

## Chapter IV

### Substitution of Branded Drug by Generic Drugs

This chapter attempts to analyze the price-quantity relationship of branded antibiotic drugs and generic antibiotic drugs and measuring the elasticity of substitution, leading to the estimation of money gain from the substitution of branded antibiotic drug by generic antibiotic drug. The discussion is divided into three parts: the empirical study of elasticity of substitution, the potential gain from the substitution and the problems of pharmaceutical industry.

#### **Substitution Mechanisms.**

The question arises here is that whether it is possible to observe the effect of quantity changes through price changes. Consider the case of generic cloxacillin capsule compared to branded cloxacillin capsule. If generic cloxacillin capsule is a perfect substitution for branded cloxacillin capsule, their prices must, by definition, be equal. An increase in the productivity in generic cloxacillin capsule implies that the price of generic cloxacillin capsule should fall. This will cause a fall in the demand for branded cloxacillin capsule. In this case, no interrelations between price and quantity changes will be observed. However, there should be the

incomplete adjustment of prices in the branded and generic drugs because of such factor as product differentiation and imperfect substitutability.

The empirical evidences in this section would serve to confirm the negative correlation between prices and quantities of the sample antibiotic drugs. This study has tried to estimate the elasticity of substitution, considering the antibiotic drug which has the difference between branded and generic market share less than 90 percent. They are pefloxacin injection, pefloxacin tablet, cloxacillin capsule, cephalixin capsule and amikacin injection (see Table 4.1), in different criteria as follows:

1. no substitution between different sub-therapeutic classes of these five antibiotic drugs.
2. perfect substitution, since the number of observations is only four years. Then, this criteria groups the firms together.
3. perfect substitution between different sub-therapeutic class of new antibiotic drugs. Since branded and generic antibiotic drugs are classified into two groups according to the off-patent period, estimated elasticity of substitution branded drug by generic drug, between old and new drug as follows:
  - a. off-patent more than 20 years i.e. cloxacillin capsule which called old drug.
  - b. off-patent less than 20 years i.e. pefloxacin injection pefloxacin tablet, cephalixin capsule and amikacin infection which called new drug.

Table 4.1 : Branded and Generic Sample Antibiotic Drug Market Share Difference, 1993

	Branded Market Share (%)	Generic Market Share (%)	Branded and Generic Market Share Difference*
azteonam injection	100.00	-	100.00
thiamphenicol injection	-	100.00	-100.00
cefsulodin injection	-	100.00	-100.00
spiramycin injection	100.00	-	100.00
tetracycline capsule	1.67	98.33	-96.66
pefloxacin injection	13.01	86.99	-73.98
pefloxacin tablet	68.36	31.64	36.72
cloxacillin capsule	22.50	77.50	-55.00
cephalexin capsule	55.98	44.02	11.96
amikacin capsule	44.73	55.27	-10.54

Note: \* + indicate brand dominate

- indicate generic dominate

Source: Calculated from the profile of FDA and IMS.

Table4.2: The Elasticity of Substitution of Branded by Generic Antibiotic Drugs, the First Criterion, 1993

DRUGS	CONSTANT	X COEFFICIENT	STD. ERROR OF COEFFICIEN T	R SQUARED
1. CLOXACILLIN CAP.	-1.3657* (-5.219)	-0.3039 (-0.437)	0.6959	0.087
2. PEFLOXACIN INJ.	4.1794 (1.558)	-5.0475 (-0.899)	6.0501	0.2581
3. PEFLOXACIN TABLET	3.9668 (2.533)	-7.0658 (-1.674)	4.2203	0.5836
4. CEPHALEXIN CAP.	-0.2961 (-0.190)	-0.4341 (-0.181)	2.3949	0.0162
5. AMIKACIN INJ.	-0.5823 (-0.704)	-0.1641 (-0.132)	1.2403	0.0087

Note : 1. The number in parentheses are t-statistics.

2. \* means the significant values at 95% level of significance .

Source : Calculated from the profile of FDA and IMS.

**Table4.3:** The Elasticity of Substitution of Branded by Generic Antibiotic Drugs, the Second Criterion, 1993

DRUGS	CONSTANT	X COEFFICIENT T	STD. ERROR OF COEFFICIENT	R SQUARED
<u>Sampling Antibiotic Drugs:</u> cloxacillin capsule, pefloxacin tablet, pafloxacin injection, caphalexin capsule, amikacin injection	1.4290 (1.4246)	-2.6683 (1.3840)	1.3948	0.0969

Note : The number in parentheses are t-statistics.

Source : Calculated from the profile of FDA and IMS.

**Table4.4:** The Elasticity of Substitution of Branded by Generic Antibiotic Drugs, the Third Criterion, 1993

DRUGS	CONSTANT	X COEFFICIENT T	STD. ERROR OF COEFFICIENT	R SQUARED
1. <u>Old Drug:</u> cloxacillin	-1.36527 (-5.219)	-0.3039	0.6959	0.087
2. <u>New Drugs:</u> pefloxacin tablet, pafloxacin injection, caphalexin capsule, amikacin injection	3.7678* (4.8243)	-6.1670* (-4.3665)	1.4124	0.5766

Note : 1. The number in parentheses are t-statistics.

2. \* means the significant values at 95% level of significance .

Source : Calculated from the profile of FDA and IMS.

Tables 4.2, 4.3 and 4.4 show that the correlation coefficients are very low, most of them have the correlation coefficients less than 0.5 implies that the non-price factors might have more influence in determining the demand in antibiotic drug market than price factor. In other way, the correlation coefficients are quite low may be resulted from the error of model which should include other variables into the model and increase more number of observations.

The negative and greater than one in absolute value of the estimated elasticity of substitution implies that if the relative price competitiveness of the new drugs in the third criterion (see Table 4.4), the second criterion (see Table 4.3) and generic pefloxacin injection and tablets (see Table 4.2) are improved, its relative price is lowered from the consumers point of view. These generic antibiotic drugs will experience a relatively greater demand in Thailand.

The positive constant term signifies the extent of non-price performance of consumers for the branded antibiotic drugs, whereas the negative constant term measures the non-price preference for generic antibiotic drugs. This means that the non-price factor makes generic antibiotic drugs more preferable to branded antibiotic drugs in the view point of consumers in the old antibiotic drugs under the third criterion (see Table 4.4) and drugs i.e. cloxacillin capsule, tetracycline capsule, cephalixin capsule and amikacin injection under the first criterion (see Table 4.2)

The absolute value of the estimated elasticity of substitution in some antibiotic drugs are very high i.e. pefloxacin injection and pefloxacin tablet (see Table 4.2), new drugs (see Table 4.3) which are 5.0475, 7.0658 and

6.1670 respectively. It might be described that the consumers are very sensitive to the change in the relative price of these drugs.

### **Potential Gain from the Substitution.**

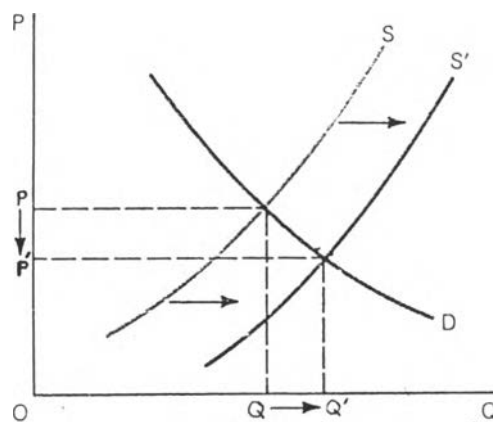
The issue of generic substitution can be economically considered. If, however, it is assumed that the consumers are both knowledgeable and rational, seeking the same drug at a lower price than generic drug availability may be a major factor in consumer decisions. Similarly, it is assumed that physicians and pharmacists are cost conscious, either on behalf of their patients or health service systems (governmental or private insurers), then the availability of cheaper versions of the same pharmaceuticals ought to be selected as part of the decision process.

There are arguments about generic quality; it has been contended that generic equivalents are different in absorption time and solubility as a function of manufacturing differences. That issue requires more researches. But in this study the generic quality was considered, the only GMP granted dosage form of generic drugs were recruited. The next calculation in the amount of money saved following the previous assumption by using elasticity of substitution between branded and generic drugs by using formula discussed in chapter I ( equation 8<sup>th</sup> ).

The empirical evidence in section 4.1 revealed that the non-price factors may have more influence in determining demand than the price factor. Hence, the saving may be increased by expanding the supply of generic drugs and at the same time introduced various measures aimed at improving the image of the generic drugs.

For instance, let D be the normal demand curve of generic antibiotic drugs( see Figure 4.1), SS the supply curve of generic antibiotic drugs. A rise in supply of generic antibiotic drugs will be reflected in a shift of the supply curve from position S to S'. The normal price of generic antibiotic drugs will decrease from OP to OP', the rate of production or consumption will increase from OQ to OQ'. An increase in the supply of generic antibiotic drugs may be due to a decline in the cost of production which may take place either because of technical improvements or because of a fall in the prices of factors of production e.g. a fall in the price of raw materials.

Figure 4.1 : Changes in supply : Changing market equilibrium.



Assumed the decreasing price of generic antibiotic drugs is 10, 20 and 30 percent whereas the other factors are constant. From the model, the amount of money saved could be calculated following the estimated elasticity of substitution criteria. Therefore, the amount of money saved could be shown in the form;

$$(1 + \beta) S_g \left[ \frac{\Delta P_g}{P_g} \right]$$

In general, suppose buyers experience an increase in income and, as a result, they increase their demand for the product. The impact on market equilibrium of an increase in supply and an increase in demand. The



equilibrium quantity will definitely rise, but price might rise or fall depending on the relative shifts of the demand and supply curves. An increase in demand is a force that, by itself, exerts upward pressure on price; an increase in supply exerts downward pressure on price. What happens to the equilibrium price will thus depend on which change dominates. In this study did not concern the changing in demand since it is assumed to be zero.

Table 4.5 : Amount of Money Saved for the First Criterion, 1993

Scenario I: $\Delta P_g / P_g = 10\%$	$\beta$	Share of Generic Drug	Saving (%)	Decrease in CPI (%)
cloxacillin capsule	-0.3039	0.7364	-5.1261	$-1.51 \cdot 10^{-5}$
pefloxacin injection	-5.0475	0.1305	5.2820	$1.58 \cdot 10^{-5}$
pefloxacin tablet	-7.0658	0.3165	19.1983	$5.76 \cdot 10^{-5}$
cephalexin capsule	-0.4341	0.4118	-5.9056	$-1.77 \cdot 10^{-5}$
amikacin injection	-0.1641	0.5278	-4.4119	$-1.31 \cdot 10^{-5}$
Scenario II: $\Delta P_g / P_g = 20\%$	$\beta$	Share of Generic Drug	Saving (%)	Decrease in CPI (%)
cloxacillin capsule	-0.3039	0.7364	-10.2522	$-3.07 \cdot 10^{-5}$
pefloxacin injection	-5.0475	0.1305	10.5640	$3.17 \cdot 10^{-5}$
pefloxacin tablet	-7.0658	0.3165	38.3966	$11.52 \cdot 10^{-5}$
cephalexin capsule	-0.4341	0.4118	-11.8112	$-3.54 \cdot 10^{-5}$
amikacin injection	-0.1641	0.5278	-8.8238	$-2.64 \cdot 10^{-5}$
Scenario III: $\Delta P_g / P_g = 30\%$	$\beta$	Share of Generic Drug	Saving (%)	Decrease in CPI (%)
cloxacillin capsule	-0.3039	0.7364	-15.3783	$-4.61 \cdot 10^{-5}$
pefloxacin injection	-5.0475	0.1305	15.846	$4.75 \cdot 10^{-5}$
pefloxacin tablet	-7.0658	0.3165	57.5949	$17.28 \cdot 10^{-5}$
cephalexin capsule	-0.4341	0.4118	-17.7168	$-5.31 \cdot 10^{-5}$
amikacin injection	-0.1641	0.5278	-13.2357	$-3.97 \cdot 10^{-5}$

Note: 1. Antibiotic drugs weight 0.03 percent of the Consumer Price Index (CPI).

2. Assume that there is no substitution between items of drugs.

Source: Calculated from profile of FDA and IMS.

Table 4.6 : Amount of Money Saved for the Second Criterion, 1993

Scenario I: $\Delta P_g / P_g = 10\%$	$\beta$	Share of Generic Drug	Saving (%)	Decrease in CPI (%)
cloxacillin capsule pefloxacin injection pefloxacin tablet cephalexin capsule amikacin injection	-2.6683	0.5815	9.7012	$2.91 \times 10^{-5}$
Scenario II: $\Delta P_g / P_g = 20\%$	$\beta$	Share of Generic Drug	Saving (%)	Decrease in CPI (%)
cloxacillin capsule pefloxacin injection pefloxacin tablet cephalexin capsule amikacin injection	-2.6683	0.5815	19.4024	$5.82 \times 10^{-5}$
Scenario III: $\Delta P_g / P_g = 30\%$	$\beta$	Share of Generic Drug	Saving (%)	Decrease in CPI (%)
cloxacillin capsule pefloxacin injection pefloxacin tablet cephalexin capsule amikacin injection	-2.6683	0.5815	29.1036	$8.73 \times 10^{-5}$

Note: 1. Antibiotic drugs weight 0.03 percent of the Consumer Price Index (CPI).

2. Assume that there is perfect substitution between items of drugs.

Source: Calculated from profile of FDA and IMS.

Table 4.7 : Amount of Money Save for the Third Criterion, 1993

Scenario I: $\Delta P_g / P_g = 10\%$	$\beta$	Share of Generic Drug	Saving (%)	Decrease in CPI (%)
Old drug	-0.3039	0.7364	-5.1261	$-1.54 \times 10^{-5}$
New drug	-2.6683	0.7740	7.9077	$2.37 \times 10^{-5}$
Scenario II: $\Delta P_g / P_g = 20\%$	$\beta$	Share of Generic Drug	Saving (%)	Decrease in CPI (%)
Old drug	-0.3039	0.7364	-5.1261	$-1.54 \times 10^{-5}$
New drug	-2.6683	0.7740	15.8154	$4.75 \times 10^{-5}$
Scenario III: $\Delta P_g / P_g = 30\%$	$\beta$	Share of Generic Drug	Saving (%)	Decrease in CPI (%)
Old drug	-0.3039	0.7364	-5.1261	$-1.54 \times 10^{-5}$
New drug	-2.6683	0.7740	23.7231	$7.12 \times 10^{-5}$

Note: 1. Antibiotic drugs weight 0.03 percent of the Consumer Price Index (CPI).

2. Assume that there is perfect substitution between items of new drugs.

Source: Calculated from profile of FDA and IMS.

Tables 4.5, 4.6 and 4.7 show the calculated amount of money saved and the effect of saving to the decreasing of CPI in 3 scenarios with 10 % , 20 % and 30 % changed for the generic drug price. The Consumer Price Index (CPI) is the commonly used price index because it attempts to measure price changes in goods and services that are commonly purchased by all consumers. The CPI provides consumers with a rough guide to how fast prices in general are changing.

The negative sign of saving implies that the consumer's welfare loss in spite of the fact that the price of generic drugs are decreased. The causation might be as follows;

a. The demand for drugs is not absolutely regardless of price; like any other economic goods, the quantity demanded varies inversely with its price. The willingness of buyers to pay for care of their health furnished an incentive for various kinds of supply response. Our society permits many ways of satisfying this demand, and these include a sector that operates in response to a profit motive-the companies that make pharmaceutical products and the distributors of these products. In addition, physicians and pharmacists themselves may be regarded as entrepreneurs who operate small firms motivated by the desire to maximize their net return. Does the man whose dinner will be paid for through his expense account pay as much attention to its cost as the one who pays for his own dinner ?

Similarly does the physician who prescribes the drugs for which he does not pay care as much about their prices as he would about the price of drugs to treat himself and for which he must pay himself ?

b. Nature of branded drugs which may be the necessary products, mean that they are not very responsive to changes in prices of generic drugs. It might be said that in the consumer's sense the branded drugs are better than generic drugs not only the non-price effect but also the limited technology existing in the generic drug firms.

The positive sign of saving implies that the consumers gain in having decreasing price of generic drugs. They may pay their saving for the necessary commodities, i.e. food, or the investment.

The negative sign in decrease CPI means that inflation is occurred. Inflation may has impact or no impact upon purchasing power dependency on the consumer's income. Some people receive fixed incomes, others receive income that generally rises more slowly than the rate of inflation and others may receive income that rises faster than the rate of inflation. When incomes change unevenly, inflation has an uneven impact. Individuals or families who receive fixed or slowly changing incomes will experience a reduction in real income (purchasing power) as a result of inflation. Whereas individuals and families who receive increases in their income that exceed the rate of inflation will actually experience an increase in real income.

### **The Problems of the Pharmaceutical Industry.**

These problems are concluded from an in-depth interview which can be listed as follows:

a. The generic drug manufacturers are still dependent on imported raw materials . This will lead to severe problems if the country is in wartime or if the supplier countries have problems.

b. At present, the actual production level of the local manufacturers are lower than their production capacity. Therefore, they can only undertake economical production if they have larger markets.

c. The lack of transfer of technology and quality equivalent which is necessary for the development of domestic production not only for accomplishing the simpler formulation and packaging stages but also producing a range of bulk chemicals. It requires a lot of technological know-how, trained manpower and especially, the large amount of funds.

It should be noted that there are a lot of problems exist in the pharmaceutical industry. All of the problems should be solved immediately and, however, to solve the problems should take into account the pros and cons of the policies before taking any further decisive action. This is because if the problems are accumulated over a longer period of time, ultimately, it is those who need the drugs may suffer the most. All of the problems should be concerned to all the parties such as the government, the medical profession, and the private sector in the immediate future.