transforms the FDI incentive policy's competitive game (Table 1) into the strategic game stated in Table 4 using a two-way system.

According to Table 4, when central government's two-way system causes R+C to grow large enough, in other

words  $R+C > \text{Max}_{i=1,2} \{Y_{1i} - \pi_{0i}, \pi_{1i} - X_{0i}\}$ , the cooperative strategy turns into the advantageous strategy stated in Table 3.

In such case, equilibrium switches from competitive strategy {(competition, competition), ( $\pi_{11}, \pi_{12}$ )} to a new cooperative strategy {(cooperation, cooperation), ( $\pi_{01}+R, \pi_{01}+R$ )}. Thus, all regions cease to use incentive policy.

ii. Central government must create a credibility environment to facilitate all regions cooperating faithfully with one another in order to attract FDI through their joint efforts. All regions have to comply with the credibility rules promulgated by central government when they initiate FDI solicitation policies. Furthermore, all regions have to correct the conducts inconsistent with the credibility rules promulgated by central government. The credibility utility was included into consideration when this study examined n regions' competition using incentive policies, and then defined the net economic benefit function derived from FDI using the quadratic function stated in Equation (23):

$$\pi_i = \pi_i^* - a_{1i} \left( w^* - \sum_{i=1}^n w_i \right)^2 - a_{2i} b w_i \quad (i = 1, 2, \dots, n) \quad (23)$$

In Equation (23),  $i=1,2,\dots,n$  denotes the regions using incentive policy for competition,  $\pi_i$  denotes the net economic benefits of region  $n_i$ ,  $\pi_i^*$  denotes the optimal net economic benefits produced by FDI for region  $n_i$ ,  $w_i$  denotes the amount of FDI flowing into region  $i$ ,  $w^*$

denotes the optimal amount of FDI needed by the whole country (the goal set by central government in accordance with the actual needs in all stages),  $a_{2i}b$  denotes the incentive policy strength for region  $i$ , the difference of incentive policy strength between region  $i$

and region  $j$  is determined by  $\frac{a_{2i}}{a_{2j}}$ ,  $b$  is a constant index representing the same incentive policy strength of all regions. The index serves as a unified standard promulgated by central government for the incentive policies implemented by all regions,  $a_{2i}$  denotes the deviation from the unified standard  $b$  of region  $i$ , When  $a_{2i} > 1$ , there is too much competition between all regions.

When  $0 \leq a_{2i} \leq 1$ , all regions comply with the rules (all regions' conducts either compliant with the requirements or better than the requirements). Furthermore, parameter  $a_{1i} > 0 (i=1,2,\dots,n)$ ,  $-a_{2i}b w_i$  denotes the interests transferred to transnational corporations by region  $i$  due to incentive policies, or the costs of incentive policies implemented by

region  $i$  when  $\sum_{i=1}^n w_i = w^*$ ,  $-a_{1i} \left( w^* - \sum_{i=1}^n w_i \right) = 0$ . Thus,

$-a_{1i} \left( w^* - \sum_{i=1}^n w_i \right)^2 = 0$  represents the damages of

credibility or penalties occurring to region  $i$  when the FDI solicitation  $w_i$  of region  $i$  deviates from the optimal goal  $w^*$  promulgated by central government. When  $w=0, \pi=0$ . When both equations are substituted into Equation (23), this study found:

$$\pi_i = a_{1i} \left( w^* - \sum_{j \neq i} w_j \right)^2 \quad (24)$$

Substituting Equation (24) into Equation (23), this study found:

$$\pi_i = a_{1i} \left( w^* - \sum_{j \neq i} w_j \right)^2 - a_{1i} \left( w^* - \sum_{i=1}^n w_i \right)^2 - a_{2i} b w_i \quad (25)$$

If n regions of the host country comply with the FDI solicitation goal promulgated by central government

$\left( w^* = \sum_{i=1}^n w_i \right)$  and meanwhile continue to increase their FDI incentive policy strengths in order to maximize their  $w_i$ . In other words, region  $i$  increases solicitation costs  $a_{2i}b w_i$  to maximize  $w_i$ . Therefore, n regions' competition for  $w_i$  meets the requirements for Cournot game model as follows:



$$\begin{aligned}
 \text{Max}_{w_i} \pi_i &= a_{1i} \left( w^* - \sum_{j \neq i} w_j \right)^2 - a_{1i} \left( w^* - \sum_{j \neq i} w_j - w_i \right)^2 - a_{2i} b w_i \\
 \text{s.t. } w^* &= \sum_{i=1}^n w_i \quad (i, j = 1, 2, \dots, n)
 \end{aligned}
 \tag{26}$$

Find the first-order condition for model (26):

$$\frac{\partial \pi_i}{\partial w_i} = 2a_{1i} \left( w^* - \sum_{j \neq i} w_j - w_i \right) - a_{2i} b = 0
 \tag{27}$$

This study found the reaction function of region  $i$  using Equation (27):

$$w_i^* = w^* - \sum_{j \neq i} w_j - \frac{a_{2i} b}{2a_{1i}} \quad (i, j = 1, 2, \dots, n)
 \tag{28}$$

In other words:

$$a_{2i} b = 2a_{1i} \left( w^* - \sum_{j \neq i} w_j - w_i^* \right)
 \tag{29}$$

According to Equation (29), when other region  $j$  maintains

its FDI scale at a constant level (in other words,  $\sum_{j \neq i} w_j$  is a constant), the incentive policy strength of region  $i$  is in direct proportion to the optimal solicitation scale  $w^*$  of the nation and in inverse ratio to the solicitation  $w_i$  of region  $i$ . In other words, when region  $i$  solicits more FDI, region  $i$  can decrease its incentive policy strength (in other words, to decrease  $a_{2i} b$ ). When  $n$  regions reach equilibrium,

$w_j = w_i^*$  and  $\sum_{i=1}^n w_i^* = w^*$ , this study adds  $n$  equations of (28) and found the following:

$$\sum_{i=1}^n \frac{a_{2i} b}{2a_{1i}} = 0
 \tag{30}$$

Given  $a_{1i} \geq 0, a_{2i} b \geq 0, (i = 1, 2, \dots, n)$ , this study found  $a_{2i} b = 0 (i = 1, 2, \dots, n)$ . Apparently, if no region resorts to incentive policy (in other words,  $a_{2i} b = 0$ ), all regions will reach equilibrium in which all regions maintain the optimal FDI scale  $w_i^*$ , and meanwhile accomplish the goals set forth by central government. Therefore, central government must not overlook the regional governments' incentive policies designed for FDI solicitation. In this connection, central government has to formulate a unified incentive policy guideline based on other countries'

investment environment and international competition environment. Thus, all regions comply with the rules set forth by central government and maintain their credibility at the same time. Furthermore, central government has to help all regions improve their credibility and encourage all regions to maintain the credibility within the country. Thus, all regions will improve their human resources and upgrade their environments in the long-run instead of competing each other using incentive policies for short-term profits. Therefore, all regions will cooperate with one another to attract FDI and thereby create a win-win situation for both central government and all regional governments as long as the central government continues to coordinate and motivate the regional governments.

### Conclusions

This study has drawn the following conclusions from previous analysis:

1. Regional governments strive to maintain SPNE when they solicit FDI. However, incentive policy strength depends on human resources and environment. The dependence is therefore construed as an inverse substitution. In other words, regional governments can reduce its incentive policy strength and reach equilibrium if they have developed their human resources (or environment) to a satisfactory level. On the other hand, human resources and environment affect FDI inflows  $w_i$  positively; the higher the human resource quality (or better environment), the more FDI inflows  $w_i$ .
2. If central government lifts the restrictions for regional governments' solicitation of FDI, all regions will act selfishly; their competition will cause the prisoner dilemma for themselves. Thus, they will not cooperate with each other faithfully and are unable to create an optimal solution for themselves, either. In other words, competition causes all regions to lose their interest and consequently causes the host country to lose its revenue.
3. Regarding the countermeasures to be taken by the host country (Taiwan) for the incentive policy, this study has noted that eastern Taiwan lacked human resources and environment. Therefore, it is not necessary for eastern Taiwan to compete for the premium FDI in the short-term. However, eastern Taiwan must improve its human resources and upgrade its environment in the long-term and meanwhile reduce its incentive policy. Furthermore, central government has to act as a coordinator and motivator to help all regions soliciting FDI constructively.

### RECOMMENDATIONS FOR SUBSEQUENT RESEARCHES

This study concentrates on the game regarding all

regions soliciting FDI. In recent years, Southeast Asian nations proposed all kinds of incentive policies to attract foreign investors (transnational corporations). The incentive policy is likely to create the prisoner dilemma. Therefore, this study recommends subsequent researchers to analyze the competition using the game between the host countries of ASEAN and NAFTA.

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