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Choosing the Mode for FDI Entry to China's Port Market based on Two-stage Game between the Foreign-funded Enterprises and Government

Zhang Wenfen[a]*, Tu Min[a], Yang Jiaqi [a]

[a,b,c]Wuhan University of Technology, Wuhan, 430063, China

Abstract

Together with Foreign Direct Investment (FDI) entering the port market in China, some important relationships emerge among three principle parts, foreign-funded enterprises, government, and the existing port enterprises. Among these three relationships, the relationship between the foreign-funded enterprises and government is the main basis in port FDI entry mode choice. The foreign-funded enterprises will consider the FDI to choose a desirable mode through either new investment or acquisitions, in order to achieve profit maximization. The Chinese government has the choice to make incentives or restrictions policies on FDI, with the objective of maximizing its social welfare. This paper applies Game Theory to analyze FDI entry mode by using a two-stage Game model between foreign-funded enterprises and government. In the first stage, this paper builds the government's utility function and the foreign-funded enterprises' Cobb-Douglas production function, analyzing the optimal strategy for foreign-funded enterprises and government. In the second stage, this paper analyzes the equity allocation of port FDI.

1. Introduction

Port is a bridge to connect the domestic market with the international. Nowadays, as the port investment changes frequently, the foreign investment plays a key role which can not be ignored in the port construction. In aspects of upgrading the technical concept, improving the service quality and dispersing the investment risk, the foreign investment plays an active role. However, introducing a large amount of foreign investment has a huge

*Corresponding author. Tel.:15926489610.
E-mail address: cicizhangwenfen@126.com

impact on the domestic port companies. Multiple connections among three major parties will be created when the foreign investment is introduced into the port market. The connection between the foreign investing companies and the government is the main basis for the entry modes of FDI port. Different entry modes of FDI have different levels of impact on the social interest, and the government need to make right choice for the foreign investment policy after weighing the benefits in every aspect to realize the maximum of social welfare after bringing in the investment (Hu Guoheng, 2009).

In general, there are three different entry modes for foreign investment entering the market in host country, that is ,entry for the exports, transfer of technology patent (license) and direct investment entry (Tang Xiaopeng, 2007). In the port industry, the foreign investment get entry to the port mainly with the mode of direct investment. Nowadays, the entry modes for port FDI are mainly new investment and acquisitions. Achieving revenue maximization, foreign-funded enterprises need to consider their own resources, capability, and the investment environment in the host country comprehensively, to make a desirable choice for the entry mode (Tu Min, 2009).

The existing literature on game analysis between companies and government focused on the field of public transportation, environmental protection (Lu, Lianxing, and Guangyu, 2011) and reverse logistics, while exploring the entry mode of port FDI quantitatively is rather rare. This article will explore the entry modes of government and port FDI based on the Two-stage Game Theory. In the first stage, the foreign-funded enterprises will consider the FDI to choose a desirable mode through either new investment or acquisitions, in order to achieve profit maximization. The China government chooses to make incentives or restrictions policies on FDI. In the second stage, this paper analyses the equity allocation of port FDI. The findings in this paper will provide the reference for the choice of Foreign Direct Investment (FDI) entering the port market in China and support the policy decision-making for the government.

2. First-stage Game: the optimal strategy for foreign-funded enterprises and Chinese government

The Government's strategy includes making incentives or restrictions policy on foreign investment. The behavior of foreign-funded enterprises includes new investment and acquisitions. This section will analyze the utility of government and foreign-funded enterprises, using the social welfare and foreign profit as the objective function respectively. The Game result determines the optimal strategy for foreign-funded enterprises and China government.

2.1. Game model assumption

Regarding government and foreign-funded enterprises as the two main body of the Game, they are rational, that is, their goal is to maximize their interests.

The game between government and foreign-funded enterprises can be seen as the benefit comparison between them. The economic profit resulting from new investment or acquisitions is recorded as foreign investment decision-making objective. The social welfare brought by government adopting the incentive or restrictions policy on foreign investment can be considered as government decision-making objective.

Foreign investment can promote export, increase taxes, increase employment in China. As the increase of the scale of foreign investment, the social welfare will also increase. Making incentive policy on FDI is a kid of interests alienation, the greater of foreign investment scale, the greater cost the China government will pay. If government implements restriction policy on foreign investment, the costs is very few and can be ignored. The overall introduction of foreign advanced technology, comparing with acquisitions mode, the port FDI department productivity will be higher with new investment mode. If the Government takes out incentives policy on FDI, foreign capital utility will be enhanced, so the elasticity of capital will increase.

2.2. The description of objective function

● The description of government's utility function (Xiaoming, 2004)

The social welfare is the difference between government's revenue and cost. China government's revenue refers to the social benefits arising from the foreign policy made by government. The government's cost include two parts: one part is the cost spent on making policy and management fee for FDI, the other part is the extra-consuming in attracting foreign investment and risk of failure when the government adopts incentive strategy. According to the principles of economics: With the increase of FDI scale, the government's returns increase, and increasing marginal.

Therefore, the function about the relationship of government revenue w and port FDI scale q can be expressed as:

$$w = a_i q - \frac{1}{q} \qquad (a_l > 0, i = l 、 h, \ a_h > a_l)$$

(1)

In the formula (1), a_h is the coefficient of the function when the government adopts incentive policy on the foreign investment, a_l is the coefficient of the function when the government adopts restricting policy on the foreign investment.

The cost (c_1)spent on making policy and management is

$$c_1 = q^2 - \frac{1}{q}(q > 1)$$

(2)

In the formula (2), q denotes the port FDI scale.

The extra-consuming (c_2) denotes the fee used attracting foreign investment and risk of failure when the government adopts incentive strategy is:

$$c_2 = dq^2 \tag{3}$$

In the formula (3), d is the relation constant between cost and port FDI scale.

According to formula (1) (2) (3), if the China government adopts restrict policy on port FDI, the government's utility function is:

$$\pi_{xz}^g = a_l q - \frac{1}{q} - (q^2 - \frac{1}{q}) = a_l q - q^2 \tag{4}$$

If the China government adopts the incentive policy on port FDI, the government's utility function is:

$$\pi_{jl}^g = a_h q - \frac{1}{q} - (q^2 - \frac{1}{q}) - dq^2 = a_h q - (1+d)q^2 \tag{5}$$

- The description of the foreign-funded enterprises objective function

Cobb - Douglas production function (CD function) studied the relationship between capital and labor inputs and outputs. Its basic form is described as: $Q = AK^\alpha L^\beta$, in this formula , Q refer to the total output value, K refer to the invested capital, L is the input of labor, α and β are respectively refer to the elasticity of capital coefficient and the elasticity coefficient of the labor, A is the production efficiency coefficient, reflecting the influence caused from some retention variables other than labor and capital in the production process.

To simplify the CD function, the two elements of the production function can transform into one .The labor input L can converter into capital. In this way, suppose $K = \mu L$, μ refer to the labor capital equivalency factor. According to the fact that the partial derivative of the actual capital and output capital to the outputs are equal, we can get $Q = A\gamma^\alpha K^{\alpha+\beta}$; $\gamma = \alpha / (\mu\beta)$ (Lei Yong, 2001).

Therefore, the foreign utility function can be expressed as:
$$\pi = A_i \gamma^{\alpha_i} q^{\alpha_i + \beta} \quad （i=l、 h,). （\alpha_i + \beta > 1）$$

If the foreign-funded enterprises adopt new investment behavior, the production efficiency of the foreign utility function coefficient is A_h, if foreign-funded enterprises deal with FDI by acquisitions, the production efficiency is A_l, and $A_h > A_l$. Foreign-funded enterprises take the new investment behavior, part of the capital invested will be used for pre-adaptation and transformation of the local environment (called FDI capital loss). When government adopts incentives policy on foreign investment, the capital elasticity in the utility function is α_h, when the government adopts restrictions policy on foreign investment, the capital elasticity is α_l, and $\alpha_h > \alpha_l$.

2.3. The Game matrix between the foreign-funded enterprises and the government

According to Game model assumptions and the description of the objective functions, we can get the Game matrix of port FDI entry strategy between foreign-funded enterprises and government.

In the condition of complete information, the game matrix between foreign-funded enterprises and government is shown in Table 1:

Table 1 Game matrix of foreign-funded enterprise and government

government, foreign utility function		Foreign-funded enterprises strategy	
		New Investment	Acquisitions
Government strategy	Incentives policy	$\left\{ a_h q - (1+d)\ q^2; A_h \gamma^{\alpha_h}(q-\sigma)^{\alpha_h+\beta} \right\}$	$\left\{ a_h q - (1+d)q^2; A_l \gamma^{\alpha_h} q^{\alpha_h+\beta} \right\}$
	Restrictions policy	$\left\{ a_l q - q^2; A_h \gamma^{\alpha_l}(q-\sigma)^{\alpha_l+\beta} \right\}$	$\left\{ a_l q - q^2; A_l \gamma^{\alpha_l} q^{\alpha_l+\beta} \right\}$

● Analysis of the Government's strategy

The condition of government to adopt incentive policies on foreign investment is:

$$\pi_{jl}^g > \pi_{xz}^g : \quad a_h q - (1+d)q^2 > a_l q - q^2$$

The result is $q < \dfrac{a_h - a_l}{d}$, if the port FDI scale $q > \dfrac{a_h - a_l}{d}$, The China government tends to take the investment incentive policy. On the contrary, the Government tends to adopt restrictions on foreign investment policy.

● Analysis of the strategy of foreign-funded enterprises

When the Government tends to take incentive policy on port FDI, if the foreign-funded enterprises take the new investment strategy, the constraint condition is:

$\pi_{xj}^{f} > \pi_{bg}^{f}$ ： $A_{h}\gamma^{\alpha_{h}}(q-\sigma)^{\alpha_{h}+\beta} > A_{l}\gamma^{\alpha_{h}}q^{\alpha_{h}+\beta}$

The result is $q > \dfrac{\sigma}{1 - A_{h}^{\frac{1}{\alpha_{h}+\beta}} A_{l}^{-\frac{1}{\alpha_{h}+\beta}}} + \sigma$, if the FDI scale $q > \dfrac{\sigma}{1 - A_{h}^{\frac{1}{\alpha_{h}+\beta}} A_{l}^{-\frac{1}{\alpha_{h}+\beta}}} + \sigma$, the port

FDI tends to enter into the market with the strategy of new investment, on the contrary, port FDI tends to enter with acquisitions.

When the China government adopts restrictions policy on port FDI, if the foreign-funded enterprises take the new investment strategy, the constraint condition is:

$\pi_{xj}^{f} > \pi_{bg}^{f}$: $A_{h}\gamma^{\alpha_{l}}(q-\sigma)^{\alpha_{l}+\beta} > A_{l}\gamma^{\alpha_{l}}q^{\alpha_{l}+\beta}$

The result is $q > \dfrac{\sigma}{1 - A_{h}^{\frac{1}{\alpha_{l}+\beta}} A_{l}^{-\frac{1}{\alpha_{l}+\beta}}} + \sigma$, if the port FDI scale $q > \dfrac{\sigma}{1 - A_{h}^{\frac{1}{\alpha_{l}+\beta}} A_{l}^{-\frac{1}{\alpha_{l}+\beta}}} + \sigma$, The Port

FDI tends to enter with the strategy of new investment. On the contrary, port FDI tends to enter with acquisitions.

3. Second-stage Game: port FDI equity allocation

After the first stage Game between the China government and foreign-funded enterprises, the premise of the port FDI entry strategy is defined. Then the game will enter the second stage, the mode of port FDI equity allocation. In early times, there are strict requirements in the joint venture port that the stock should be controlled by China in China port. Since April 1, 2002, the shareholding restrictions on the construction and operation of port facilities is canceled, the equity allocation of the port become more flexible.

The current theory on FDI equity entry mode in domestic and abroad can be divided into four categories: transaction cost theory, bargaining plus theory, resource theory, the theory of institutional factors (Hung, 2004; Lin and Jianming, 2011). The study is mainly qualitative analysis, lacking of quantitative analysis to determine the equity allocation. In this section, game theory will be used to find the optimal equity allocation in FDI port. The study result will provide a reference for FDI entry mode in other field.

3.1. Game model assumption

1) The total capital of the FDI port is I, the actual total available revenue is π .In which foreign ownership equity ratio of the joint venture port is ω , and China holding a FDI port equity ratio $(1-\omega)$.

2) Due to the China government policy on FDI, the FDI port's equity and power of control are not consistent. ξ (The degree of openness, preferential level) refers to the level of matching the equity and the actual power of

control. When the policy is benefit for one party, the party will receive an additional hidden income. In the study, suppose $\xi > 0$, when the policy tend to foreign capital.

3) In the FDI port, when the enterprises of China due diligence, the success probability of FDI port is p_h.While enterprises of China pursue private benefits is v, with the resources and local advantages, they take opportunistic behavior, and it also known as not due diligence, then the success probability of FDI port is p_l. Foreign-funded enterprises will take supervision on the opportunistic behavior of China enterprises. The supervision will cost some money. The private benefit is related with equity ratio $(1-\omega)$ positively, which can be described as $v(1-\omega)$, v is a constant, referring to the largest private benefits when the host has full equity). Monitoring cost and the proportion of foreign equity ratio are related positively, which can be described as $c\omega$.

3.2. Game model matrix

Under the model assumption, revenue function can be drawn as follows (Chunyu, 2005):

1) when the enterprises in China is due diligence,
The China enterprises income is $(1-\omega)P_h[(1-\xi)\pi - I - cw]$

The Foreign-funded enterprises income is $\omega P_h[(1-\xi)\pi - I - cw] + \xi\pi$

2) when the enterprises in China is not due diligence,
The China enterprises income is $(1-\omega)P_l[(1-\xi)\pi - I - cw - v(1-\omega)] + v(1-\omega)$

The Foreign-funded enterprises income is $\omega P_l[(1-\xi)\pi - I - cw - v(1-\omega)] + \xi\pi$

Port FDI equity game matrix is shown in the Table 2 below, based on Game between the China enterprises and foreign-funded enterprises.

Table 2   FDI Port equity game matrix

Game proceeds	Corporate behavior of the host country	
	due diligence	Not due diligence
The host country's net income	$(1-\omega)P_h[(1-\xi)\pi - I - cw]$	$(1-\omega)P_l[(1-\xi)\pi - I - cw - v(1-\omega)] + v(1-\omega)$
Foreign-funded enterprises' net income	$\omega P_h[(1-\xi)\pi - I - cw] + \xi\pi$	$\omega P_l[(1-\xi)\pi - I - cw - v(1-\omega)] + \xi\pi$

3.3. Establishment of incentive compatibility model of FDI port

Constraint conditions one: the benefit of China enterprises when it chooses to fulfill its duty is not less than when it does not choose to fulfill its duty.

Constraint conditions two: the benefit which is gained by foreign capital is more than the initial input and monitoring costs.

From the first constraint condition，we can get:

$$(1-\omega)P_h\left[(1-\xi)\pi-I-c\omega\right] \geqslant (1-\omega)P_l\left[(1-\xi)\pi-I-c\omega-v(1-\omega)\right]+v(1-\omega)$$
(6)

From the second constraint condition, we can get:

$$\omega P_h\left[(1-\xi)\pi-I-c\omega\right]+\xi\pi \geqslant \omega P_l\left[(1-\xi)\pi-I-c\omega-v(1-\omega)\right]+\xi\pi$$
(7)

Combine formula（6）and（7）, it is easy to get: $\omega \geq \dfrac{[(1-\xi)\pi-I]P_h - P_l[(1-\xi)\pi - I - v] - v}{P_h c + P_l(v-c)}$

$\omega^* = \dfrac{[(1-\xi)\pi-I]P_h - P_l[(1-\xi)\pi - I - v] - v}{P_h c + P_l(v-c)}$ is the optimal equity allocation game model. When the

foreign shareholding proportion $\omega > \omega^*$, opportunistic behavior of China enterprises will be avoided.

4. Numerical example

Since the date in practice is difficult to collect, numerical example is given to explain the two-stage game model. Give each parameter a reasonable value respectively, then the finally result is calculated by the use of MATLAB.

4.1. Assignment for parameter

The assignment for each parameter is list in Table 3.

Table 3 Assignment for each parameter

parameter	value	parameter	value	parameter	value
a_h	10	α_h	0.2	P_h	0.7
a_l	6	α_l	0.1	P_l	0.3
d	1	γ	2	I	10
A_h	5	σ	3	π	15
A_l	3	β	0.1	ξ	0.2
c	1	v	2		

4.2. The matrix of two-stage game

Now the values of each parameter are brought into the two-stage model in the text, the result is calculated using MATLAB. In the first stage, the game matrix between foreign-funded enterprises and government is shown in Table 4. In the second stage, Port FDI equity game matrix is shown in the Table 5, based on the host enterprises and foreign-funded enterprises Game.

Table 4 Game matrix of foreign-funded enterprise and government

Government, foreign utility function		Foreign-funded enterprises	
		New Investment	Cross-border mergers and acquisitions
Government strategy	Incentives policy	$\{10q - q^2; 5.74(q-3)^{0.3}\}$	$\{10q - 2q^2; 3.45q^{0.3}\}$
	Restrictions policy	$\{6q - q^2; 5.36(q-3)^{0.2}\}$	$\{6q - q^2; 3.21q^{0.2}\}$

Table 5   Port FDI equity game matrix

Game proceeds	Corporate behavior of the host country	
	due diligence	Not due diligence
The host country net income	$0.7(1-\omega)(2-\omega)$	$0.3(1-\omega)[2-\omega-2(1-\omega)]+2(1-\omega)$
Foreign-funded enterprises net income	$0.7\omega(2-\omega)+3$	$0.3\omega[2-\omega-2(1-\omega)]+3$

4.3. The result of two-stage game

From Table 4 and Table 5, we can get the result as follows.

● In the first stage of the game

In the condition of incomplete information, if the port FDI scale $q < 4$, government tends to take the investment incentive policy. On the contrary, the government tends to adopt restrictions on foreign investment policy. When the Government tends to take the investment incentive policies, if the amount of investment of a foreign-funded enterprise $q > 2.3317$,   the foreign-funded enterprises tend to take the strategy of new investment, on the contrary, port FDI tends to enter with acquisitions. When the Government adopt restriction policy on port FDI, if the port FDI scale $q > 2.3317$ the foreign-funded enterprises tend to take the strategy of new investment. On the contrary, port FDI tends to enter with acquisitions.

● In the second stage of the game

Using MATLAB, the lowest foreign ownership equity ratio of the joint venture port is $\omega^* = 0.1$ when the foreign shareholding proportion $\omega \geq 0.1$, opportunistic behavior of China enterprises will be avoided.

5. Conclusions

The paper discusses the entry mode of port FDI quantitatively. However, since the influencing factors of the objective function are not comprehensive, and the situation is not involved that equity and control are separate when analyzing the equity allocation. Moreover, the non-equity arrangement is not taken into consideration. Therefore, the study remains to be further in-depth.

Acknowledgement

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