

## CHAPTER III

### RESEARCH METHODOLOGY



#### 3.1 Cost Function concept

Cost function is a function of outputs and input prices. Where for hospital, cost function is a function of outputs, input prices and also management efficiency or x-efficiency of the hospital is another factor that should be focus on also.

$$\text{Cost} = f(Q, W)$$

The total cost function shows that for any set of input costs and for any output level, the minimum total cost incurred by the firm is:

$$TC = C(r, w, q)$$

Where  $r$  is rent of capital,  $w$  is wage and  $q$  is output.

Total cost increases as output increases, a change in an input price shifts the expansion path and its related cost functions (Nicholson, 1985).

Average cost function (AC) is cost per unit of output.

$$AC = AC(r, w, q) = C(r, w, q) / q$$

This study will take focus on the function of average charges for in-patients services which will reflects to the function of average cost per relative weight of DRGs. Factors that have may have influence on average charges will be studied and

defined which is significantly related to the average charge in providing in-patient services and to what degrees and direction.

### **3.2 Operation Definitions**

#### **Admission rate:**

The admission rate refers to the percentage of in-patient cases relative to the total cases of that hospital.

#### **Average Charges per 1 relative weight of DRGs:**

The average charge of in-patient cases per one relative weight of DRGs refers to the total charges for every in-patient's case of the hospital divided by the total DRGs relative weights of hospital.

#### **Average Total Cost:**

The average total cost refers to the total costs occur divided by the total quantity of outputs of the hospital.

#### **Capitation payment:**

A method of payment for medical services whereby medical care providers receive a fixed payment per person in return for providing medical care services regardless of the quantity of medical care delivered.

#### **Case Flow rate (CFR)/Capacity Utilization:**

The ratio of hospital's output per period to hospital's capacity or numbers of patient cases per bed per year.

**Consumer price index (CPI):**

A price index that measures the cost of purchasing a fixed market basket of consumer goods and services over times. The CPI is used to measure the consumer price inflation rate from one period to the next.

**Diagnosis Related Groups (DRGs):**

A reimbursement system developed under Medicare used to compensate hospitals based on the patient's primary diagnosis.

**DRGs index/Hospitals case-mix:**

An index refers to the variety or severity of illness that are treated in the hospitals or the sum of relative weight of hospital admission divided by total number of admissions.

**Hospital's Costs Function:**

A mathematical expression containing the various factors that influences the cost of output for a given hospital. Cost function will be estimated as a function of outputs, input prices, and management efficiency and other external factors.

**Inventory Turnover Ratio:**

The inventory turnover ratio compares total current operating revenue to investment in inventory.

**Referral rate:**

The referral rate refers to the percentage of accepting referral cases into the hospital relative to the total referral in and referral out cases of that hospital.

**Relative weight:**

An indication of the relative intensity of care provided. It represents the average resources consumption and costs of treating an in-patient within a particular DRG relative to the average costs of in-patient treatment across all DRGs

**3.3 Research Assumption**

In this study average charges per relative weight are used to imply for average cost per relative weight due to limitation of data availability in public hospitals under the Ministry of Public Health. Since full units cost analyses of in-patient services in the hospitals are performing only in some hospitals during this study, then cost per relative weight of hospitals could not be obtained. From studies done in the United States of America, the charges are corresponding to the costs (Berman, Weeks and Kukla, 1986 refer to Feldstein and Waldman) and from The American Hospital Association, in its publication “ Factors to Evaluate in the Establishment of Hospital Charges” states that “ the rates charged for each individual service should reflect properly the operating expenses of the service rendered, plus an equitable share of the other financial needs for which the patient is responsible”. Moreover, charge and cost have positive relationships, eventhough charges are slightly higher than cost but, if cost of service rendered increases, charge increases also. In some circumstance hospitals may increase their charges by ordering more treatments to reflect the cost of services. In Thailand, hospitals are in the transitional period of the budgeting system and studies about relation of cost and charges are not finalized yet. This study will use the assumption that is adopted from the United States of America that charges reflect the cost of the services provided for analyzing the data.

### 3.4 Research Design

A cross-sectional descriptive research, by collecting and analyzing data that are assume to be related to the average charges per one unit of relative weight of DRGs for in-patient services in fiscal year 2001.

#### 3.4.1 Target Population

All public hospitals in the Office of Permanent Secretary, Ministry of Public Health except Bangkok, including

- Regional hospitals
- General hospitals
- Community hospitals

**Table 3.1: Number of hospitals in different level**

<b>Levels of hospitals</b>	<b>Numbers of hospitals</b>
Regional Hospitals with teaching status	12
Regional Hospitals without teaching status	13
General Hospitals	67
Community hospitals	721
<b>Total</b>	<b>813</b>

Source: Ministry of Public Health, September 2001

### 3.4.2 Exclusion Criteria

Hospitals that will be excluded from this study are hospitals that do not have complete records of in-patient DRGs data with total charge per case of in-patient services of fiscal year 2001. Outliers DRGs data which has length of stay (LOS) longer than standard LOS and data with LOS shorter than 1/3 of weighted LOS are also excluded. The DRGs data used in this study will be secondary data collected from the Health Insurance Office which the hospitals submitted the data for reimbursement of high cost care. Hospitals that did not submit monthly report (0110 Report 5) in fiscal year 2001 to the Bureau of Provincial Health Development, Office of Permanent Secretary of the Ministry of Public Health will also be excluded from this study.

### 3.4.3 Limitation

From the target population of 813 public hospitals, due to some limitation in availability of complete data set of all dependent and explanatory variables, this study may have to exclude some hospital out. The remaining hospitals are assumed to be able to represent the public hospital in Thailand.

### 3.4.4 Data collection

This study proposes to collect secondary data from 813 hospitals under the Ministry of Public Health in fiscal year 2001 and other socio-economics data in the most recent year as possible.

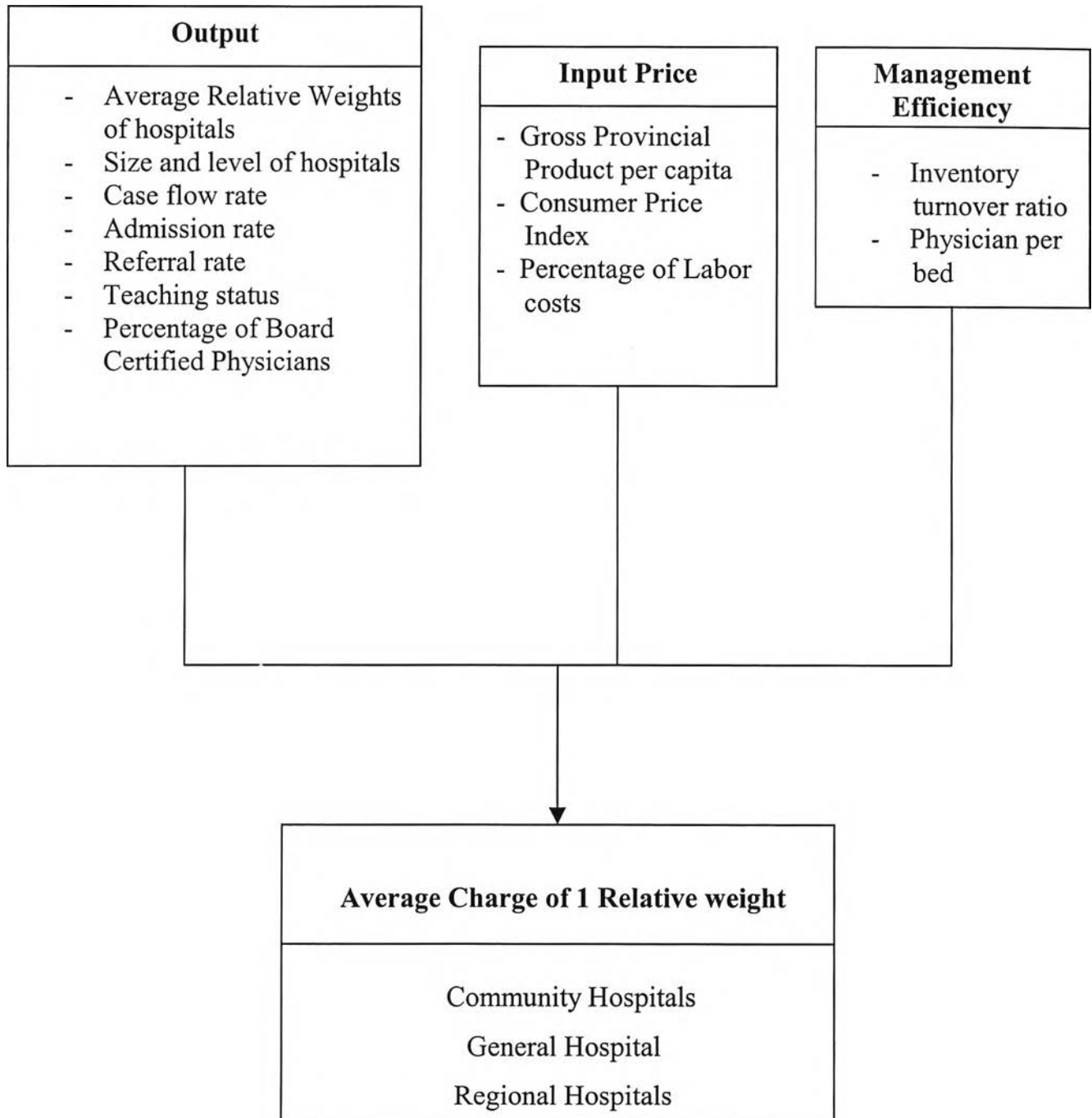
### 3.4.5 Sources of Data

**Table 3.2: Health and socioeconomic data sources**

<b>Data</b>	<b>Sources</b>
Population of Province	National Statistical Office
Gross Provincial Product (GPP)	National Economic and Social Development Board
Consumer price index (CPI)	Department of Internal Trade, Ministry of Commerce
DRGs and relative weights	Ministry of Public Health
Number of Hospitals and beds	Ministry of Public Health
Number of Physicians	Ministry of Public Health
Number of Board Certified Physicians	Ministry of Public Health
Out-patient and In-patient records	Ministry of Public Health
Expenditure of hospitals	Ministry of Public Health

### 3.5 Conceptual Framework

Figure 3.1: Conceptual framework





### 3.6 Data analysis

The multiple regression model used in explaining and estimate the magnitude of factors that determine the average charges per relative weight of DRGs will use functional form as state below:

$$\text{ACRW} = f(\text{AVRW}, \text{BEDS}, \text{LEV}, \text{INVCFR}, \text{LC}, \text{PHY}, \text{BDPHY}, \text{ADM}, \text{RF}, \text{GPP}, \text{CPI}, \text{TR})$$

Where

ACRW	= average charges per relative weight of DRGs
AVRW	= average relative weights of DRGs (case-mix index) of the hospital
BEDS	= number of hospital beds
LEV	= level of hospital
INVCFR	= inverse of occupancy rate or inverse of total admission cases divided by the number of beds of hospital
LC	= percentage of labor cost to total expenditure of the hospital
PHY	= percentage of physicians from the total beds of the hospital
BDPHY	= percentage of board certified physicians from the total physician in the hospital
ADM	= percentage admission cases from the total number of patients of hospital
RF	= accepted referral cases into hospital, from the number of total accepted referral in and referral cases out of the hospital
TR	= inventory turnover ratio of the hospital
GPP	= gross provincial product per capita
CPI	= consumer price index

### 3.6.1 Variables used in the regression models

#### 3.6.1.1 Dependent variable

The average charge per relative weight of DRGs in the hospital is use to estimate the regression model as a representative of the cost of providing in-patient service per 1 relative weight of DRGs, measured in real term.

#### *Average charges (baht) per relative weight of DRGs*

$$= \frac{\sum \text{In-patient charges of individual data (baht)}}{\sum \text{Relative weight of individual data}}$$

Data are collected from the hospital in-patients records, which is submitted to the Health Insurance Office from October 2000 to September 2001. This study uses the reimbursement criteria of the Health Insurance Office in analyzing the DRGs data. Cases which are categorized into DRG 468, DRG476 and DRG 477 are exclude from the study due to unrelated procedures to the MDC (Major Diagnostic Category) and cases in DRG 470 which is ungroupable is also exclude.

#### 3.6.1.2. Explanatory variables

#### **Average relative weights of DRGs (case-mix index): AVRW**

The average DRGs relative weight measures the complexity of a hospital services in term of relativeness to the cost. The hypothesis of this variable is that as higher average relative weights, the more complicate the treatment of that hospital which refers to more resources used and higher outputs. This variable is expected to

have positive relationship with output and positive co-efficient to the cost/charges function. Data of relative weights for each in-patient will be sum and divided by the total in-patient cases of that hospital.

***Average relative weights of DRGs***

$$= \frac{\sum \text{Relative weight of individual in-patient data}}{\sum \text{In-patient cases}}$$

**Number of hospital beds: BEDS**

The number of hospital beds is a proxy of the size of the hospital, the hypothesis of this variable is the increase in sizes of hospital, normally increases the output and the cost of outputs also. This variable should have positive relation to cost/charge function. However if there are increases in number of beds but the output didn't increase, this may be a problem of x-efficiency in management of that hospital also which will leads to higher cost per unit.

**Level of hospital: LEV**

The variable level of hospital is defined into regional hospitals with teaching status, regional hospitals without teaching status, general hospitals and community hospitals. The hypothesis is cost per unit of service or output is different in different level of hospitals, higher-level hospitals should have higher cost, which leads to higher charges. Level of hospital is also the proxy of urban and rural area. The community hospitals usually are located in the rural area, but general hospitals and regionals are usually located in central district or urban area. General and regional

hospitals are expected to have higher level of case-mix index and higher output, which need more resources in providing services, so hospitals in urban area should have positive relationship to cost/charge function.

The teaching status is also another control variable for hospital characteristics which may affect charge. This variable is defined as the hospitals that have resident training program which consist of 12 regional hospitals. Hospitals that have resident training programs may have some more cost from extra laboratory diagnosis cost for teaching purpose, more complicated cases etc. and higher output which should have positive relationship to the cost/charge function

LEV1	= 0 if otherwise = 1 if regional hospital with teaching status
LEV2	= 0 if otherwise = 1 if regional hospital without teaching status
LEV3	= 0 if otherwise = 1 if general hospital
LEV4	= 0 if otherwise = 1 if community hospital

### **Inverse of case flow rates/occupancy rates: INVCFR**

The case flow rates or occupancy rates variable is defined as the total admission cases divided by the number of beds of the hospital which is one of the indicators of outputs of the hospital. The inverse of the occupancy rate is a proxy for fixed capacity or utilization capacity of the hospital. Assuming that fixed cost are positively related to capacity, average fixed cost will depend positively on the inverse of the occupancy rate, which refers to the average cost of output.

$$\text{Case flow rate} = \frac{\sum \text{In-patient cases}}{\text{Beds of the hospital}}$$

$$\text{Inverse of case flow rate} = \frac{\text{Beds of the hospital}}{\sum \text{In-patient cases}}$$

### **Percentage labor cost / total expenditure: LC**

The percentage of labor cost to total expenditure of the hospital is a proxy for hospital wage and can be used as a wage index to size of the hospital that can reflect costs of providing care. Labor cost is one of the components of input prices or the fixed cost of the hospital. If labor cost consists of a high ratio in comparison with total expenditure, the hospital will have fewer budgets in improving quality of service due to high labor cost. The cost per unit output of service usually will be high also. Large hospitals tend to have more skilled high salary personnel, which lead to a high portion of labor cost and implies a higher cost per output. This variable is expected to have a positive relation with the cost/charge function.

$$\text{Percentage of Labor cost} = \frac{\text{Labor cost} \times 100}{\text{Total expenditure of the hospital}}$$

### **Physicians to beds ratio: PHYS**

This variable is defined as the percentage of physician to the beds in the hospital. Physicians have higher incentives than other personnel in the hospital, other than

salary there are incentives for not practicing private clinics and overtime wage for extra office hour of medical treatment. Hospitals that have many physicians are expected to have higher output, which leads to higher cost per output. If small hospitals with low output have many physicians, this is a problem of x-efficiency in management. If the former is true, this variable should have negative relationship to the management factor and the cost per unit of output will be high.

$$\text{Percentage of Physician to Bed} = \frac{\sum \text{Physicians} \times 100}{\text{Beds of the hospital}}$$

#### **Percent of Board Certified Physicians: BPHY**

Boards certified physicians are specialist-trained physicians, which have capacity in treating more complicated cases, which need more resources, especially high technology equipment. Percent of board certified physicians are proxies of high medical technology equipment and high labor costs; outputs should be higher and leads to higher charges of services to balance the cost. This variable is defined as the percent of Board Certified Physicians from the total physicians of the hospitals and the hypothesis is it has positive relationship to the cost/charge function.

#### **Percentage of Board Certified Physician**

$$= \frac{\sum \text{Board Certified Physicians} \times 100}{\sum \text{Physician}}$$

### **Admission rates: ADM**

This variable is defined as the ratio of number of admission cases, from the total number of patients of hospital. Hospitals that admit in-patients cases much may or may not have higher total relative weights because it depend on complexity of case but will have higher cost per output because of some fixed cost in admitting a patient. This variable hypothesis is that it has positive relation to the cost/charge function.

$$\text{Admission rates} = \frac{\sum \text{In-patient cases} \times 100}{\sum \text{In-patients cases} + \sum \text{Out-patients cases}}$$

$$\text{Total number of patients} = \text{Total in-patient cases} + \text{Total out-patient cases}$$

### **Referral rates: RF**

This variable is defined as the percentage of accepted referral cases into hospital, from the total number of accepted referral cases in and out of the hospital. This rate refers to the capability in treating complicated cases and output. Hospitals that have high capability in treating complicated cases may have more cost per output of services or referral rate have positive relationship with the cost/charge function.

$$\text{Referral rates} = \frac{\sum \text{Accepted Referral cases} \times 100}{\sum \text{Referral cases}}$$

*Total number of referral cases*

$$= \textit{Total accepted referral cases} + \textit{Total referral-out cases}$$

### **Gross Provincial Product per capita: GPP**

This variable is defined as a proxy of the wealthiness of the population in that province. Higher income per capita may indicate the exogenous demand and higher cost of living, which lead to high input prices and higher cost per output in that area.

$$\textit{Gross Provincial Product per capita} = \frac{\textit{Gross Provincial Product}}{\textit{Population}}$$

### **Regional consumer price index: CPI**

Consumer price index is a price index that measures the cost of purchasing a fixed market basket of consumer goods and services over time. The CPI is used to measure the consumer price from one period to the next and the difference in cost of living in different areas. This is a proxy of the style and cost of living in that area and refers to input price. This variable is expected to have a positive relationship to the cost/charge function as high CPI, higher cost per unit output.

### **Inventory Turnover ratio: TR**

This ratio indicates how much revenue is generated relative to the investment inventory; thus the more revenue per bath of inventory, the better the financial position of the hospital. This variable is defined as the total operating revenue



divided by investment inventory. This variable is a proxy of management efficiency, if the turnover ratio is high, it will have positive relationship to management efficiency.

$$\textit{Inventory turnover} = \frac{\textit{Total operating revenue}}{\textit{Inventory}}$$

### 3.6.2 Data processing

SPSS version 10.0 program will be used to process and analyze the data. Ordinary least square (OLS) will be applied to this model to estimate the relationship between characteristics of hospitals, hospital outputs, input prices and management efficiency. The degrees and direction of co-efficient will be taken into consideration for average charge per 1 unit relative weight of DRGs for hospitals, which will reflects to average cost per 1 relative weight of DRGs.