CHAPTER 3

METHODOLOGY

As in the objectives indicated, the analysis and forecast of the demand for zinc, will be done by the statistical analysis. The former objective will be achieved by employing an econometric method that analyzes the influential variables on zinc demand directly. For the method used to achieve the latter objective, it will be stated in Chapter 5.

According to other factor demand studies in the literature review (Ch. 1.5, pp.13-23), there are two kinds of method used for this purpose. This study chooses the method which directly studies the influential variables on zinc demand instead of study final demand for zinc derivative product. The reasons are the data of some final products are not available while the data of zinc purchased by all zinc derivative industries are available, moreover, the conversion factors of some final products do not exist.

The demand for zinc by each zinc derivative industry will be studied serarately. This is because along the period studied from 1978 to 1988, the supply of zinc both abroad and domestic acts as perfectly elastic curves. Hence, the amount of zinc purchased by one industry will not affect the other.

3.1 Model Formulation

The seven zinc demand equations from seven industries will be formulated in the same way based on the conventional demand theory and on the appropriateness of that specified independent variable

expected to affect the demand. Then, the statistical model of zinc demand should be specified as follows:

$$Z_i = f(RPZ, RP_i, Q_i, D)$$

where subscript "i" belongs to zinc derivative industry "i".

This demand equation indicates that the independent variables assigned in the model to influence the amount of zinc purchased by industry "i" (Z) are:

Real price of zinc (RPZ), theoretically, the demand for a certain commodity is explained by its own price. The demand for zinc can be analyzed in the same way as the demand for other commodities. Then it is expected that zinc demand will be influenced by change in its own price.

Real price of final product "i" (RP_i), according to the theoretical background (Ch. 1, section 1.4, pp. 11-15) and from other factor demand studies using this direct method, they suggest that the factor demand model should include price of final product as an independent variable. So it is expected that zinc demand by industry "i" will be influenced by change in product price "i".

Output of industry "i" (Q_i), theoretically, the conventional independent variables of demand model besides its own price are income and price of substitution. This is a case of final demand. For factor demand, the income variable should be represented by real economic activity of the industry. Hence, it is expected that zinc demand by industry "i" will be affected by change in economic activity of industry "i". Since the data of real economic activity is not available, output of the industry is used instead as a proxy.

Besides those conventional explanatory variables, the dummy variable (D) is also assigned in each demand model so as to capture

the effect of the establishment of the Padaeng Industry Company on the amount of zinc purchased. Along the studied period there was a big change in the supply side, i.e. the establishment of a domestic supplier which most buyers switched to buy from. This point is also interesting to study whether it will have the impact on zinc demand or not. Thus, the dummy variable reflecting this factor has its value equal to one during the first quarter of 1985 to the fourth quarter of 1988 and zero otherwise.

Finally, the zinc demand models by each zinc derivative industry are as follows:

(1) Galvanized sheet industry: Z1 = F1(RPZ, RP1, Q1, D)

(2) Galvanized pipe industry: Z2 = F2(RPZ, RP2, Q2, D)

(3) Brass industry: Z3 = F3(RPZ, RP3, Q3, D)

(4) Zinc oxide industry: Z4 = F4(RPZ, RP4, Q4, D)

(5) Dry cell industry: Z5 = F5(RPZ, RP5, Q5, D)

(6) Die-casting: Z6 = F6(RPZ, RP6, Q6, D)

(7) Miscellaneous: Z7 = F7(RPZ, RP7, Q7, D)

In addition, the demand functions for the final products produced by zinc will also be constructed. The own price elasticities estimated from these demand equations will be used to verify the value of the zinc price elasticities of zinc demand equations. The model formulations of these demands are also based on the conventional demand theory. Unfortunately, from the seven final products produced by zinc, the data about the quantity purchased of three products are not available and there are no good proxies for them. Hence, those three demands, i.e. demand for brass, die-casting and the miscellaneous will not be estimated. However, this problem

is not so serious as these industries are not the major users of zinc.

The model formulations of these demands are also based on the conventional demand theory. The demand models for the two major zinc users, galvanized sheet and galvanized pipe, will be formulated in the same way as both of them are the raw materials used in construction. These two demand models are as follows:

(8) Demand for galvanized sheet: Q1 = F8(RP1, RPA1, QS)

(9) Demand for galvanized pipe : Q2 = F9(RP2, RPA2, QS)

These demands indicate that the quantity purchased (Q_i) is treated as a function of its own price (RP_i), value of construction sector (QS) and price of its substitute (RPA_i). In this study, roman tile is assumed to be the substitute for galvanized sheet and PVC pipe is the substitute for galvanized pipe.

For the demand for zinc oxide and dry cell, their models are as follows:

(10) Demand for zinc oxide : Q4 = F10(RP4, PM, QM)

(11) Demand for dry cell : Q5 = F11(RP5, PM, GDP)

Demand for zinc oxide (Q4) is set as a function of its own price (RP4), price of manufacturing product (PM) and value of manufacturing product (QM). Demand for dry cell (Q5) is set as a function of its own price (RP5), price of manufacturing product (PM) and gross domestic product (GDP).

3.2 Expected Signs of Explanatory Variables to Zinc Demand

The demand for zinc and other zinc derivative products are, in principle, no different from that for any other commodities and the statistical analysis is based on the conventional neoclassical

analysis. Having adopted this approach, it is expected that the major factors affecting the change in zinc and other final demands are their real own price.

Due to the conventional demand theory, the quantity purchased is expected to have negative relationship with its real own price and positive relationship with the output.

For the prices of zinc derivative products (RP1 to RP7), it is likely that when product prices rise, firms want to sell more and employ more inputs or vice versa, so the prices of zinc derivative products are expected to have positive effect on zinc demand.

For price of the substitute in the final demand equations, it is expected to have positive effect on quantity demand.

3.3 Description of Variable

GDP = Real gross domestic product, in million baht. Since the quarterly GDP is not available, the QGEN program is used to interpolate the quarterly series of GDP from the annual data. This method is used because there is no related quarterly series serving as an index to determine the distribution factors. (Appendix A)

Q1 = Quantity of galvanized sheet produced, also used as a proxy of quantity purchased, in ton.

Q2 = Quantity of galvanized pipe produced, also used as a proxy of quantity purchased, in ton.

Q3 = Quantity of brass produced, as this data is not available and most of brass end uses are in the manufacturing products as already stated in the industry background (see Ch.2, section 2.5, p.44-45) so the value of manufacturing products (QM), is

used instead as a proxy, in million baht.

Q4 = Quantity of zinc oxide produced, also used as a proxy of quantity purchased, in ton.

Q5 = Quantity of dry cell produced, also used as a proxy of quantity purchased, in ton.

Q6 = Quantity of die-casting produced, since die-casting is only a process in production not a product itself as already stated in the industry background (see Ch.2, section 2.5, p.45), the value of manufacturing product (GM) is used as a proxy.

Q7 = Quantity of the miscellaneous, the value of manufacturing product (GM) is also used as a proxy for the same reason as Q3 and Q6.

QS = Real value of construction sector, again, the QGEN program is used to generate the quarterly series of QS from the annual data.

RP1 = Real wholesale price of galvanized sheet at Bangkok , corrugated iron No.35, in baht per foot.

RP2 = Real wholesale price of galvanized pipe at Bangkok, length 6 m. with diameter 15 mm., in baht per one pipe.

RP3 = Real average retail price of brass products. Since the brass products comprise of various commodities, such as, decorative item, furniture, general hardware , automobile's parts , etc. and those brass product firms, mostly sell their products directly to the customers, so the consumer price index (P3) in the item of housing is used as a proxy.

RP4 = Real wholesale price of zinc oxide at Bangkok, the price of Gold Seal type is used as a representative, in baht per ton.

RP5 = Real average wholesale price of dry cell at Bangkok, for size R(20), R(14), R(6), in baht per one dozen.

RP6 = Real price of die-casting. Since die-casting is only one of the process in production for any final product that has to be die-casted, so this data does not exist and the wholesale price index in the item of industrial products (PM) is used instead as a proxy.

RP7 = Real wholesale price of the miscellaneous item. Since this price has to reflect the price of all those zinc derivative products that can not be grouped in any other categories and those products are various as described in the industry background , so the wholesale price index in the item of industrial products (PM) is also used as a proxy.

RPA1 = Real wholesale price of roman tile at Bangkok, 50 cm. width and 120 cm. length, in baht per sheet.

RPA2 = Real wholesale price of PVC pipe at Bangkok, 4 m. length with diameter of 20 cm., in baht per pipe.

RPZ = Real import price of zinc in the period 1978-1984 and real domestic price of zinc in the period 1985-1988 at Bangkok, in baht per ton.

Z1 = Quantity of zinc purchased by galvanized sheet industry, in ton.

Z2 = Quantity of zinc purchased by galvanized pipe industry, in ton.

Z3 = Quantity of zinc purchased by brass product industry, in ton.

Z4 = Quantity of zinc purchased by zinc oxide industry, in ton.

Z5 = Quantity of zinc purchased by dry cell industry, in ton.

Z6 = Quantity of zinc purchased by die-casting industry, in ton.

Z7 = Quantity of zinc purchased by miscellaneous, in ton.

The variable in real terms are obtained from deflating current terms by wholesale price index (WP), the year 1981 was the base year. The justification of using WP as a deflator is that the firms sell their products and buy factors of production at the wholesale level. For real import price, the import price index (MP) will be used as a deflator and the GDP deflator is used for the value of gross domestic. All price indices are based on the year 1981. The details calculating import price can be seen in Appendix B.

3.4 Sources of Data

All the price data except price of zinc and also price index are obtained from Department of Economic Commerce, Ministry of Commerce. All output data are obtained from Industrial Economics and Planing Division, Ministry of Industry, except the output of zinc oxide obtained directly from the producers. The amounts of zinc used in each industry are obtained from Department of Mineral Resource, Ministry of Industry and Department of Customs, Ministry of Finance and these two sources also provide zinc price. The value of gross domestic product and construction sector are obtained from Bank of Thailand.

3.5 Method of Estimation

All demand studies have to face the identification problem which has to be solved by simultaneous equation. In this study, it is likely that this problem can be totally avoided since the zinc price is not affected by domestic demand at all. According to the

statement of problem (Ch.1.1, pp.1-9), the zinc buyers perceive that zinc supply both domestic and abroad is perfectly elastic. Hence, zinc price can be considered as exogenous.

In pure theory, the demand curve is taken as a unique functional relation between the quantity bought and the price paid. Normally, the larger is the price the smaller is the quantity demanded. Schultz[1] has mentioned in his study that the demand curve has many shapes. However, most price-quantity observations generally fall within a comparatively narrow range, and within this range the straight line, though is the simplest curve, gives as good a fit as does other curves. Thus, for simplicity, derived demand models used in this study are linear models.

The ordinary least squares (OLS) technique is applied to estimate all equations with the help of the TSP program. The quarterly data are used, starting from the first quarter of 1978 to the fourth quarter of 1988 including 44 observations.

The quarterly data are used to make the observations large because the data of zinc uses can be available only for 11 years. By doing this, there may occur the "seasonal variation" in the obtained data. This term refers to systematic though not necessarily regular movements in economic time series. Seasonal movements are assumed to be caused by exogenous forces and are deemed uncontrollable. To capture this seasonal variation, the dummy variables are used. Those dummy variables are:

D1 = 1 if the observation is for the first quarter

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[1]Henry Schultz , The Theory and Measurement of Demand (Chicaco: University of Chicaco Press, 1966), pp. 146-150.

= 0 otherwise

D2 = 1 if the observation is for the second quarter

= 0 otherwise

D3 = 1 if the observation is for the third quarter

= 0 otherwise.

These three dummy variables[2] then will also be included in the zinc demand models. Finally, the estimated demand models are:

(12) Z1 = F12(RPZ, RP1, Q1, D, D1, D2, D3)

(13) Z2 = F13(RPZ, RP2, Q2, D, D1, D2, D3)

(14) Z3 = F14(RPZ, P3, QM, D, D1, D2, D3)

(15) Z4 = F15(RPZ, RP4, Q4, D, D1, D2, D3)

(16) Z5 = F16(RPZ, RP5, Q5, D, D1, D2, D3)

(17) Z6 = F17(RPZ, PM, QM, D, D1, D2, D3)

(18) Z7 = F18(RPZ, PM, QM, D, D1, D2, D3)

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[2]If there is a constant term in the regression equation, the number of dummies defined should always be one less than the number of groupings by that category because the constant term is the intercept for the base group and the coefficients of the dummy variables measure differences in intercepts. This is because in using dummy variable, the implicit assumption is that the regression lines for the different groups differ only in the intercept term but have the same slope coefficients. For example, suppose the relationship between the dependent variable (Y) and the independent variable (X) for four quarter are:

$Y = a_1 + \beta X + u$ for the first quarter
$Y = a_2 + \beta X + u$ for the second quarter
$Y = a_3 + \beta X + u$ for the third quarter
$Y = a_4 + \beta X + u$ for the fourth quarter

These equations can be combined into a single equation as

$$Y = a_4 + [(a_1+a_2+a_3)-a_4]D + \beta X + u$$

where D = 1 for quarter 1,2,3
= 0 for quarter 4