Chapter 3
Statistical Analysis on the Determination of the National Car Production

3.1 Introduction

This chapter investigates first the factors that determine total national car production and also price of national cars in Malaysia along with statistical evidence. The secondary data obtained from the various published data was analysed using the Eviews package. The hypothesis as mentioned in Chapter I are also tested.

3.2 Hypotheses

Hypothesis 1: Factors of Total National Cars Production in Malaysia

Other passenger cars (PSC), Price (PRC), Population (POP) and Gross Domestic product (GDP) will influence by Total cars production (TCP).

Dependent variable: TCP.

Independent variable: PSC, PRC, POP, and GDP.

Hypothesis 2: Factors of Price of National cars Malaysia

Population (POP), Total car producted (TCP), Passenger cars (PSC) and Gross Demand (GDP) will influence by Price of National cars Malaysia (PRC).

Dependent variable: PRC.

Independent variable: POP, TCP, PSC, and GDP.

3.3 The Model

i) Hypothesis 1

Total National Cars Production (TCP) is influenced by other passenger cars (PSC), Price (PRC), Population (POP) and Gross Domestic Product (GDP).

Model to Test: $TCP = f[PSC, PRC, POP, GDP]$

$$TCP = a_0 + a_1PSC + a_2PRC + a_3POP + a_4 GDP + \Sigma$$

Where,

Other passenger cars change by one percent; Total National Cars production will change by a_1 percent.

Price change by one percent, Total National Cars production will change by a_2 percent.

Population change one percent, Total National Cars production will change by a_3 percent.

Gross Domestic Product change by one percent, Total National Cars production will change by a_4 percent.

Σ = Stochastic disturbance

a_0 = the intercept

ii) Hypothesis 2

Price (PRC) is influenced by Population (POP), Total Car Production (TCP), other passenger cars (PSC), and Gross Domestic Product (GDP).

Model to Test:

$$PRC = f [POP, TCP, PSC, GDP]$$

$$PRC = b_0 + b_1POP + b_2TCP + b_3PSC + b_4 GDP + \Sigma$$

Where,

Population change by one percent, Price will change by b_1 percent.

Total Car Production change by one percent, Price will change by b_2 percent.

Other passenger cars change by one percent, Price will change by b_3 percent.

Gross Domestic Product change one percent, Price will change by b_4 percent.

Σ = Stochastic disturbance

b_0 = the intercept

3.4 Results of the Study

Both of the hypotheses will be presented with discussion on the statistical significance of the regression coefficients and the reliability of the regression findings.

3.4.1 Regression Model

Hypothesis 1

Hypothesis 1 is to determine relationship between other passenger cars (PSC), Price (PRC), Population (POP), and Gross Domestic Product (GDP) against Total National cars production (TCP).

Summaries of Least Squares Results

Dependent Variable: TCP
Sample: 1986 1999
Included observations: 14

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	-339.2228	113.1784	-2.997239	0.0150
PSC	0.030255	0.074856	0.404175	0.6955
PRC	0.134189	0.055596	2.413633	0.0390
POP	11.46468	8.155444	1.405770	0.1934
GDP	0.000269	0.000207	1.301146	0.2255

R-squared	0.989179	Mean dependent var	107.6786
Adjusted R-squared	0.984370	S.D. dependent var	68.73070
S.E. of regression	8.592629	Akaike info criterion	4.574263
Sum squared resid	664.4995	Schwartz criterion	4.802497
Log likelihood	-46.88498	F-statistic	205.6875
Durbin-Watson stat	2.224950	Prob(F-statistic)	0.000000

A standard way of reporting the empirical results is:

$$TCP = -339.2228 + 0.030255\ PSC + 0.134189\ PRC + 11.46468\ POP + 0.000269\ GDP$$

(113.1784) (0.074856) (0.055596) (8.155444) (0.000207)

The interpretation of this model:

This model has four explanatory or independent variables that are PSC, PRC, POP, and GDP. If all of the four explanatory are fixed at zero value, the average value of Total National car production is estimated decrease at about 339 units.

The partial regression coefficient of 0.030255 means that, holding all other variables constant; an increase per unit in other passenger cars is accompanied by an increase in total national cars production by 0.030255%.

The partial regression coefficient of 0.134189 means that, holding all other variables constant; an increase of prices of National Cars is accompanied by an increase total national cars production by 0.134189%.

The partial regression coefficient of 11.46468 means that, holding all other variables constant; an increase in population is accompanied by an increase total national cars production by 11.46468%.

The partial regression coefficient of 0.000269 means that, holding all other variables constant; an increase in Gross Domestic Product is accompanied by an increase total national cars production by 0.000269%.

Hypothesis 2

Hypothesis 2 is to determine relationship between Population (POP), Total National cars production (TCP), other passenger cars (PSC), and Gross Domestic Product (GDP) against Prices of National cars in Malaysia (PRC).

Summary of Least Squares Results
Dependent Variable: PRC
Sample: 1986 1999
Included observations: 14

Variable	Coefficient	Std. Error	T-Statistic	Prob.
C	1132.155	645.0720	1.755083	0.1131
POP	0.955016	42.07140	0.022700	0.9824
TCP	2.928276	1.213223	2.413633	0.0390
PSC	0.322414	0.336074	0.959353	0.3624
GDP	-0.001162	0.000980	-1.185700	0.2661

R-squared	0.956554	Mean dependent var	1329.300
Adjusted R-squared	0.937244	S.D. dependent var	160.2309
S.E. of regression	40.13963	Akaike info criterion	7.657181
Sum squared resid	14500.71	Schwartz criterion	7.885416
Log likelihood	-68.46541	F-statistic	49.53801
Durbin-Watson stat	2.492327	Prob (F-statistic)	0.000004

A standard way of reporting the empirical results is:

PRC = 1132.155 + 0.955016POP + 2.928276TCP + 0.322414PSC

(645.0720) (42.06995) (1.213223) (0.336074)

- 0.001162GDP

(0.000980)

The interpretation of this model:

This model has four explanatory or independent variables that are POP, TCP, PSC, and GDP. If all of the four explanatory are fixed at zero value, the average value of price is estimated increase at about RM1237.

The partial regression coefficient of 0.955016 means that, holding all other variables constant, an increase in population is accompanied by an increase of price by 0.955016%.

The partial regression coefficient of 0.322414 means that, holding all other variables constant; an increase in other passenger's cars is accompanied by an increase of price by 0.322414%.

The partial regression coefficient of 0.001162 means that, holding all other variables constant, an increase in Gross Domestic Product is accompanied by a decrease of price by 0.001162%.

3.4.2 Economic Criteria

Hypothesis 1

Elasticity Aspect

i) Elasticity of TCP with respect to PSC is defined as

$$\eta = \Delta TCP/\Delta PSC \times \bar{PSC}/\bar{TCP}$$

$$= 0.030255 \times \frac{2440.24/15}{1507.5/15}$$

$$= 1.649$$

- With $\eta > 1$, when other passenger cars increase by 1%, Total National cars will increase by 1.649%.

ii) Elasticity of TCP with respect to PRC is defined as

$$\eta = \Delta TCP/\Delta PRC \times \bar{PRC}/\bar{TCP}$$

$$= 0.134189 \times \frac{18610.2/15}{1507.5/15}$$

$$= 1.657$$

- With $\eta > 1$, when price increase by 1%, Total National cars will increase by 1.657%.

iii) Elasticity of TCP with respect to POP is defined as

$$\eta = \Delta TCP/\Delta POP \times \bar{POP}/\bar{TCP}$$

$$= 11.46468 \times \frac{266.97/15}{1507.5/15}$$

= 2.03

- With $\eta > 1$, when population increases by 1%, Total National cars will increase by 2.03%.

iv) Elasticity of TCP with respect to GDP is defined as

$$\eta = \Delta TCP/\Delta GDP \times GDP/TCP$$

$$= 0.000269 \times \frac{2,320,249/15}{1507.5/15}$$

$$= 0.414$$

- With $\eta < 1$, when Gross Domestic Product increase by 1%, Total National cars will increase by 0.414%.

Hypothesis 2

Elasticity Aspect

i) Elasticity of PRC with respect to POP is defined as

$$\eta = \Delta PRC/\Delta POP \times POP/PRC$$

$$= 0.955016 \times \frac{266.97/15}{18610.2/15}$$

$$= 0.014$$

- With $\eta < 1$, when Population increase by 1%, price will increase by 0.014%.

ii) Elasticity of PRC with respect to TCP is defined as

$$\eta = \Delta PRC/\Delta TCP \times TCP/PRC$$

$$= 2.928276 \times \frac{1507.5/15}{18610.2/15}$$

$$= 0.24$$

- With $\eta < 1$, when Total National cars increase by 1%, price will increase by 0.24%.

iii) Elasticity of PRC with respect to PSC is defined as

$$\eta = \Delta PRC/\Delta PSC \times \overline{PSC}/\overline{PRC}$$

$$= 0.322414 \times \frac{2440.24/15}{18610.2/15}$$

$$= 0.03$$

- With $\eta < 1$, when other passenger cars increase by 1%, price will increase by 0.03%.

iv) Elasticity of PRC with respect to GDP is defined as

$$\eta = \Delta PRC/\Delta GDP \times \overline{GDP}/\overline{PRC}$$

$$= -0.001162 \times \frac{2,320,249/15}{18610.2/15}$$

$$= -0.0145$$

- With $\eta > -1$, when Gross Domestic Product increases by 1%, price will decrease by 0.0145%.

3.4.3 Statistical Criteria

Hypothesis 1

i) R square

The R^2 , value of 0.988985 shows that the four independent variables that are PSC, PRC, POP, and GDP accounted for over 98 per cent of the variation in Total National Cars over the period 1986-1999. On the other hand, about 0.0102 is explained by other independent variables.

F-test

Hypothesis 1: $TCP = - a_0 + a_1PSC + a_2PRC + a_3POP + a_4GDP + \Sigma$

Hypothesis Null, $H_0 : \beta_1 = \beta_2 = \beta_3 = 0$

Hypothesis Alternative, H_a : Not all slope coefficients are simultaneously zero.

Number of Observation to test, N = 15

Number of independent variable include intercept, K = 5

F-value = 205.6875

Critical F-value (Statistical Table of the F distribution) $(F^C_{4, 10})$ = 3.92

F-value (202.0078) computed from computer output for Hypothesis 1 exceeds the critical F-value (3.92) at the α =1 % level of significance. So, F-value is significant, and hence the null hypothesis can be rejected.

ii) t-test

Hypothesis 1: $TCP = - a_0 + a_1PSC + a_2PRC + a_3POP + a_4GDP + \Sigma$

a) t-test for other passenger cars (a_1) :

Ho : $a_1 = 0$

$H_1 : a_1 \neq 0$

$\alpha = 0.01$

at the level of significance, $\alpha/2 = 0.005$

critical value $-t_{\alpha/2,n-1}, t_{\alpha/2,n-1}$

$-t_{0.005, 14}, t_{0.005, 14}$

-2.977, 2.977

T-Statistic = 0.404175 < $t_{\alpha/2,n-1}$ = 2.977

Result: do not reject H_o, PSC is not significant.

ɔ) t-test for PRC (a_2) :

Ho : $a_2 = 0$

$H_1 : a_2 \neq 0$

$\alpha = 0.10$

at the level of significance, $\alpha/2 = 0.05$

critical value $-t_{\alpha/2,n-1}, t_{\alpha/2,n-1}$

$-t_{0.05, 14}, t_{0.05, 14}$

-1.761, 1.761

T-Statistic = 2.4136 > $t_{\alpha/2,n-1}$ = 1.761

Result: reject H_o , PRC is significant.

:) t-test for Population (a_3) :

Ho : $a_3 = 0$

H_1 : $a_3 \neq 0$

$\alpha = 0.2$

at the level of significance, $\alpha/2 = 0.1$

critical value $-t_{\alpha/2,n-1}$, $t_{\alpha/2,n-1}$

$-t_{0.1,14}$, $t_{0.1,14}$

-1.345, 1.345

T-Statistic = 1.4057 > $t_{\alpha/2,n-1}$ = 1.345

Result: reject H_o , POP is significant.

d) t-test for Gross Domestic Product (a_4) :

Ho: $a_4 = 0$

H_1 : $a_4 \neq 0$

$\alpha = 0.2$

at the level of significance, $\alpha/2 = 0.1$

critical value $-t_{\alpha/2,n-1}$, $t_{\alpha/2,n-1}$

$-t_{0.1,14}$, $t_{0.1,14}$

-1.345, 1.345

T-Statistic = 1.3011 < $t_{\alpha/2,n-1}$ = 1.345

Result: do not reject H_o , GDP is not significant.

Hypothesis 2

i) R square

The R^2 value of 0.956554 shows that the four independent variables that is POP, TCP, PSC, and GDP accounted for about 95.65 per cent of the variation in prices of National Cars over the period 1986-1999. On the other hand, about 0.043446 is explained by other independent variables.

ii) F-test

Hypothesis 2: $PRC = b_0 + b_1POP + b_2TCP + b_3PSC + b_4 GDP + \Sigma$

Hypothesis Null, H_0 : $\beta_1 = \beta_2 = \beta_3 = \beta_4 = 0$

Hypothesis Alternative, H_a: Not all slope coefficients are simultaneously zero.

Number of Observation to test, N	= 15
Number of independent variable include intercept, K	= 5
F-value	= 49.53801
Critical F-value (Statistical Table of the F distribution) ($F^C_{4, 10}$)	= 3.92

F-value (49.53801) computed from computer output for Hypothesis 2 exceeds the critical F-value (3.92) at the α =1 % level of significance. So, F-value is significant, and hence the null hypothesis can be rejected.

iii) t-test

Hypothesis 2: $PRC = b_0 + b_1POP + b_2TCP + b_3PSC + b_4 GDP + \Sigma$

a) t-test for Population (b_1) :

Ho: $b_1 = 0$

$H_1 : b_1 \neq 0$

$\alpha = 0.1$

at the level of significance, $\alpha/2 = 0.05$

critical value $-t_{\alpha/2,n-1}, t_{\alpha/2,n-1}$

$-t_{0.05, 14}, t_{0.05, 14}$

-1.761, 1.761

T-Statistic = 0.00227 < $t_{\alpha/2,n-1}$ = 1.761

Result: do not reject H_o , POP is not significant.

b) t-test for Total National Cars (b_2) :

Ho : $b_2 = 0$

$H_1 : b_2 \neq 0$

$\alpha = 0.05$

at the level of significance, $\alpha/2 = 0.025$

critical value $-t_{\alpha/2,n-1}, t_{\alpha/2,n-1}$

$-t_{0.025, 14}, t_{0.025, 14}$

-2.145, 2.145

T-Statistic = 2.413 > $t_{\alpha/2,n-1}$ = 2.145

Result: reject H_o , TCP is significant.

c) t-test for other passenger cars (b_3) :

Ho : $b_3 = 0$

H_1 : $b_3 \neq 0$

$\alpha = 0.5$

at the level of significance, $\alpha/2 = 0.25$

critical value $-t_{\alpha/2,n-1}$, $t_{\alpha/2,n-1}$

$-t_{0.25,\ 14}$, $t_{0.25,\ 14}$

-0.692, 0.692

T-Statistic = 0.959 < $t_{\alpha/2,n-1}$ = 0.692

Result: reject H_o , PSC is significant.

d) t-test for Gross Domestic Product (b_4) :

Ho : $b_4 = 0$

H_1 : $b_4 \neq 0$

$\alpha = 0.5$

at the level of significance, $\alpha/2 = 0.25$

critical value $-t_{\alpha/2,n-1}$, $t_{\alpha/2,n-1}$

$-t_{0.25,\ 14}$, $t_{0.25,\ 14}$

-0.692, 0.692

T-Statistic = -1.1857 < $-t_{\alpha/2,n-1}$ = -0.692

Result: reject H_o , GDP is significant.

3.5 Conclusion

Overall, the price of National Cars, and populations are significant related to with Total National Cars. For second hypothesis, all independent variables those are significant with Prices of National Cars except population. The economic impact of Proton Industry in Malaysia will be discussed in the following Chapter in the light of the statistical evidence of this Chapter.