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ABSTRACT

This paper examines the choice of port multinational enterprise's entry modes and the host country's FDI policies, when the port multinational enterprise (MNE) enters another country via foreign direct investment (FDI).There are two theoretical models in this paper to find the desirable FDI entry modes and policies systematically. The paper is constituted of two main sections. In section one, It presents a Game model to help the port MNE to determine the entry strategy between the greenfield and cross-boder M&A, and help the host country adopt reasonable FDI policy between incentive and restrict FDI policies. In section two, it develops a theoretical model of equity structure to balance between social welfare and port MNE profits, and a reasonable ownership of port equity for port MNE is raised at last.

Keywords: Port FDI, Game Theory, Entry modes, Equity distribution

INTRODUCTION

For most countries, coastline is limited and precious. So, each port plan should be allowed by local government, including the operating management and equity distribution. When a port multinational enterprise(port MNE),such as PSA and Hutchiaon Whampoa, gets ready to enter into a new foreign port market, he should choose the reasonable enter modes to realize the profit maximization. At the same time, the host country government will take some measures to keep the social welfare increase according to the behaviour of port MNE. As we know, there will be many conflicts between the two parts' interests. Thus, how to find a suitable mode is what this paper tries to solve.

Port is a capital intensive industry, the enter threshold of which is rather high. According to the statistical data from the private participation in infrastructure (PPI) project database, port FDI has shown some new trends. Before 2005, the port FDI concentrated on container terminals, but during the recent years, port types which FDI enter into becomes diverse, such as liquid chemical port, multipurpose port ,bulk cargo port. However, by the influence of global economic crisis, the amount of port FDI has been decreasing for a long time. Some port MNE start to aim at developing countries instead of developed ones.

The port MNE's entry modes include the enter strategy and the equity distribution. On the one hand, the port MNE should choose between greenfield investment and cross-boder M&A; on the other hand, he should decide the investment scale.

Elizabeth Asiedu(2001) analyzes equity structure of different partners in FDI project with the Cobb-Douglas, and get equilibrium foreign equity share by the influence of investor assets and local assets. Bong Geul Chun(2012) examines the choice of the multinational firm entry modes between licensing and foreign direct investment. Based on studying the relevance of MNC strategic behaviour and the development of global economy, Isabel Álvarez (2009) finds the factors affecting the FDI entry modes, make the relationship between FDI and national systems assess as the objective. Larry D. Qiu and Shengzu Wang(2011)considering the host country's FDI policy, focus on the choice between the two entry modes of FDI, called greenfield and cross-border M&A, and develop a partial equilibrium model with two countries to choose the optimal strategy.

However, most previous studies focus on only one aspect of FDI entry modes, equity distribution or choice between greenfield and brownfield. Moreover, these studies don't take account of the enterprises' characteristic in different fields. In practise, especially in port field, both entry strategy (greenfield or brownfield) and equity distribution are two important aspects of FDI entry modes.

For the port MNE, port is just a profit-seeking business. In choosing the FDI entry modes, the objective of port MNE is to gain more profits. In fact, the factors affecting the entry strategy (greenfield or brownfield) and equity distribution are not the same. Therefore, the expressions of profit function are different. From the host country's perspective, the choice of the MNE impacts upon social welfare in the country. Therefore, the government of the host country tends to strategically use various policies to limit the behaviours of port MNE, in order to realize the social welfare maximization. As is similar to port MNE's profit function, the descriptions of social welfare are diverse in choosing entry policies and equity distribution.

This paper examines the choice of port multinational's entry modes and the host country's FDI policies, when it enters another country via foreign direct investment (FDI).There are two theoretical models in this paper to find the desirable FDI entry modes and policies systematically. In section 1, It present a Game model to help the port MNE determine the entry strategy between the greenfield or cross-boder M&A, and help the host country adopt reasonable FDI policy between incentives or restrictions. In section 2,it develop a theoretical model of equity structure to balance between social welfare and port MNE profits, a reasonable ownership of port equity for port MNE is raised at last.

THE CHOICE OF PORT FDI ENTRY STRATEGIES AND POLICIES

As we mentioned above, the FDI entry strategies for port MNE include new investment and cross-border M&A. The host country's government policies include incentives and restriction on port FDI.

We know that, if there are too much FDI in host country's ports, the operation of local port will be influenced and the social welfare will go down. In this situation, the government will set up

restrict policy to limit the FDI. As is the same to the behaviour of government, the port MNE will take different entry strategies according to the scale of FDI.

In this section, we develop a Game model between port MNE and host country's government to analyze the optimal FDI entry strategies and policies. By introducing a Cobb –Douglas production to present the profit of port MNE, and the social welfare as the objective of host country's government, the result of Game can realize the interest maximization for two parts.

In actual port production, many factors will affect the objective functions. We just select some important factors in choice of FDI entry strategies such as policy cost and capital elasticity and so on.

The game model can be set up under some certain assumptions.

Game model assumption

1)The host government and port MNE are rational, that is, both of them have got the right to do their own choice.

2) The game between government and port MNE can be seen as the benefit comparison between them. The economic profit resulting from new investment or cross-boder M&A is recorded as port MNE 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.

3)For government, port FDI can promote export, increase taxes and employment of host country. As the increase of the scale of port FDI, the social welfare will also increase. Making incentive policy on FDI is a kid of interest alienation, the greater of foreign investment scale, the greater cost the China government will pay. If host country's government sets up restriction policy on foreign investment, the cost is very few and can be ignored.

4)Since the overall introduction of foreign advanced technology with the mode of new investment, the productivity of the FDI port department will be higher than the one with cross-boder M&A mode. If the host country's government adopts incentives policy on FDI, the foreign capital utility will be enhanced, so the elasticity of capital will increase.

The description of objective function

The description of government's utility function

The goal of government is to realize the maximization of social welfare. In this section, we will find a reasonable FDI policy between incentive or restrict policies for the host country government under different FDI scale. So in the Game model, the social welfare is related with government's policy under different FDI scale. The social welfare can be represented as the difference between income and cost owing to port FDI. Government's income mainly refers to the social welfare benefit from the government's FDI policy, the cost of the government includes two parts: one is spent in the plan of FDI policy and management cost, another is the government extra-consuming tax and attracting fee in setting up incentive policy on FDI.

According to the principles of economics, with the increase of FDI scale, the host government's income increases, marginal income reduces. With the increase of the port FDI scale, government costs increase, moreover, marginal increment.

Therefore, the function about the relationship of government revenue *w* and port FDI scale *q* can be expressed as: $w_i=a_iq-1/q$ $(a_i>0,i=l、h,)$.where a denotes the scale coefficient of the function, when the government adopts incentive policy on the FDI, the scale coefficient is a_h, when the government adopts restricting policy on FDI, the scale coefficient is a_i. Obviously, $a_h> a_i$.

The host government will spend some money on setting up the policy on FDI, for both incentive and restricting policy.c_1 denotes this kind of plan cost. The relationship of plan cost(c_1) and port FDI scale(q) can be expressed as:$c_1=q^2-1/q$ $(q>1)$,where the FDI scale should be more than one certain level, the lowest level of FDI set as one unit.

However, when the host government adopts incentive policy on FDI, there is a kind of extra fee to cover the interest alienation, c_2 denotes the kind of extra cost. The relationship of extra cost(c_2) and port FDI scale(q) can be expressed as:$c_2=dq^2$,where *d* denotes the relation constant of cost and port FDI scale.

Clearly, if the host government adopts restricting policy of FDI, the social welfare can be present as the difference between income and plan cost as follows:

$$\pi_{xz}^{g} = w_l - c_1 = a_l q - 1/q - (q^2 - 1/q) = a_l q - q^2 \qquad (1)$$

If the host government adopts incentive policy of FDI, the social welfare can be present as the difference between income and two kinds of cost as follows:

$$\pi_{jl}^{g} = w_h - (c_1 + c_2) = a_h q - 1/q - (q^2 - 1/q) - dq^2 = a_h q - (1+d)q^2 \quad (2)$$

The description of the port MNE objective function

Cobb - Douglas production function (CD function) is used to represent the relationship between capital and labour inputs and outputs. The basic form is described as: $Q=AK^{\alpha}L^{\beta}$,in this formula , the parameter *Q* refers to the total value of output, *K* denotes the input of investment fund, *L* denotes the input of labour, α and β denote the elasticity of capital coefficient and the labour coefficient respectively. *A* is called the production efficiency coefficient, reflecting the influence caused from some retention variables other than labour and capital in the production process. Elizabeth Asiedu (2001) has introduced the C-D function into the FDI field. Ge Tao(2012) apply the expend C-D model in study of FDI structure. Lei Yong(2001) change the model to a simple form.

To simplify the study, the two kinds of input in the production function, can transform into one single element. The labour input *L* can convert into the input of investment fund. In this way, supposes $K=\mu L$, μ denotes the ratio of labour convert into capital. According to the fact that the partial derivatives of the actual capital and output capital to the outputs are equal, we can get $Q=A\gamma^{\alpha}K^{\alpha+\beta}$, where $\gamma=\alpha/(\mu\beta)$.

Therefore, the profit of port MNE can be expressed as:

$$\pi = A_i \gamma^{\alpha_i} q^{\alpha_i+\beta} \qquad (i = l,h;\alpha_i + \beta > 1) \quad (3)$$

In the formula (3),If the port MNE chooses the FDI entry strategy with new investment, the production efficiency coefficient of FDI is A_h .If the port MNE chooses the FDI entry strategy with cross-border M&A, the production efficiency coefficients is A_l. In the situation of new investment, the port MNE will introduce all the high develop technology in the port, so the

port production efficiency will be higher than the one with the strategy of cross-border M&A, that is $A_h > A_l$. For the new investment entry strategy, part of the port MNE's investment fund will be used for pre-adaptation and transformation of the local environment (called FDI capital loss). Besides, the FDI policy made by host government will affect the port production efficiency. When the host government adopts incentives policy on port FDI, the capital elasticity coefficient of port MNE profit function is α_h, When the government adopts restrict policy on port FDI, the capital elasticity coefficient is α_l. Due to the benefit of incentive policy, the port MNE will get more profit in port production, *thus,* $\alpha_h > \alpha_l$. Moreover, the profit of port MNE under new investment can be read as π_{xj}^{f};the profit of port MNE under cross-border M&A can be read as π_{bg}^{f}.

The Game matrix between the port MNE and the host country's government

According to Game model assumptions and the descriptions of the objective functions, we can develop a Game model between the port MNE and the host country's government. The Game model is consist of social welfare and port MNE's profit. Comparing the profit of MNE in new investment entry strategy with that in cross-border M&A entry strategy, we can choose a reasonable entry strategy in different FDI scale. Likewise, the host government can choose a suitable port FDI policy owing to the FDI scale.

The Game matrix between port MNE and host country's government is shown in Table 1.

In the Game, the port MNE is regard as player 1,and the host country's government is regard as the player 2.In the table box, there are four braces. The left formula within the braces denotes the social welfare of the host country; the right one denotes the profit of port MNE. Clearly, the upper two braces represent the utility functions of the two player when the government take incentive policy and the port MNE choose the FDI entry strategies with new investment and cross-border M&A .The two braces below represent the utility functions of the two player when the government take restrict policy and the port MNE choose the FDI entry strategies with new investment and cross-border M&A .

Table 1 Game matrix between port MNE and host country's government

Utility function		Port MNE entry strategies of FDI	
		New Investment	Cross-border M&A
Government policy	Incentives	$\left\{a_h q-(1+d)\ q^2; A_h \gamma^{\alpha_h}(q-\sigma)^{\alpha_h+\beta}\right\}$	$\left\{a_h q-(1+d)q^2; A_l \gamma^{\alpha_h} q^{\alpha_h+\beta}\right\}$
	Restrict	$\left\{a_l q-q^2; A_h \gamma^{\alpha_l}(q-\sigma)^{\alpha_l+\beta}\right\}$	$\left\{a_l q-q^2; A_l \gamma^{\alpha_l} q^{\alpha_l+\beta}\right\}$

The host government's choice of FDI policy

Before setting up FDI policies, the host government compares the social welfare under the incentive and restrict policy. If the social welfare under the incentive policy is higher than that under the restrict policy, the government will adopt incentive policies on FDI. The constraint condition can be read as :

$$\pi_{jl}^{g} > \pi_{xz}^{g}: \quad a_h q-(1+d)q^2 > a_l q-q^2 \quad (4)$$

The solution to the inequality (4) is $q<(a_h-a_l)/d$. So, the preferred FDI policy is dependent upon the FDI scale. When the scale of port FDI q is less than $(a_h-a_l)/d$, the host country

government tends to adopt incentive policy on FDI. On the contrary, the host government tends to adopt restrict policy on port FDI.

The port MNE's choice of FDI entry strategy

In any situation, the goal of port MNE is to realize the maximization of profit. However, the profit function of port MNE is different under the different FDI policies made by host government. So there are two cases, corresponding respectively to the incentive and restrict policies.

Case 1:the host government adopts incentive policy of FDI.

If the port MNE's profit under new investment is more than that under the cross-border M&A, the port MNE will choose the FDI entry strategy of new investment. The constraint condition can be read as:

$$\pi_{xj}^{f} > \pi_{bg}^{f} \quad A_h \gamma^{\alpha_h} (q-\sigma)^{\alpha_h+\beta} > A_l \gamma^{\alpha_h} q^{\alpha_h+\beta} \quad (5)$$

The solution to the inequality (5) is $q > \dfrac{\sigma}{1 - A_h^{\frac{1}{\alpha_h+\beta}} A_l^{-\frac{1}{\alpha_h+\beta}}} + \sigma$ .So, the preferred FDI entry strategy is dependent upon the FDI scale. If the scale of FDI $q > \dfrac{\sigma}{1 - A_h^{\frac{1}{\alpha_h+\beta}} A_l^{-\frac{1}{\alpha_h+\beta}}} + \sigma$,the port MNE tends to choose the FDI entry strategy with new investment. On the contrary, port MNE tends to choose the FDI entry strategy with new investment FDI tends to enter with cross-border M&A.

Case 2: the host government adopts restrict policy of FDI.

If the port MNE's profit under new investment is more than that under the cross-border M&A, the port MNE will choose the FDI entry strategy of new investment. The constraint condition can be read as:

$$\pi_{xj}^{f} > \pi_{bg}^{f} \qquad A_h \gamma^{\alpha_l} (q-\sigma)^{\alpha_l+\beta} > A_l \gamma^{\alpha_l} q^{\alpha_l+\beta} \quad (6)$$

The solution to the inequality (6) is $q > \dfrac{\sigma}{1 - A_h^{\frac{1}{\alpha_l+\beta}} A_l^{-\frac{1}{\alpha_l+\beta}}} + \sigma$. So, the preferred FDI entry strategy is dependent upon the FDI scale. If the scale of FDI $q > \dfrac{\sigma}{1 - A_h^{\frac{1}{\alpha_l+\beta}} A_l^{-\frac{1}{\alpha_l+\beta}}} + \sigma$,the port MNE tends to choose the FDI entry strategy with new investment. On the contrary, port MNE tends to choose the FDI entry strategy with new investment FDI tends to enter with cross-border M&A.

Therefore, the FDI policy will affect the choice of FDI entry strategy. However, the choice trends are almost the same. When the FDI scale is more then a certain level, the port MNE will tend to choose the new investment entry strategy of FDI.

PORT FDI EQUITY DISRIBUTION

In section 1, we discuss the choice of port MNE enter strategies and the FDI policies. However, after the port MNE enters into the foreign country either by greenfield investment or cross-boder M&A, it will face with the some problem how to distribute the port equity.

Maybe, the port will be a Wholly Foreign Owned Enterprise (WFOE) or Joint Venture Enterprise (JVE).Even, in the JVE, the concrete percentage of the ownership can be different. So, in this section, we will discuss the optimal equity structure of the port. If the port MNE owns too much port equity, the host country's port will get too little profit, the situation is bad for the development of local port. On the contrary, the port MNE owns only a little port equity, the port MNE will get small profit suffer quitting from the host country's market. To keep a long-term and healthy development of port, a reasonable equity structure is important. We will develop a theoretical model of equity structure to balance between social welfare and port MNE profits.

Since the factors influenced the equity distribution are related with price, so the social welfare and profit function is different from that in the section 1.Therefore, the equity distribution model assumption is not the same as the Game model.

The model assumptions

The mathematical models of entry strategies for port MNE and host countries here are based on the following assumptions:

a)Royalty fee is a two-part tariff. A licensor receives not only an initial fixed payment but also a linear licensing fee from the licensee for the use of know-how. Since the fixed payment is a constant, it does not affect the optimal solution to the problem. Consequently, for convenience, we omit the constant fixed payment throughout the paper.

b)There are two types of cost in the port operation, fixed cost and variable cost, account for total cost. Again, although the fixed cost of port is large but it is constant, and does not affect the optimal solution. Therefore, we omit the constant fixed cost in this paper for convenience. Some important factors(such as host government's desire to keep the population employed, the role of sunk costs, hysteretic, etc.)are beyond the scope of this research, and have been omitted here.

c)The port market demand for the port handling service in the host country is assumed to be linear: $Q=A-p(t)$,where A is a measure of port market size, Q is the scale of port handling service in the market.

Before writing down the mathematical models we need to state the following notation:

T:terminal time of the licensing;

r: discount rate;

ω:percentage of the ownership of the port MNE(a decision variable);

(Note that $0 \leqslant \omega \leqslant 1$.If $\omega=1$,then a port MNE undertakes a wholly owned subsidiary in a foreign country. Otherwise, it engages in a joint venture (JV) or a combination of JV and licensing with a local firm)

ξ:unit royalty fee for licensing its technology know-how;

υ:constant unit production cost;

$p(t)$: unit price of port handling service at time t (a decision variable for a foreign partner of an port MNE);

Analysis of the optimal price of port handling service

The optimal price of port handling service is different by host country's government and port MNE, which is an important factor in distributing the ownership of port equity. We can analysis the optimal price for the two parts respectively, and then find the optimal port equity structure.

For host country's government

The host country's government is able to set up policies on equity under the criterion of maximizing its total national welfare. Total domestic welfare is defined as the sum of consumer surplus and local producer surplus. In this paper, the local producer refers to the port MNE partner.

In general, a port MNE partner designs its optimal pricing strategy to maximize the present value of profits based on the entry strategy of the port MNE(i.e, the value of ξ is provided by the port MNE).Therefore, the objective function for the port MNE partner is:

$$\max_{p} H=(1-\omega)\int_0^{\infty}\left[\left(p-\upsilon-\xi\right)Q\right]e^{-rt}dt=(1-\omega)\int_0^{\infty}\left\{\left(p-\upsilon-\xi\right)\left[A-p\left(t\right)\right]\right\}e^{-rt}dt \quad (7)$$

Where *(p-υ-β)[a-p(t)]* represents the net revenue received from port service.

According to the principle of economics, we know the objective function for consumer surplus in the host country is denoted as follows:

$$\max S=\int_0^{Q^*}\left[p(Q)-p^*(Q)\right]dQ \quad (8)$$

As the assumptions mentioned, the *Q=A-p(t)*,so the consumer surplus can be expressed by the dash area in the Fig.1.

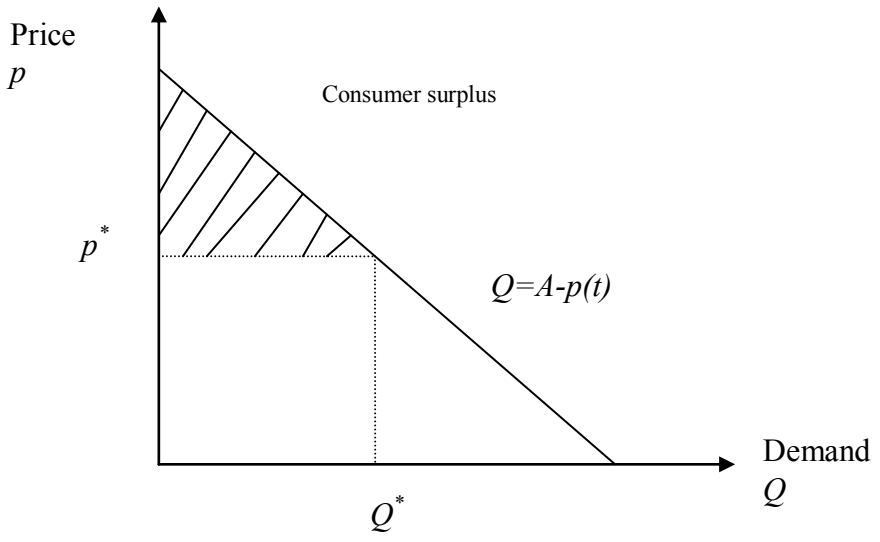

Fig.1 Graphical representation of consumer surplus

In this way, the objective function for the host country is:

$$\begin{aligned}\max W(\omega,p)&=\int_0^{Q^*}\left[p(Q)-p^*(Q)\right]dQ+(1-\omega)\int_0^{\infty}\left\{\left(p-\upsilon-\xi\right)\left[A-p\left(t\right)\right]\right\}e^{-rt}dt\\&=\frac{1}{2}(A-p)^2+(1-\omega)\left(p-\upsilon-\xi\right)(A-p)\end{aligned} \quad (9)$$

Where $p^*(Q)$ is the optimal price in the port market. The first term of (9) represents the consumer surplus in the host country. The second term stands for the local producer surplus in the host country.

Hence, the partial differentiation with respect to price is

$$W_p(\omega, p) = (1-\omega)(A+\upsilon+\xi-2p)+p-A \quad (10)$$

By setting Eq.(10) to zero, we get the optimal price from the point of view by government as follows:

$$p_g^* = \frac{(1-\omega)(A+\upsilon+\xi)-A}{1-2\omega} \quad (11)$$

From the perspective of host government, the result shows, the optimal price is related with unit royalty fee ξ *and* unit production cost υ positively.

For port MNE

The port MNE wants to maximize the present value of its total profits, Thus, the objective function for port MNE is:

$$\max M(\omega,\xi) = \omega\int_0^{\infty}\left[(p-\upsilon-\xi)f(p)\right]e^{-rt}dt + \xi\int_0^{T} f(p)e^{-rt}dt \quad (12)$$

Where the port MNE has to choose the optimal values for ω andξ, the first term of Eq.(12) represents the profits gained by the ownership of local firm, and the second term of Eq.(12) is the licensing royalty fees. For simplicity, we shall only consider the perpetual licensing case. In a perpetual licensing case, the MNE is able to maintain control of its technology know-how forever due to permanent patent protection, i.e.,$T\to\infty$. The net present value of the profits for the MNE is:

$$\begin{aligned}\max M(\omega,p) &= \omega\int_0^{\infty}\left[(p-\upsilon-\xi)f(p)\right]e^{-rt}dt + \xi\int_0^{\infty} f(p)e^{-rt}dt \\ &= \left\{\omega\left[(p-\upsilon-\xi)f+\xi f\right]\right\}/r\end{aligned} \quad (13)$$

Thus, under perpetual licensing, the above equation can be reduced to a timeless model. For convenience, we assume without loss of generality that $\pi(\alpha,p)=\alpha[(p-c-\beta)f]+\beta f$.

the partial differentiation with respect to price is

$$M_p(\omega,p) = (A-p)\omega-\omega(p-\upsilon-\xi)-\xi \quad (14)$$

By setting Eq.(14) to zero, we get the optimal price from the point of view by port MNE as follows:

$$p_f^* = \frac{A\omega+\omega\upsilon+\omega\xi-\xi}{2\omega} \quad (15)$$

Decision of ownership of port equity

As we know, if a port can operate successful, the most important reason is the port shareholders are united. At the same time, the teamwork are under the supervise of government. Due to the total national welfare includes the profit of local firm, so the host government can stands for the benefit of local firm. In this way, the management strategy of port MNE and government should be the same. To ensure the high degree of uniformity in the optimal price level, the port MNE should share reasonable port equity. So the

requirement is $p_g^* = p_f^*$, Combine Eq.(11) and Eq.(15),we can get the optimal percentage of port MNE ownership is :

$$\omega^* = \xi/(A+\xi-\upsilon) \quad (16)$$

We can learn from the result of Eq.(16),the optimal equity share ω^* for port MNE is related to ξ, υ, A , and the ω^* is related with unit production cost υ positive, and related with A *and* unit royalty fee ξ negatively. It means that, the higher of the unit production cost, the higher of the ω^*.The result is in accordance with the actual case. In general, the port MNE has some advanced technology, if the port MNE have got more port equity, there are more opportunity to adopt new technology to cut the cost and could improve the efficiency, realize the maximization of social welfare and profits.

CONCLUSIONS

This paper has theoretically and empirically examined the choice of port FDI entry modes. Regarding the FDI entry strategies (new investment and cross-boder M&A) and equity distribution as two aspect of the FDI entry modes, at the some time, the paper take account of the influence of the FDI policies in host country.An important contribution of this paper is to introduce the method of FDI entry modes choice into the port field, considering the port' characteristic.It also manages to develop a useful measures for host government in set up FDI policy owing to the different scale of FDI. The paper get a reasonable concrete ownership of port MNE successfully in order to realize the constant profit in the long way.

From the perspective of port MNE, the greater of the FDI scale, the possibility of the new investment entry choice, the higher of the unit production cost ,the bigger of the ownership of the port equity. For the host government, the greater of the FDI scale, the possibility of the restrict FDI policy, the ownership of the port equity choice is nearly the same with port MNE.

The result of the paper can give a reference for a port MNE in choosing the entry strategies and the scale of FDI. It also provides a suggestion for the host government in setting up the FDI policies.

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

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