Chapter IV

Research methodology and Model

In the preceding chapter, the authorities and functions of the Thai FDA towards health consumer protection sector have been briefly reviewed. In this chapter, a methodology to construct the models for investigating the determinants of FDA costs is set out. The cost functions estimated here are patterned that they model costs as being a function of multiple outputs.

4.1 Cost and output concept

The dimensions of the output concept are obviously important in determining cost curves. Niskanen's (1975) model of bureaucratic behavior assumes that the agency's sponsors can measure and monitor agency output. If this were impossible, the agency could obtain a larger budget simply by promising more than it could produce. In practice, regulatory agencies and those who monitor their activities use indices of the agency's monitoring and enforcement activities as a measure of the agency's 'output'. The choice of a particular activity to represent an organization's output implies choice of the 'production function' for the organization. This production function is the relationship between the output and the inputs required to produce the output. Together with the prices of the inputs, this production function determines the total cost of producing any level of the output.

The form of a regulatory agency's cost function depends both on what the agency's output is conceived to be and on the associated production function affected

to the output concept. The production function may depend on characteristics of the regulated firms or the legal system. However, none of these complexities is dealt with in analyses cost function of the Thai FDA.

Every firm needs to know what it costs to produce its products if it is to make rational decisions. The firm's cost rely on how much it produces for any given set of input prices. A cost curve comprises a great deal of information. For instance, knowing how the cost curve changes as wages change, one can indicate the production technology, that is the relation of output to inputs, of a firm. The total expenditures of a regulatory agency, like a firm's total costs, equals the sum of the quantities of each input employed by the agency multiplied by the price of the input. Let x = inputs (eg. labor, raw materials), q = output, w = wage rate (and other unit prices for inputs), f = production function ; that is f(x) = output if x are the inputs. The cost function C(q,w) solves the problem of which minimize the cost of producing q units subject to the constraint that q units are produced according to the engineering relationship between q and x. A cost function shows how much it costs the firm to produce various amounts of output or various combinations of different outputs. It depends not only on the outputs produced, but also on the cost of the factors of production, like wages of workers and the cost of raw materials.

Theoretical model (Layard and Walters, 1978)

Total cost is the whole expenditures happened in the production process.

$$TC = \sum_{i=1}^{n} w_i x_i \qquad (1)$$

where TC = total cost

x_i = quantity of i^{th} factor input

w_i = unit price of i^{th} factor input

A cost function shows the least cost which is used to produce an amount of outputs at a unit price of factor input.

$$TC = f(Q, w_i) \quad ; i = 1,...,n \qquad (2)$$

Where Q is an amount of outputs that firms want to produce. If there are only two kinds of factor inputs ; capital (K) and labor (L) where r = unit price of capital, then the total cost function can be of the following form :

$$TC = f(Q,w,r) \qquad (3)$$

However, since the price of capital is usually defined as the rate of interest plus the rate of depreciation, which did not affect much in the cost of a government agency, therefore, the term of unit price of capital factor input is excluded from this study.

4.2 Methodology and model specification

In order to find the cost determinants of the Thai FDA, the multi-product cost functions are estimated using data drawn from the previous record of expenses and

outputs of the organization. The economic model to be used views the Thai FDA as a firm, then the total cost functions are assumed to be of the following form :

$$TC = aQ^{\beta}P^{\gamma} \quad (4)$$

where Q is the vector of outputs and P is the vector of input prices. At present, only the prices of labor input are determined and assumed that the price of capital inputs did not affect costs.

To estimate the parameters of the cost functions of the Thai FDA, the output factors have to be employed into the functions. As mentioned in the part of the output concept that regulatory agencies usually use indices of the agency's monitoring and enforcement activities as a measure of "output", so this concept will be used in this study. Since the principal activities of the Thai FDA are pre-marketing control and post-marketing monitoring, the cost functions are therefore written as :

$$\ln TC = \alpha_1 + \beta_3 \ln Q_3 + \gamma_1 \ln P_L + \theta_1 dummy + \Sigma_1 \quad (4.1)$$

$$\ln TC = \alpha_2 + \beta_1 \ln Q_1 + \beta_2 \ln Q_2 + \gamma_2 \ln P_L + \theta_2 dummy + \Sigma_2 \quad (4.2)$$

$$\ln TC = \alpha_3 + \beta_{11} \ln Q_{11} + \beta_{12} \ln Q_{12} + \beta_{13} \ln Q_{13} + \beta_{21} \ln Q_{21} + \beta_{22} \ln Q_{22} + \beta_{23} \ln Q_{23} + \gamma_3 \ln P_L + \theta_3 dummy + \Sigma_3 \quad (4.3)$$

$$\ln C_1 = \alpha_{11} + \beta_{111} \ln Q_{11} + \beta_{121} \ln Q_{12} + \beta_{131} \ln Q_{13} + \gamma_{11} \ln P_L + \theta_{11} dummy_1 + \Sigma_{11} \quad (4.4)$$

$$\ln C_2 = \alpha_{22} + \beta_{212} \ln Q_{21} + \beta_{222} \ln Q_{22} + \beta_{232} \ln Q_{23} + \gamma_{22} \ln P_L + \theta_{22} dummy_1 + \Sigma_{22} \quad (4.5)$$

where, $\ln TC$ = ln-value of total cost per year

$\ln Q_1$ = ln-value of the outputs of pre-marketing activities per year

$\ln Q_2$ = ln-value of the outputs of post-marketing activities per year

$\ln P_L$ = ln-value of unit price of labor input per year

$\ln C_1$ = ln-value of total cost of pre-marketing activities per year

$\ln C_2$ = ln-value of total cost of post-marketing activities per year

$\ln Q_{11}$ = ln-value of the amount of premises and warehouses licence approval and unapproval per year

$\ln Q_{12}$ = ln-value of the amount of product registration approval and unapproval per year

$\ln Q_{13}$ = ln-value of the amount of other activities such as registration and licence correction, label, advertisement approval and unapproval per year

$\ln Q_{21}$ = ln-value of the amount of premises and warehouses inspection per year

$\ln Q_{22}$ = ln-value of the amount of products inspection per year

$\ln Q_{23}$ = ln-value of the amount of label, advertisement inspection and inspection at customs per year

$Q_3 = Q_1 + Q_2$

dummy = 1 for public education expenditure in 1998

= 0 otherwise

dummy_1 = 1 for administrative structural changes during 1992-1999

= 0 otherwise

4.3 Definition and measurement of variables

Most of the studies in cost functions were substantially different in their statistical methodology, specification of costs and outputs which bring about differences in the result of studies. One of the important factors that results in variety of cost studies is the specification of outputs. The cost function analysis comes from the theory of production function in economic analysis, therefore, all variables should be measured in real physical units. The usual measure for output is the flow of goods and services during an accounting period. This study used enforcement activities of the Thai FDA, digested to pre-marketing and post-marketing activities, as indices of outputs.

Outputs

The data was collected from annual performance report of the Thai FDA. Actually, the annual report of outputs show a lot of detailed data of FDA's works, so these data have to be summarized in groups. The outputs of pre-marketing activities can be grouped in three principal items ; premises and warehouses licence approval and unapproval (Q_{11}), products registration approval and unapproval (Q_{12}) and the last item is others such as the correction of registration and licence, label and advertisement approval and unapproval (Q_{13}). Before these items were summarized again to be as the whole outputs (Q_1), they had been weighted by the value presented as social benefit gain from each activity. From the recommendation of the experts working at the Thai FDA, they indicated that Q_{12} should be 50% weighted, Q_{11} 40% and Q_{13} should be only 10% weighted. The same concept was employed for the

outputs of post-marketing activities (Q_2) that were summarized from three principal items as premises and warehouses inspection (Q_{21}), products inspection (Q_{22}) and others such as label, inserted document and advertisement inspection (Q_{23}). They were also weighted at 40%, 50% and 10%, respectively. Although it is very subjective, it can reduce some bias from sum up every data altogether. It is believed that the quality and safety of the products should be firstly guaranteed. Further, if the premises and warehouses of any manufacturers or stores are guaranteed, the products will be also proved about their safety and quality.

Costs

Total cost was defined as the sum of labor, capital and operational expenditures. Labor expenditure was obtained by the sum of total salaries and wages paid. Capital expenditure was computed from real payments and depreciation. Consequently, the cost items used for this study will consist of real expenditures (total costs ; TC) as well as the real expenses on pre-marketing (C_1) and post-marketing (C_2) activities. These data came from annual expenditures of the Thai FDA. The budgets allocated to provincial health offices for health consumer protection activities are excluded. Since the study covers only the administrative costs, thus any economic loss resulting from social regulation is also excluded.

When costs are counted as they are incurred, they are called to be expensed ; when they are spread out over the useful life of the machine, they are said to be amortized. Economists want costs to reflect the value of the resources used when those resources are employed in their most productive use, other than the current one.

This study used the concept of opportunity cost of land and amortization on capital expenditures to adjust costs data available.

The main capital expenses of the Thai FDA comprise of the real payment on cars and computer system. They are expressed as annual expenditures. Annualization factor at 7% discount rate was used and can be obtained from the annualization table (Creese & Parker, 1993). The expected useful lives of cars and computer system are determined as 10 years and 5 years respectively.

Total costs were also adjusted by the amortization of the building expenditures. Although the real payment of building did not firstly include in the real payment of the total costs, economic cost depreciation was also employed by using annualization factor at 7% discount rate. The expected working lives of building are determined as 30 years.

Opportunity cost of land was calculated from this formula:

(price of land) x (interest rate of fixed bank deposit)[1]

In practice, it is very difficult to search for the price of land during the past 20 years. Only the present value (price) of land was known as well as the data from published document of a research work[2] indicated the trend of land price in Bangkok and suburban areas. From these data, the price and opportunity cost of land during the

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[1] Document for the training course of National adverse drug reaction monitoring center, Food and drug administration, September,1999.

[2] 'Thailand Property Outlook,1999', Agency for real estate affairs co.,ltd.

past 20 years can be computed, using the yearly fixed deposit interest rate of the Thai farmer bank. The overhead cost share of pre-marketing and post-marketing activities were allocated up to the real capital usage of each activity.

Wage rates

Labor input was measured as the number of persons employed, so the unit price of labor is calculated from total labor expenditure divided by quantity of labor.

Other variables

Still, there are some variables needed. It is impossible not to define dummy variables into the functions because of the structural changes observed from data available. From the total cost (TC) data, total cost shifted up immidiately in 1998 from the large amount of public education expenditures, so dummy variable ; determined in the year 1998, is included. Furthermore, there are some changes in the task structure such as the establishment of medical device control division and the deconcentration of consumer protection activities to provincial health offices, so dummy 1 variable is determined (1992-1999) into the functions.

It is observed that dummy variable was used in the total cost functions and dummy 1 variable employed in the sub-cost functions. This is assumed from the description of the total cost (TC) that shifted up suddenly in 1998, hence, dummy variable helps to handle the effects of the shifted-up expenditures. Dummy 1 variable also helps to manage the effects of task-structural changes due to the description of

outputs during the period 1992-1999, which seems to differ from the period 1980-1991.

4.4 Hypothesis

The hypothesis regarding each of the coefficient value be in the positive sign implies that outputs, input and costs have positive relationship with efficiency. As outputs or inputs increases, costs should increase according to the theoretical model of a cost function.

4.5 Estimation method

Finally, Ordinary Least Square (OLS) method of regression analysis which is proved to be the best linear unbias estimation (BLUE) is employed to estimate the cost functions.