

CHAPTER 4

EMPIRICAL RESULT

This chapter discusses the results and their interpretations outlined in the previous section. As it is impossible to specify a priori the exact functional form, the structural equations in the model are, therefore, specified as linear forms providing elasticities at the means. The results presented here are the best one selected among many which can be seen in Appendix C. The criteria to choose the best one are based on the appropriateness of many components, i.e. the high R-square value, the theoretically correct sign, the significant t-statistics and the Durbin-Watson statistics.

The dummy variable D which is specified in the model in order to capture the effect of the establishment of the Padaeng Industry Company on zinc demand is insignificant in all estimated equations (the results from the original models can be seen in Appendix C). This may be because zinc is a derived demand and the amount of zinc purchased directly depends on the amount of the output produced. Hence, when zinc can be domestically supplied and most users switched to buy from this source as it was more convenient and cheaper, but it did not imply that those users have to change their pattern of buying. The dummy variable is thus dropped from the equations.

All the estimated coefficients of seasonal dummies are also insignificant (the result can also be seen in Appendix C), except for demand for zinc by zinc oxide. It implies that there are no seasonal effects in those six demands. This may be because those six zinc

derivative industries are manufacturing products whose consumptions do not depend on season. Hence, the productions of these products do not depend on season either. The seasonal dummies are thus also dropped from the equations except the demand for zinc by zinc oxide.

The explanation of each regression result will be given on (1) the value of the elasticity and (2) the sign of the estimated coefficient that is insignificant and/or yielding unexpected sign. If everything is correct, i.e. the sign is as expected and significant, it will be assumed that all underlined reasons from the previous chapter are already hold.

4.1 Demand for Zinc by Galvanized Sheet Industry

$$Z1 = 1509.81 - 0.07 RPZ + 187.51 RP1 + 0.09 Q1$$

(1.87)*
(-3.23)***
(2.26)**
(7.54)***

e
-0.41
0.35
0.91

$R^2 = 0.84$
SER = 262.17

D.W. = 2.04
F = 52.21

Note: Reestimated by MA(1) process.

Figures in parentheses are t-statistics.

e is elasticity estimated at the mean.

***Significantly different from zero at 99% confidence level.

** Significantly different from zero at 95% confidence level.

* Significantly different from zero at 90% confidence level.

The above equation shows that all the independent variables, i.e. real price of zinc (RPZ), real price of galvanized sheet (RP1) and output of galvanized sheet industry (Q1) can explain 84 percent of the total variation in the amount of zinc demanded by galvanized sheet industry.

All the estimated coefficients are statistically significant and consistent with the postulated relationships. This implies that real price of zinc (RPZ), real price of galvanized sheet (RP1) and

output of galvanized sheet industry (Q1) are important determinants of zinc quantity demand (Z1).

The value of zinc price (RPZ)'s elasticity indicates that a 1% change in zinc price will result in a 0.41% change in the amount of zinc demand in the opposite direction. This inelasticity of zinc price can be explained by Marshall's rules which are already stated in theoretical background (see Ch. 1, section 1.4, p. 11-15). Two points from Marshall's rules will be applied in this study to verify the value of zinc price elasticity which will vary directly with the share of zinc in the cost of production and the own price elasticity of final demand.

The share of zinc in the cost of galvanized sheet production is about 8%¹. This share is quite low which can imply that zinc is not the important cost in producing galvanized sheet. Hence, it results in the less responsiveness of the amount of zinc purchased to zinc price.

For the own price elasticity of demand for galvanized sheet, it can be obtained from the galvanized sheet demand equation. Thus, the galvanized sheet demand is estimated as follows:

$$Q1 = 18841.90 - 1056.40 RP1 + 3037.95 RPA1 + 0.31 QS$$

$$(4.15)^{***} \quad (-5.88)^{***} \quad (3.56)^{***} \quad (8.48)^{***}$$

$$R^2 = 0.78, \quad D.W. = 1.97, \quad e = -0.38$$

Note: e is own price elasticity estimated at the mean.

The amount of galvanized sheet consumption (Q1) is treated as a function of its own price (RP1), price of roman tile (RPA1) and value of construction sector (QS). From this equation, it can be

¹This value is roughly estimated by the writer.

known that the own price elasticity of demand for galvanized sheet is - 0.38 which is inelastic.

Hence, the inelasticity of zinc price arises from the low share of zinc in cost of production and the inelasticity of galvanized sheet demand with respect to its own price together with the nature of zinc which has no other substitute.

The elasticity of output (Q1) is 0.91 which is almost unity. This confirms the nature of production of galvanized sheet which employs zinc in fixed proportion and the value of the estimated coefficient is 0.09 which is close to the input coefficient of zinc which is about 10%.

The elasticity of real price of galvanized sheet (RP1) is 0.35, which implies that a 1% change in real price of galvanized sheet will result in a 0.35% change in the amount of zinc demand in the same direction. This inelasticity directly arises from the inelasticity of galvanized sheet demand with respect to its own price. Since the amount of zinc demand varies in almost the same percentage as the change in output of galvanized sheet, thus, real price of galvanized sheet will affect the change of zinc demand almost the same percentage as it affects its output.

The reason for the inelasticity of galvanized sheet demand with respect to its own price is galvanized sheet is necessary for the poor which are its major users. Though roman tile can be substitute for it, as the coefficient of real price of roman tile (RPA1) is significantly positive, however, the substitution may not be perfect as a difference in both prices is quite high. Hence, it results in a less responsiveness of galvanized sheet demand to its

own price and finally leads to a less responsiveness of the amount of zinc purchased (Z1) to galvanized sheet price (RPA1).

4.2 Demand for Zinc by Galvanized Pipe Industry

$$Z2 = 1885.29 - 0.09 RPZ + 18.31 RP2 + 0.08 Q2$$

(2.87)^{***}
(-2.89)^{***}
(2.08)^{**}
(3.93)^{***}

e
-0.61
1.32
0.88

$R^2 = 0.84$
SER = 341.92

D.W. = 1.99
F = 49.41

Note: Reestimated by AR(1) process.

Figures in parentheses are t-statistics.

e is elasticity estimated at the mean.

***Significantly different from zero at 99% confidence level.

** Significantly different from zero at 95% confidence level.

This equation shows that all the assigned explanatory variables, i.e. real price of zinc (RPZ), real price of galvanized pipe (RP2) and output of galvanized pipe industry (Q2) can explain 84 percent of the total variation in the amount of zinc demanded by galvanized pipe industry.

All the signs of these variables are consistent with priori expectations and two of them, i.e. real price of zinc (RPZ) and output (Q2) are statistically significant at 99 percent confidence level. For real price of galvanized pipe (RP2) it is statistically significant at 95 percent confidence level. This indicates that these three variables are important determinants of zinc quantity demand (Z2).

The (absolute) elasticity of zinc demand by galvanized pipe industry (Z2) with respect to zinc price (RPZ) is also less than unity the same as demand by galvanized sheet industry. Its value of

-0.61 implies that a 1% change in zinc price will result in a 0.61% change in the amount of zinc demand (Z2) in the opposite direction.

The share of zinc in the cost of production of galvanized pipe is the same as galvanized sheet which is about 8%. For the own price elasticity of demand for galvanized pipe, it can be obtained from the galvanized pipe demand equation as follows:

$$Q2 = - 16472 - 2296.95 RP2 + 533.88 RPA2 + 0.43 Q2$$

$$(-0.86) \quad (-3.58)^{***} \quad (3.37)^{***} \quad (8.57)^{***}$$

$$R^2 = 0.88, \quad D.W. = 1.81, \quad e = -1.58$$

Note: e is the own price elasticity estimated at the mean.

From the estimated demand equation, the own price elasticity of demand for galvanized pipe is -1.58.

Though the (absolute) own price elasticity of demand for galvanized pipe exceeds unity which will make the zinc price elasticity high but the share of zinc in cost of production is quite low. This share is so low that it can outweigh the high value of the own price elasticity of galvanized pipe demand. Besides, in galvanized pipe production, zinc has no other substitute. Hence, it results in an inelastic of the amount of zinc purchased by galvanized pipe industry (Q2) with respect to zinc price (RPZ).

The output elasticity is 0.88, this value is considerably close to unity which is the elasticity value of fixed proportion production of output with respect to its input. The estimated coefficient of this variable (Q2) is 0.08 which is also close to the value of input coefficient of zinc which is 10%.

For the elasticity of real price of galvanized pipe (RP2), it indicates that a 1% change in galvanized pipe price will result in a 1.32 % change in the amount of zinc purchased in the same direction.

The magnitude of this elasticity obviously comes from the demand equation of galvanized pipe. The responsiveness of the amount of zinc purchased to output price relates directly to the responsiveness of the amount of output and its own price. This is because output is transformed proportionately from zinc. Hence, the variable affecting the amount of output should affect the amount of zinc in the same (or nearly the same) percentage. It can be seen that the value of zinc demand's elasticity with respect to galvanized pipe price which is -1.32 is close to the value of galvanized pipe demand's elasticity with respect to its own price which is -1.58.

4.3 Demand for Zinc by Brass Industry

$$Z_3 = 1731.85 - 0.05 RPZ + 4.58 P_3 + 0.01 QM$$

(1.61)	(-1.38)	(0.55)	(1.79)*
e	-1.01	0.63	3.16

$$R^2 = 0.23 \qquad \text{SER} = 386.25$$

$$D.W. = 2.03 \qquad F = 4.08$$

Note: Figures in parentheses are t-statistics.

e is elasticity estimated at the mean.

* significantly different from zero at 90% confidence level.

The result of this equation shows a rather poor power of explanation of all the assigned independent variables, it indicates that real price of zinc (RPZ), consumer price index in the item of housing (P3) and value of manufacturing product (QM) can explain only 23% of the total variation in the amount of zinc demanded by brass industry.

This poor power of explanation may be because the brass market comprises of small and numerous users (see Ch. 2, section 2.5, p. 44-45). For the supply side, brass is produced from many sources

i.e., brass makers themselves, brass users and also come from recycling brass. For the demand side, brass users are really various. Hence, the amount of source affecting the quantity of zinc demand for making brass is too high and this will result in an omitting of too many other influential variables. Moreover, the data of brass price is not available and the consumer price index in the item of housing (P3) is used as a proxy, and this proxy may not be able to fit well with the amount of zinc demand.

However, all of those estimated coefficients yield the signs as expected. The value of manufacturing product (QM), though it is a proxy variable for the output of brass industry, is significant with a 90% confidence level. This confirms the source of brass end-uses that most of them are used in manufacturing sector as already stated.

The insignificance of real price of zinc (RPZ) and consumer price index in the item of housing (P3) may be due to the same reasons as the poor power of explanation which will increase the variances of the estimates and finally lower the t-statistics of real price of zinc (RPZ) and price index (P3), or price index in the item of housing is not a good proxy of real price of brass.

Another reason is due to the data problem about the quantity of zinc used in making brass (Z3). As it is very difficult to distinguish zinc used in brass among other zinc-uses, there may be some mistake in the data of this variable and, hence, making the estimation yield a poor result.

4.4 Demand for Zinc by Zinc Oxide Industry

$$Z4 = 263.0881 - 0.0091 RPZ + 0.0018 RP4 + 0.6837 Q4 + 3.93 D1$$

(1.39) (-1.31) (0.83) (7.82)^{***} (0.12)

$$\begin{array}{r}
 - 22.97 \text{ D2} - 59.92 \text{ D3} \\
 (-0.70) \quad (-1.81)^* \\
 \\
 e \quad \quad - 0.25 \quad \quad 0.16 \quad \quad 0.84 \\
 \\
 R^2 = 0.78 \quad \quad \quad \text{SER} = 76.56 \\
 \\
 \text{D.W.} = 2.14 \quad \quad \quad \text{F} = 21.36
 \end{array}$$

Note: Figures in parentheses are t-statistics.

e is elasticity estimated at the mean.

***Significantly different from zero at 99% confidence level.

* Significantly different from zero at 90% confidence level.

This equation shows that real price of zinc (RPZ), real price of zinc oxide (RP4) and output of zinc-oxide industry (Q4) and all seasonal dummies (D1, D2, D3) can explain 73 percent of the total variation in the amount of zinc demanded by zinc oxide industry.

Only the estimated coefficient of output of zinc oxide industry that is significant at 99 percent confidence level. Real price of zinc (RPZ) and real price of zinc oxide (RP4) do not seem to have strong impact on zinc demand. However, all of these estimated coefficients yield signs as expected.

For this industry, the estimated coefficient of seasonal dummy (D3) is significantly different from zero at the 90 percent confidence level. It implies that there is seasonal effect in demand for zinc by zinc oxide industry. This may be because the pattern of zinc purchase by this industry is quite certain. As it is the only industry that there is a contract between producers and buyers and this contract will state about the interval of time they have to send their products to their customers. Usually, this interval of time has a certain pattern. Hence, this may cause the seasonal effect on zinc demand by zinc oxide industry.

The insignificance of zinc price and zinc oxide price may be because the zinc oxide firms do not pay much attention on the change

in zinc price to the production level as long as they still have their regular customers. This is also the same as zinc oxide price, as zinc oxide is a very important input, the zinc oxide buyers do not pay much attention on the change in its price but on the amount they need for their production. Hence, zinc price and zinc oxide price cannot significantly affect the zinc demand.

The (absolute) elasticity of zinc price (RPZ) is -0.25 which is less than unity, it implies that a 1% change in real price of zinc will result in a 0.25% change in the amount of zinc purchased by zinc oxide industry in the opposite direction.

To verify the inelasticity of zinc demand with respect to zinc price, the demand for zinc oxide is estimated as follows:

$$Q_4 = 361.13 - 0.0026 RP_4 + 1.81 PM + 0.0019 QM$$

$$(1.85)^* \quad (1.79)^* \quad (0.38) \quad (1.22)$$

$$R^2 = 0.40, \quad D.W. = 2.00, \quad e = -0.13$$

Note: e is own price elasticity estimated at the mean.

This equation indicates that the amount of zinc oxide purchased (Q_4) is treated as a function of its own price (RP_4), price of manufacturing product (PM) and value of manufacturing product (QM). From this equation, the elasticity of zinc oxide demand with respect to its own price is -0.13. Another determinant of input price elasticity is its share in the cost of production. In this case, the share of zinc in the cost of zinc oxide production is about 55%.²

It will be seen that although the share of zinc in the cost is quite high which will make the value of zinc price elasticity high but it is outweighed by a very low value of its output price

²This value is roughly estimated by the writer.

elasticity. Besides, in zinc oxide production, zinc has no other substitute. Hence, it results in an inelasticity of zinc price.

The elasticity of zinc demanded by zinc oxide industry (Z4) with respect output price (RP4) is also less than unity. It implies that, a 1% change in real price of zinc-oxide will result in a 0.16% change in zinc demanded Z4 in the same direction. This inelasticity arises directly from the inelasticity of zinc oxide demand with respect to its own price.

Since zinc oxide is a very important input with there is no other substitute, its price elasticity is very low. When the responsiveness of zinc oxide produced to its price is low, this will also lead to a low responsiveness of zinc demanded by zinc oxide industry to real price of zinc oxide (RP4).

The above statement can be proved by the elasticity of zinc demanded by zinc oxide industry with respect to the amount of zinc oxide produced. Its value is 0.84 which implies that a 1% change in the amount of zinc oxide produced will lead to almost a 1% change in zinc demand. Hence, it implies further that whatever affects the amount of zinc oxide produced will affect the amount of zinc demand in nearly the same magnitude.

4.5 Demand for Zinc by Dry Cell Industry

$$Z5 = - 522.8029 - 0.0002 RPZ + 15.8836 RP5 + 0.0086 Q5$$

(-0.91)	(-0.01)	(2.14)**	(5.59)***
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e	- 0.006	0.72	0.63
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R ²	= 0.52	SER = 138.98	
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D.W.	= 1.97	F = 10.68	
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Note: Reestimated by AR1 process.

Figures in parentheses are t-statistics.

e is elasticity estimated at the mean.

***Significantly different from zero at 99% confidence level.

** Significantly different from zero at 95% confidence level.

The assigned explanatory variables, i.e. real price of zinc (RPZ), real price of dry cell (RP5) and output of dry cell industry (Q5) can explain 52 percent of the total variation in the amount of zinc demanded by dry cell industry. The quite low R^2 of the result may be due to the lack of the other important influential variables. In this study, the raw material comprises of many things, which no one dominates each other, so the changes in prices of the other inputs should considerably affect the amount of zinc used. However, the price of those inputs are omitted as this industry is not so important and it consumes zinc only not more than 10%. Thus, only the hypothesized most relevant variables will be included in the model.

Two out of three variables, i.e. real price of dry cell (RP5) and output of dry cell industry (Q5) are statistically significant at the 95 and 99 percent confidence level respectively and the signs of all coefficients are consistent with priori expectations. The insignificance of zinc price (RPZ) may be due to the behavior of the dry cell firms which may not pay much attention on the change in price of the non-dominate input such as zinc.

The elasticity of zinc demand with respect to its output of 0.63 is quite far below unity as it should be. This may be because some of influential variables are omitted in the model, hence, it results in a specification bias in the estimated coefficient and finally makes the value of output elasticity less than it should be.

The (absolute) elasticity of real price of dry cell is also less than unity as a 1% change in dry cell price (RP5) will result in a 0.72% change in the amount of zinc demanded (Z5). This inelasticity can be explained in the same way as the previous explanation in the first four demand equations. It should arise from the inelasticity of dry cell demand with respect to its own price. Unfortunately, this value can not be verified by the value of the own price elasticity of dry cell demand. It is because there is a mistake in the estimation of dry cell demand equation, the estimated coefficient of dry cell price yields a positive sign.

Since real price of zinc (RPZ) is not an important determinant of zinc demanded by dry cell industry (Z5) as its estimated coefficient is insignificant, there will be no verification for the zinc price elasticity.

4.6 Demand for Zinc by Die-Casting

$$Z_6 = 2231.6627 - 0.0638 RPZ - 10.7091 PM + 0.0063 QM$$

(2.76) ^{***}	(-2.34) ^{**}	(-1.12)	(2.11) ^{**}
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e	- 1.74	- 1.67	0.37
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R ²	= 0.36	SER	= 300.34
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D.W.	= 1.98	F	= 5.54
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Note: Figures in parentheses are t-statistics.

e is elasticity estimated at the mean.

***Significantly different from zero at 99% confidence level.

** Significantly different from zero at 95% confidence level.

The result of this equation not only gives a poor power of explanation of the independent variables but also yields the unexpected sign of one estimated coefficient, i.e. the wholesale price index in the item of industrial product (PM) but it is insignificantly different from zero.

However, the estimated coefficients of real price of zinc and value of manufacturing product show signs which are consistent with a priori expectation and significantly different from zero at the 95 percent confidence level.

As it is stated earlier in the industry background that die-casting is not a product but is only a process in production for any product having to be die-casted, so it is very difficult to assign the influential variables on zinc demand by die-casting. To set the independent variables in the same way as in the other industry equations, the next two terms beside RPZ should be real price and output of die-casting. Since these two data do not exist, price index in the item of industrial product (PM) and value of manufacturing product (GM) are used as proxies for real price and output of die-casting respectively. The result shows that price index in the item of housing is not a good proxy by yielding the incorrect sign.

The (absolute) elasticity of zinc demanded by die-casting (Z6) with respect to zinc price (RPZ) of -1.74 is rather high. It implies that a 1% change in real price of zinc will result in a 1.74% change in the amount of zinc demand in the opposite direction. The reason for this may be because in producing any output which die-casting is also one of the production process, the firm need to buy zinc only once when they are preparing for die-casting. Then, the amount of output and the period the output produced will not be related to the amount of zinc used at all. In other words, zinc used in die-casting acts as it is a fixed variable. This makes the firm able to buy zinc at the time when zinc price is low or declined and stop buying at the time they think the zinc price is too high.

Hence, it results in a high responsiveness of the amount of zinc purchased to zinc price.

4.7 Demand for Zinc by the Miscellaneous

$$Z7 = 1137.6513 - 0.0089 \text{ RPZ} - 7.9025 \text{ PM} + 0.0091 \text{ QM}^{**}$$

(0.78) (-0.25) (-0.72) (2.32)

$$e \quad - 0.16 \quad - 0.64 \quad 0.58$$

$$R^2 = 0.23 \quad \text{SER} = 528.75$$

$$\text{D.W.} = 1.98 \quad F = 4.03$$

Note: Reestimated by the MA(1).

e is elasticity estimated at the mean.

** Significantly different from zero at 95% confidence level.

This equation gives the poorest result of all the seven estimations. The power of explanation of all the independent variables to the variation of zinc demand (Z7) is only 23 percent. Only the estimated coefficient of value of manufacturing product (QM) is significantly different from zero at the 95% confidence level. The price index in the item of industrial product (PM) which is used as a proxy of real price of the miscellaneous gives an unexpected sign but not significantly different from zero.

The reasons for the poor power of explanation and the insignificance of the independent variables are due to the fact that the quantity of zinc demanded by the miscellaneous (Z7) comprises of the zinc used in many industries which cannot be classified into the previous six industries, such as nail, wire net, wire, zip, etc.. Moreover, it also included the amount of zinc which cannot be investigated to its end-uses, this amount may belong to the previous six industries or to the industry that is not classified before. Hence, there will be many explanatory variables affecting zinc demand

that are not specified in the model. Another reason may be zinc is used in small proportion in these industries.

Again, the insignificance of the wholesale price index in the item of industrial product (PM) may be because it is not a good proxy for real price of the miscellaneous.

The insignificance of real price of zinc (RPZ) is also come from the previous reasons. Since there are various industries included here, it will result in a variety in the pattern of the responsiveness of zinc used to zinc price.