



## CHAPTER 3

### RESEARCH METHODOLOGY

The objective of this study is to analyze effects of exchange rate on drug prices. This chapter is organized into five main sections. The first section focuses on the rationale and reasons of independent variables influencing change in drug prices such as change in foreign exchange rate, length of time, change in quantity procured, types of drug, increasing in value added tax, cancellation of medium price policy and change in Civil Servant Medical Benefit. The second section involves modeling factors determining change in drug prices. The third section focuses on the hypothesis of coefficient sign of each determinant. The fourth section focuses on the data collection. The last section involves econometric method in this study.

#### **3.1 Rationale and Reasons of Independent Variables**

Many factors determine changes in drug prices. One of the most important factors is fluctuation of foreign exchange rate, a direct consequence when Bank of Thailand decided to change the currency system from basket pegged to managed floated system on July 2<sup>nd</sup>, 1997. Thailand relies on foreign countries by importing both raw material and finished products for manufacturing in pharmaceutical industry. Therefore, when exchange rate changes, prices of drugs also change.

Furthermore, procurement of pharmaceutical and medical products by the public providers must follow government regulations. Since economic crisis, some regulations have been changed causing great impact on prices of drugs, namely increase in value added tax on August 2<sup>nd</sup>, 1997, cancellation of medium prices on

December 15<sup>th</sup>, 1997 and change in Civil Servant Medical Benefit Scheme (CSMBS) on March 1<sup>st</sup>, 1998. Producers usually take advantage by passing on the increase in tax to consumers. According to the Prime Minister Office's Procurement Regulation, public hospitals cannot purchase pharmaceuticals and medical equipment higher than medium prices set by Ministry of Public Health. When the medium prices were cancelled, hospitals can procure pharmaceuticals products at higher prices thereby setting the trend for more expensive medication.

Other government regulation that influences drug prices is the change in CSMBS -- health insurance for civil servants and their families. Beneficiaries in this scheme make advance payment for outpatient service and get reimbursed later same as in the previous scheme when all items of drugs in the medical bill could be refunded. Charges for inpatient services could be billed directly from hospitals. Since the change in regulation, the reimbursement covers only items announced by Ministry of Finance, which are mostly similar to those stated in the national essential drug list and also other items as allowed by hospital committee. As a result, physicians were likely to prescribe only drugs that can be reimbursed to the majority of patients in the hospital. Hence the change in prices and demand for drug in the market.

As foreign exchange fluctuates drug prices do not change in the same pattern, so different type of drugs should be controlled in the model as dependent variable. In this study, drugs are categorized by National Essential Drug List (NEDL) under each production firms. There are 2 groups of drugs classified by NEDL known as essential and non-essential drugs. When classified by type of production firms, two groups of drugs are generic or local made drugs and brand name or original drugs. Thus, one

item is categorized in 2 groups, for instance, Sara whose generic name is Paracetamol is a local made drug and also an essential drugs.

### 3.2 Model

The model assumes that factors effecting drug price include changes in foreign exchange rate, type of drugs, changes in quantity procured and length of time as well as government policies on drug prices such as increasing in VAT, cancellation of medium prices and changes in CSMBS shown in Equation (1). In order to normalize the scale effect of drug prices, we will quote the percentage change in drug prices depending on the changes in those factors.

$$DLNP_t = \beta_0 + \beta_1 (DLNFX_{it}) + \beta_2 (DLNFX*ORI_{it}) + \beta_3 (DLNFX*ED_{it}) + \beta_4 (ORI_{it}) + \beta_5 (ED_{it}) + \beta_6 (DT_{it}) + \beta_7 (DLNQ_{it}) + \beta_8 (VAT_{it}) - \beta_9 (MP_{it}) + \beta_{10}(CSMB_{it}) + \beta_{11} (H1_t) + \beta_{12} (H2_t) + \mu_t \text{ -----(1)}$$

Where;

DLNP = percentage change in drug price ( lnPit – lnPito)

$\beta$  = Slope coefficient of independent variable

DT = length of time (t-to)

DLNFX= percentage change in foreign exchange rate (lnFXt-lnFXto)

DLNQ = percentage change in quantity procured

ORI = 1 for original drugs, ORI = 0 for local made drugs

ED = 1 for essential drugs, ED = 0 for non-essential drugs

VAT = 1 if value added tax is charged 10 percent

VAT = 0 if value added tax is charged 7 percent

MP = 1 if medium price was cancelled

MP = 0 if medium price was effective

CSMB = 1 under new system of Civil Servant Medical Benefit Scheme

CSMB = 0 under old system of Civil Servant Medical Benefit Scheme

H1 = 1 for Police General Hospital, H1 = 0 otherwise

H2 = 1 for Siriraj Hospital, H2 = 0 otherwise

$\mu_i$  = Error term with normal distribution and zero mean value

$$[\mu \sim N(0, \delta^2)]$$

Subscripts  $i$  and  $t$  refer to individual drug prices and time period respectively.

In this model, percentage changes in drug prices between drug prices of actual procurement date ( $t$ ) and drug price at based time ( $t_0$ ). Based time ( $t_0$ ) of each drug is between the period of May 1996 and October 1996\*. Length of time (DT) is a difference between drug procurement date after July 1997 and procurement at base time in each drug ( $i$ ). Percentage change in foreign exchange rate (DLNFX) is a subtraction of logarithms of foreign exchange rate (lnFX) at  $t$  and logarithms of foreign exchange rate at  $t_0$ . The foreign exchange rate (Baht/US\$) uses the value in the middle of the month or at date 15<sup>th</sup> in each month.

Original drug type (ORI) and essential drug type (ED) are defined as dummy variables. If drug is an original drug, ORI is equal to one. However, if drug is local made drug, ORI is equal to zero. If drug is an essential drug, ED is equal to one. But Ed is equal to zero, if drug was non-essential drug.

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\* Each drug has different base time because all drugs are not procured at the same time.

Percentage changes in quantity procured (DLNQ) is a difference in percent of quantity procured in each time of item of drug  $i$ . DLNQ shows the effect of quantity on drug price, that is, high volume procurement makes the price decrease if the coefficient sign of QT is negative.

Percentage changes in foreign exchange rate multiplied by original drug type (DLNFX\*ORI) and percentage change in foreign exchange rate multiplied by essential drug type (DLNFX\*ED) present effect of type of drug on percentage change in drug prices when foreign exchange rate changes.

Government regulations such as change in Value Added Tax (VAT), cancellation of medium price (MP) and change in Civil Servant Medical Benefit scheme (CSMB) also are defined as dummy variables. If drug procurement date ( $t$ ) is before August 2<sup>nd</sup>, 1997, VAT is equal to zero. Otherwise, VAT is equal to one. If drug procurement date ( $t$ ) is before December 15<sup>th</sup>, 1997, MP is equal to zero. If procurement date is after December 15<sup>th</sup>, 1997, MP is equal to one. When procurement date is before March 1<sup>st</sup>, 1998, CSMB is equal to zero. When procurement date is after March 1<sup>st</sup>, 1998, CSMB is equal to one.

In this study, sampling areas purposely select 3 hospitals, which are Police General Hospital (H1), Siriraj Hospital (H2) and Ramathibodi Hospital (H3). The drug prices in each hospital are defined as H1 and H2. If drug prices are collected from Police Hospital, H1 is equal to one and H2 is equal to zero. If drug prices are collected from Siriraj Hospital, H1 is equal to zero and H2 is equal to one. If drug prices are collected from Ramathibodi Hospital, both H1 and H2 are equal to zero.

### 3.3 Hypothesis

Factor determining percentage changes in drug prices are percentage changes in foreign exchange rate, percentage changes in quantity procured, types of drugs either essential or non-essential, original or local made drugs, length of time, increase in value added tax, cancellation and change in Civil Servant Medical Benefit scheme. The expectation of coefficient signs is as follows;

$$DLNP = f \{DLNFX, DLNQ, ED, ORI, DT, VAT, MP, CSMB\}$$

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1. Percentage changes in foreign exchange rate (DLNFX) may have positive impact on percentage changes in drug price. Most of pharmaceutical raw materials and finished drugs are imported. When depreciation of exchange rate leads to an increase in prices of imported drug and raw materials. Therefore, prices of drugs may increase.
2. Percentage changes in quantity procured (DLNQ) may have negative impact on percentage changes in drug prices, that is because the longer quantity of purchased volume, the higher bargaining power of the hospital.
3. Essential drugs (ED) may have positive impact on percentage changes in drug prices. According to microeconomic theory, elasticity of demand for essential goods or drug is less elastic than that of non-essential goods. An upward shift in supply will lead to a higher price change in essential goods than in non-essential drugs.

4. Original drugs (ORI) may have positive impact on percentage changes in drug prices. Since original drugs have higher import content than local made drugs, depreciation of local exchange rate should have greater effect on original drugs.
5. Length of time (DT) may have positive or negative impact on percentage changes in drug prices. The positive impact involves inflation factor. Longer period should cover greater price adjustment.

The negative impact concerns demand for drugs. During the period of study which is during the economic crisis the longer period may reflect the lower income.

6. An increase in value added tax (VAT) may have positive impact on percentage change in drug price. According to microeconomic theory, any increase in tax on goods lead to higher prices of goods. Therefore, when valued added tax increases from 7 percent to 10 percent, the percentage changes in drug prices may increase.
7. Cancellation of medium price (MP) do have positive impact on change in drug prices. Medium prices are the ceiling prices for public hospitals to purchase essential drugs. When medium prices were canceled, prices can be adjusted freely and higher than medium prices but not higher than limit prices set by Department of Internal Trade. Hence, when medium prices were cancelled, the percentage changes in drug prices may increase.
8. Change in Civil Servant Medical Benefit scheme (CSMB) may have negative or positive impact on percentage changes in drug prices. The new Civil Servant

Medical Benefit Scheme aim to control medical cost. It limits the type of drugs, which can be reimbursed. As a result, price of drug, which is out of the scheme may have negative effect of the implementation of new scheme.

### **3.4 Data Collection**

Purchasing drug prices collected from hospitals are actual figures representing prices in real situation. Primary data used in this research are time series data obtained mainly from stock cards in three hospitals in the period of 1996-1998. Sampling areas are Police General Hospital, Siriraj Hospital and Ramathibodi Hospital. Criteria to select the items of drugs or samples are as follows:

1. Drugs represent a high percentage of budget based on dispensing values of the first 30 drugs in 1997 in 52 regional or provincial hospitals, Drug Information Center, Provincial Hospital Department, Ministry of Public Health.

2. Drugs represent a high frequency use based on requisition values of inventory in each therapeutic group.

Twenty-four items of drugs listed classified into 11 therapeutic groups, according to National List of Essential Drugs 1999 by National Drug Committee were shown in Table 3.1.



Table 3.1 : List of Samples Classified by Therapeutic Groups.

Therapeutic groups	Generic name
1. Anti-infective drugs :	Amoxicillin cap, Ceftriazone inj., Cloxacillin. Roxithromycin, Zidovudine
2. Antineoplastics and immunomodulating drugs	Cisplatinium , Tagafur + Uracil
3. Cardiovascular drugs	Enalapril, Nifedipine
4. Drugs acting on central nervous system	Paracetamol
5. Dermatological drugs	Benzoyl Peroxide jel.
6. Endocrinologic drugs	Glibenclamide, Metformin
7. Gastrointestinal drugs	Domperidone, Omeprazole
8. Immunological drugs	Antirabies Vaccine
9. Drugs acting on musculo skeletal system ( Non-steroidal anti-inflammatory and anti-rheumatic drugs)	Diclofen, Piroxicam. Naproxen
10. Psychotherapeutic drugs	Dipotassium Chlorazepate, Fluoxetine, Lorazepan
11. Drugs acting on respiratory system	Dextromethorphan, Salbutamol

All of trade name drugs with every dosage form and strength in the hospital were collected. Drugs that were stopped or just started to procure during this time period would be excluded.

In each stock card, data to be collected are brand name, dosage form, strength, size of package, buying or inventory date, volume of individual purchased, and buying drug price.

Data collected were identified according to the dummy variables such as to identify original or local made drugs and essential or non-essential drugs, set the time that change government regulations. Furthermore, monthly foreign exchange rates of Thai and US currency from January 1996 to December 1998 are collected.

### **3.5 Econometric Estimation Method**

Coefficients in the equation (1) as stated will be estimated by using ordinary least square (OLS) method to test percentage changes in drug price before and after July 2<sup>nd</sup>, 1997, as a dependent variable. The factors that impact on changes in drugs prices or explanatory factors were changes in foreign exchange rate, changes in CSMBS, cancellation of medium prices, increasing in value added tax, length of time, percentage change in quantity procured.