

## CHAPTER V

### HEDONIC PRICE ANALYSIS

Hedonic price analysis was conducted in February to September in 2000 by sampling selected vegetables from 11 retail market places in Chiang Mai and Bangkok. 15 high value vegetables of the Project were selected to study the relationship of their retail prices and characteristics. The prices and characteristics of sampled vegetables e.g. color, freshness, weight per unit, length, acid content, sweetness, width, number of culled out leave, percentage of damaged, firmness, brand name, product hygiene, and imported product were recorded. The colors of vegetables were read by using color reader. The aspects of color which are addressed directly in the color chart-based Munsell notation that specifies the elements of perceived color as value (lightness, from black to white on a scale of 1 to 10), chroma (degree of departure from gray toward pure chromatic color), and hue (red, orange, yellow, green, etc.). The length and width of vegetables were measured by using Vernier Calipers. The acid content in products was measured only for cherry tomato and common tomato by using Titrate technique. The number of culled out leave was the amount of inedible leave to be peeled, which decided by one person. Percentage of damaged is the proportion of a whole vegetable and the damaged part. The sweetness was measure by using Digital Refractometer. And the firmness of vegetable was measured by using the Firmness tester. The detail of all characteristics was shown in Appendix1. All vegetables were brought from 11 market places in Chiang Mai and Bangkok, and their characteristics were measured within one day. Fortnightly data was used to capture the price fluctuation. After all of vegetables' characteristics were checked, quantitative analysis was used to acquire the relationship between selected characteristics and prices. The results of hedonic price models of each vegetable are as following section:

## 5.1 Head Lettuce

Head lettuce is the main product of the Royal Project, its purchased value that the Project paid to the farmers was 17,205,766 baht in 2000. There were 8 and 12 brand names of head lettuce in Chiang Mai and Bangkok, including imported products sold in Bangkok. 119 observations of this product were sampled from the studied marketplaces. The mean of price from all studied market places was equal to 73.59 baht per kg. (Appendix 2). 19 characteristics of head lettuce were checked, only 9 characteristics were eventually included in the hedonic price model.

Table 5.1 Least Squares Estimated Hedonic Price Equation of Head Lettuce

Variable	Coefficient	t-Statistic
Constant	23.142***	3.66
WEIGHT1	-18.39***	-2.53
WEIGHT2	-9.11	-1.03
NUM	6.08	0.86
NR	34.76***	3.80
RP	-24.09***	-2.59
SEASON	16.00***	2.52
IMPORT	61.31***	8.92
FBA	40.92***	5.43
SUPER	23.32***	3.85

$R^2 = 0.5254$     Adjust- $R^2 = 0.4863$      $F(9, 109) = 13.41$     Prob = 00

Estimated by using LIMDEP version 7.0

Corrected Heteroskedasticity Problem by White method

\*\*\* Significant at 1% level

The associated variables of the head lettuce price are weight per unit, number of culled out leave, hygiene of product, the Royal Project's brand name, season, market places, and imported product. Seven variables are significant in hedonic price model. From the model the price of imported product (IMPORT) is higher than the domestic one by 61.31 baht per kg.. For the domestic product, market place plays an important role to selling at the high price, the marginal effect of selling in the foreigner-business-area supermarket (FBA) is 40.92 baht per kg., while price in supermarket (SUPER) is higher

than fresh market 23.32 baht per kg.. The variable of selling in Bangkok was omitted due to it correlated to the variable of the Royal project product. Season (SEASON) and hygiene of product (NR) are also positively significant at 1% level with marginal effect at 16.00 and 34.76 baht per kg. For head lettuce, season does not affect its quality sold in the sampling retail markets, this might be because there are enough products to be sold after they were graded and controlled for quality.

The price of non-chemical residue head lettuce is higher than the normal product at 34.76 baht per kg., and in the rainy season, the price will increase 16.00 baht per kg., compared to summer. From the model, it was found that the price of the Royal Project product (RP) is lower than other brand names by 24.09 baht per kg.. The big size of head lettuce is not important to the price, negative signs of weight per head variable (WEIGHT) represent that price of the less weight per head is higher than the weightier one. The last variable in hedonic price model is the number of culled out leaves, even it is not significant but its sign is positive. The price of product (when the amounts of leaves to be culled out is more than 2) is higher than product that has a less amount to be culled out.

## 5.2 Cos lettuce

There were 2 and 8 brand names of cos lettuce sold in supermarkets in Chiang Mai and Bangkok respectively. All most of them were sold as non-chemical residue products. The prices of this product in Bangkok ranged from 80 to 179 baht per kg. while, selling prices in Chiang Mai were between 20 to 109 baht per kg.. The dummy variables of selling in Bangkok (BKK) and imported product (IMPORT) are positively significant to the price in the model. The price will be increased by 46.56 baht per kg. if products are sold in Bangkok. Source of product is another variable that is positively significant to the price, the price of imported product is higher than domestic product by 53.83 baht per kg.. The amount of culled out leaves variable (NUM), season (SEASON), and shape (SHAPE) of product were not significantly in the model but the signs of the

first two variables were negative. The price of product (when there are leaves to be culled out of more than 3) is higher than the other variable (NUM=1, if the amount of culled out leave is less than 3).

Table 5.2 OLS Estimated Hedonic Price Equation of Cos Lettuce

Variable	Coefficient	t-Statistic
Constant	73.27***	12.36
SHAPE	3.66	0.63
NUM	-2.41	-3.42
SEASON	-0.36	-0.59
IMPORT	53.84***	7.06
BKK	46.56***	6.58

$R^2 = 0.6077$  Adjust- $R^2 = 0.5801$   $F(5, 71) = 22.00$  Prob = 00

Estimated by using LIMDEP version 7.0

No serious heteroscedasticity problem detected

\*\*\*Significant at 1%level.

The retail price in the rainy season is slightly less than price in the summer however, the variable of season is not significant in the hedonic price model. The results of the restriction test show that quality of cos lettuce varies by season, however the retail prices in both seasons were not different from each other. The price of normal shape of product is higher than abnormal shape product. Dummy variable of the Royal Project product (RP) was omitted due to it highly correlating to the variable of selling in Bangkok, therefore almost all of the Royal Project products were sold in Chiang Mai.

### 5.3 Celery

There were 5 and 6 brand names of celery sold in sampling places, including imported product, in Bangkok and Chiang Mai. Average price in Bangkok and Chiang Mai were equal to 88.88 and 80.47 baht per kg.. There were no imported celery sold in Chiang Mai, it was sold only in the foreigner-business-area in Bangkok with the average price at 120 baht per kg.. Nine variables associate to the price of celery, two dummy variables of length (LENGTH), percentage of damage (DAMAGE), product of the Royal

Project foundation (RP), season (SEASON), imported product (IMPORT), and three market places.

Table 5.3 Least Squares Estimated Hedonic Price Equation of Celery

Variable	Coefficient	t-Statistic
Constant	34.89***	4.17
LENGTH 1	-6.85	-0.70
LENGTH 2	-9.41	-1.18
DAMAGE	-0.019***	-4.19
RP	23.18***	3.27
Time	18.58***	4.41
IMPORT	39.91***	6.32
FBA	-6.36	-1.05
BKK	27.37***	4.05
SUPER	23.65***	4.14

$R^2 = 0.6871$     Adjust- $R^2 = 0.6319$      $F(9, 51) = 12.45$     Prob = 00

Estimated by using LIMDEP version 7.0

Corrected Heteroskedasticity Problem by White method

\*\*\* Significant at 1% level

The most important variable associated to the price is the imported product, which is significant at 1% level and its marginal effect is equal to 39.91 baht per kg.. Apart from imported product there are 5 more variables significant in the hedonic price model, those are selling in Bangkok, selling in supermarket, percentage of damage, product of the Royal Project, and seasonal. The marginal effect of selling in Bangkok, selling in supermarket and product of the Royal Project are almost the same number, 27.37, 23.65, and 23.18 baht per kg., respectively and all three numbers are significant at 1% level.

The result from the model represents that the price in the rainy season is higher than in summer by 18.58 baht per kg but season does not affect quality of this product sold in the market. The variable of percentage of damage from pest and breakage was ranked from 0-100 %, and is positively significant at 1% level, but its marginal effect is very tiny. The variables of selling in big supermarkets and length of product are not

when the length is between 30-35 cm., is higher. The lengths of this product sold in each marketplace are different, in fresh markets they were sold with leaves while the leaves were cut and there were only stems for imported product. The other product qualities such as firmness, color, and weight per unit do not affect the price and non-chemical product correlated to a variable of the Royal Project product, all of them were omitted from the model.

#### 5.4 Baby Carrot

Baby carrot was sold only in supermarkets in Chiang Mai and foreigner-business-area supermarkets in Bangkok under several brand names. Eighteen characteristics of this vegetable were checked which consisted of physical, chemical characteristics and market place. Chemical and physical characteristics such as color, weight per head, sweetness, meat firmness, and non-chemical residue did not associate to baby carrot's price, they were omitted from the model. The hedonic price model of baby carrot is in Table 5.4.

Table 5.4 Least Squares Estimated Hedonic Price Equation of Baby Carrot

Variable	Coefficient	t-Statistic
C	49.25***	18.907
Length1	2.96	0.786
Length2	6.55**	2.000
RP	16.05***	5.996
BKK	58.04***	10.943
IMPORTED	70.55***	13.903
SEASON	15.20***	5.176

$$R^2 = 0.9407 \quad \text{Adjust-}R^2 = 0.9362 \quad F(6, 79) = 208.99 \quad \text{Prob} = 00$$

Estimated by using LIMDEP version 7.0

Corrected Heteroskedasticity Problem by White method

\*\*\* Significant at 1% level, \*\* Significant at 5% level

The significant variables associated to the price are season, source of product, marketplace, and the length of product. The length of sampled baby carrot ranged from 5 to 13 cm., the length was categorized into three levels: (i) less than 10 cm., (ii) 10-12 cm.

The significant variables associated to the price are season, source of product, marketplace, and the length of product. The length of sampled baby carrot ranged from 5 to 13 cm., the length was categorized into three levels: (i) less than 10 cm., (ii) 10-12 cm. (LENGTH1), and (iii) more than 12 cm.(LENGTH2). The result shows that for the same quality, the most influential variable to the price is imported product; its price is higher than domestic product by 70.55 baht per kg.. In Bangkok, almost all baby carrots were sold in the foreigner-business-area supermarket and the retail price is higher than selling in Chiang Mai by 58.03 baht per kg.. Retail price in the rainy season (SEASON) is higher than in summer, marginal effect of selling in the rainy season is 15.20 baht per kg. The product of the Royal Project (RP) is only one brand name sold as non-chemical residue (NR), its marginal effect is 16.04 baht per kg, and retail price of baby carrot sold under the brand name “Doikham” (RP) is higher than others by this amount. The length of baby carrot in the model was in 3 categories; those are, less than 10 cm., between 10 and 12 cm., and longer than 12 cm. The marginal effect of length longer than 12 cm is 6.54 baht per kg., and it is significant at 5% level. Even the variable of the length 10-12 cm does not appear significant, but its sign is positive, the longer the product, the higher the price. And the result of the restriction test of season on quality shows that quality of baby carrot did not change by season, while the season influences the retail price in the market.

### 5.5 Carrot

There are at least 5 and 10 brand names of carrot sold in Bangkok and Chiang Mai respectively. In Bangkok almost 50% of sampled carrot were imported, on the contrary almost all of the products sold in Chiang Mai were from local areas. The retail prices in both Chiang Mai and Bangkok ranged from 23 to 85 baht per kg.. The average prices in each market place were equal to 65.91, 55.68, 44.43, and 35.27 baht per kg. for imported and local product sold in Bangkok and Chiang Mai. The same as baby carrot,

18 characteristics of carrot were checked, only 7 characteristics were included in the model, which are weight per unit, length, shape, percent of damage, the Royal Project brand name, season, and marketplaces.

Table 5.5 Least Squares Estimated Hedonic Price Equation of Carrot

Variable	Coefficient	t-Statistic
Constant	34.26***	10.86
WEIGHT1	-3.50	-1.18
WEIGHT2	-3.19	-0.97
WEIGHT3	-9.98***	-3.37
LENGTH1	0.97	0.35
LENGTH2	3.62	1.25
LENGTH3	6.34**	2.08
SHAPE	-13.43***	-6.91
DAMAGE	0.016	1.77
RP	14.66***	4.81
SEASON	8.09***	5.72
FBA	24.82***	8.07
BKK	6.26***	3.24
SUPER	8.84***	5.59

$R^2 = 0.6950$  Adjust- $R^2 = 0.6711$   $F(13, 166) = 29.10$  Prob = 00

Estimated by using LIMDEP version 7.0

Corrected Heteroskedasticity Problem by White method

\*\*\* Significant at 1% level, \*\* Significant at 5% level

The longer shape and lighter weight of product sells at the higher price. Weight per unit of carrot can be categorized into 4 levels: (i) less than 100 gram, (ii) 100-150 gram (WEIGHT1), (iii) 150.1-200 gram (WEIGHT2), and (iv) more than 200 gram (WEIGHT3). The marginal effect of weight per unit is negative when the weight is more than 100 gram and the marginal effect of the length is positively significant when the length is increasing. Due to the length of sampled carrot ranging between 12 to 23.95 cm., its length was categorized into 4 levels, which are (i) less than 15 cm., (ii) 15-18 cm. (LENGTH1), (iii) 18.1-20 cm. (LENGTH2), (iv) more than 20 cm. (LENGTH3). The price of length of carrot of more than 20 cm. is higher than the short product by 6.34 baht per kg.. Moreover the variable of shape (SHAPE) is negatively significant at 1 % level and its marginal effect is -13.43 baht per kg. when the product is cone shaped, the price



of cylinder shaped product is higher. The shape of carrot implies the sources of products, all imported carrots are cylinder shaped while domestic varieties are cone shaped.

From the model, dummy variables of selling in the foreigner-business-area supermarket (FBA) and supermarket in Bangkok (BKK) are positively significant at 1% level with the marginal effect at 24.82 and 6.26 baht per kg. respectively. While in Chiang Mai, at the same product quality, retail price in supermarket is higher than in fresh market by 8.8 baht per kg.. Dummy variable of The Royal Project brand name (RP) is significant at 1% level, which marginal effect is equal to 14.66 baht per kg. The retail price of the Project's carrot is higher than other brand names. The retail prices in the rainy season are higher than in summer, the seasonal variable (SEASON) is significant at 1% level, its marginal effect is 8.09 bath per kg.. And the result of the restriction test of season on quality, represents that the qualities of carrot in summer and rainy season are different from each other. Retail prices and quality of this product change by season. The variable of damage from pest or broken (DAMAGE) is not significant in the model. For the other physical and chemical characteristics (such as color, sweetness, firmness) are omitted from the model, due to no relation to the price.

## **5.6 Red Cabbage**

There were 5 brand names of red cabbage including imported product sold in Bangkok, two brand names were non-chemical residue product. In Chiang Mai 4 brand names of red cabbage were found in sampling marketplaces. Retail prices ranked from 15 to 195 baht per kg and mean of price is equal to 61.92 baht. There are 9 variables included in the hedonic price model, which are imported product (IMPORT), season (SEASON), three market places, hygiene product (NR), and variables of weight per unit.

Table 5.6 OLS Estimated Hedonic Price Equation of Red Cabbage

Variable	Coefficient	t-Statistic
Constant	21.51***	3.94
WEIGHT1	-1.16	-0.23
WEIGHT2	-13.41	-1.86
DAMAGE	0.05	0.74
NR	11.15**	2.29
SEASON	26.09***	5.33
IMPORT	129.87***	10.95
FBA	16.19**	2.20
BKK	8.71	1.57
SUPER	18.92***	3.76

$R^2 = 0.8535$       Adjust- $R^2 = 0.8221$        $F(9, 42) = 27.19$       Prob = 00

Estimated by using LIMDEP version 7.0  
 No serious heteroscedasticity problem detected  
 \*\*\* Significant at 1% level, \*\* Significant at 5% level

The highest marginal effect of red cabbage is the variable of imported product which is equal to 129.87 baht per kg., all imported cabbage samplings were from the foreigner-business-area supermarket in Bangkok. Dummy variable of selling in foreigner-business-area supermarket (FBA) and in supermarket (SUPER) are significant at 1% and 5% level, the marginal effects are 16.19 and 18.92 baht per kg.. Dummy variable of selling in Bangkok (BKK) is not significant, retail price in supermarket in Bangkok is higher than in Chiang Mai.

The price of non-chemical residue is higher than normal product, the result from analysis shows that the marginal effect of hygienic product is 11.15 baht per kg.. Season is also influential to retail price, the price in summer is lower than rainy season, its marginal effect is 26.09 baht per kg. and the restriction test of season on quality represents that quality, of red cabbage varies by season. Weight per head and percentage of damaged (DAMAGE) from breakage and pest are not significant in the model. The signs of two level of weight per unit are negative. The price of product, where the weight is more than 500 gram (WEIGHT2) is less than the product that the weight is between 300-500 gram (WEIGHT1).

## 5.7 Michilli

There were 6 brand names of michilli sold in both Chiang Mai and Bangkok with the average prices of 28.2 and 62.36 baht per kg. respectively. Only one non-chemical residue brand name was in Chiang Mai, the Royal Project product. In Bangkok there were 3 brand names sold as non-chemical residue product. Some variables such as non-chemical residue product and foreigner-business-area supermarket correlated to selected variables, and were excluded from the model. Three characteristics of michilli e.g. weight per unit, length, and selling in Bangkok are significant in the model.

Table 5.7 Least Squares Estimated Hedonic Price Equation of Michilli

Variable	Coefficient	t-Statistic
Constant	22.13***	6.88
WEIGHT	-8.30**	-2.17
LENGTH	9.31***	2.60
RP	-2.71	-0.79
SEASON	-2.41	-0.75
BKK	31.98***	5.36
SUPER	3.47	1.35

$R^2 = 0.601$  Adjust- $R^2 = 0.556$   $F(6, 53) = 13.33$  Prob = 00

Estimated by using LIMDEP version 7.0

Corrected Heteroskedasticity Problem by White method

\*\*\* Significant at 1% level, \*\* Significant at 5% level

Similarly to other vegetables, the price of michilli is very highly associated to market segmentation. The marginal price of selling in Bangkok (BKK) is 31.97 baht per kg. dummy variable of selling in supermarket (SUPER) is not significant however, price in supermarket is higher than in fresh market. The variable marginal effect of length (LENGTH) is equal to 9.31, the price of the length which is more than 30 cm. is higher than the shorter one 9.31 baht per kg.. Weight per unit of samplings ranked from 216.32 to 1000 gram. The price of product which weight per unit is less than 500 gram is higher than the others 8.30 baht per kg.. Season and the Royal Project variables are not significant, but its sign is negative, as the same quality, price in rainy season is lower

than summer. And the selling price of the Royal Project product (RP) is less than the other brand names.

### 5.8 Chinese Cabbage

The prices of Chinese cabbage ranked from 11 to 65 baht per kg., Average price in Bangkok and Chiang Mai were 44.75 and 22.69 baht per kg. From the sampling market places, 14 brand names were found in Bangkok and the average price of 8 non-chemical brand names were higher than normal product by 6.78 baht per kg.. In Chiang Mai, totally 11 brand names were sold in the sampling places, 5 brand names of non-chemical residue were sold at 6.65 baht higher than normal products.

Table 5.8 Least Squares Estimated Hedonic Price Equation of Chinese Cabbage

Variable	Coefficient	t-Statistic
Constant	14.05***	6.58
WEIGHT	0.31	0.14
LENGTH	3.41	1.63
DAMAGE	-0.05	-0.68
NR	12.96***	5.48
RP	-7.69***	-3.71
SEASON	6.03	2.47
FBA	18.15***	4.51
BKK	10.59***	4.78
SUPERMARKET	-0.0058	-0.002

$R^2 = 0.7449$      $\text{Adjust-}R^2 = 0.7131$      $F(9, 72) = 23.37$      $\text{Prob} = 00$

Estimated by using LIMDEP version 7.0

Corrected Heteroskedasticity Problem by White method

\*\*\* Significant at 1% level, \*\* Significant at 5% level

There are 8 variables associated to the Chinese cabbage price, 9 variables are significant in hedonic price model. The variable of selling in the foreigner-business-area supermarkets (FBA), selling in Bangkok (BKK), non-chemical residue product (NR), season (SEASON), and the Royal project's brand name (RP) are significant at 1% level, coefficient of the first four are positive and the last one is negative. Marginal effects of selling in big supermarkets and in Bangkok variable are equal to 18.15 and 10.59 baht per kg. Not only marketplace, but also hygiene of product plays an importance role to

the price of Chinese cabbage, its marginal effect is 12.96 baht per kg. The variable of season is not significant, however its sign is positive, price in summer is higher than in the rainy season by 6.03 baht per kg. and the quality of this product sold in the market is harmonious throughout the year. At the same quality, the price of product under the Royal Project is cheaper than other brand names by 7.69 baht per kg.. The variables of weight per unit, selling in supermarkets, and percentage of damage from pest are not significant in the model. The sign of the first variable is positive - the more weight, the higher price. The signs of the last two variables are negative - the selling price in supermarkets is a bit lower than in the fresh market, and the more damage, the lower the price.

### 5.9 Sweet Pepper

Table 5.9 OLS Estimated Hedonic Price Equation of Sweet Pepper

Variable	Coefficient	t-Statistic
Constant	39.52***	3.67
WEIGHT1	8.92**	4.52
WEIGHT2	10.10***	3.34
SHAPE	5.34	4.75
RP	2.23	5.05
SEASON2	-2.24	2.76
SUPERMARKET	55.22***	4.59

$R^2 = 0.7743$     Adjust- $R^2 = 0.7609$      $F(6, 101) = 57.76$     Prob = 00

Estimated by using LIMDEP version 7.0

No serious heteroscedasticity problem detected

\*\*\* Significant at 1% level, \*\* Significant at 5% level

The average prices in Bangkok and Chiang Mai were 106.06 and 48.57 baht per kg. respectively. Mean of retail in both in Chiang Mai and Bangkok is equal to 70.29 baht per kg.. In Bangkok, 8 brand names of this vegetable were found in the sampling places, only 4 brand names were non-chemical residue products. Six brand names were found in the selected supermarkets in Chiang Mai, and 2 brand names were non-chemical residue. Eighteen characteristics of sweet pepper were checked, 6 variables associated to the price.

The variables of weight per unit and selling in Bangkok are positively significant to the price. Marketing segmentation has the most affect to its retail price. At the same quality the price of selling in Bangkok (BKK) will be higher than in Chiang Mai by 55.22 baht per kg.. The average weight per fruit of sweet pepper sold in Chiang Mai and Bangkok are 157.21 and 133.61 gram respectively. The marginal effect of weight per unit, which is more than 200 gram (WEIGHT1) is higher than the other size by 8.92 baht per kg and the price of the weight between 150-200 gram (WEIGHT2) is higher than other sizes at 10.10 baht per kg.. The variable of the Royal Project and shape (SHAPE) of sweet pepper are not significant in the model but the signs are positive. The prices of normal shape and the product of the project are higher than others. Even though weight per unit of products sold in Chiang Mai was slightly bigger, the selling price in Chiang Mai is lower. In addition the price in summer season is lower than in the rainy season but this variable is not significant.

The result from the restriction test shows that the quality of sweet pepper does not change by season. Another variable that is not significant in the model is the Royal Project product, however its sign is positive, its retail price is higher than other brand names. Some variables such as the non-chemical residue product, and all physical and chemical do not relate to selling price, they were omitted from the model.

#### **5.10 Common Tomato**

There were 12 and 9 tomato brand names of common tomato sold in Chiang Mai and Bangkok. The results from descriptive analysis show that mean of common tomato retail price is equal to 55.11 baht per kg and the interval of prices range from 9 to 430 baht per kg (Appendix 1). Some tomatoes imported from Australia were a variety different from the local products, all of them were sold in the foreigner-business-area supermarket in Bangkok with very high price. Nineteen characteristics of tomato were measured.

Table 5.10 Least Squares Estimated Hedonic Price Equation of Common Tomato

Variable	Coefficient	t-Statistic
C	10.75***	2.93
WEIGHT1	8.79	0.93
WEIGHT2	15.94	1.16
SHAPE	6.52**	2.27
NR	29.28***	4.80
RP	-17.90***	-2.49
TIME	16.33***	4.02
IMPORT	178.02***	4.87
FBA	10.57	1.04
BKK	27.66***	2.60
SUPERMARKET	2.34	0.80

$R^2 = 0.8026$       Adjust- $R^2 = 0.7902$        $F(10, 160) = 65.60$       Prob = 00

Estimated by using LIMDEP version 7.0

Corrected Heteroskedasticity Problem by White method

\*\*\* Significant at 1% level, \*\* Significant at 5% level

There were 12 and 9 tomato brand names of common tomato sold in Chiang Mai and Bangkok. The results from descriptive analysis show that mean of common tomato retail price is equal to 55.11 baht per kg and the interval of prices range from 9 to 430 baht per kg (Appendix 1). Some tomatoes imported from Australia were a variety different from the local products, all of them were sold in the foreigner-business-area supermarket in Bangkok with very high price. Nineteen characteristics of tomato were measured. Only 7 characteristics are in the hedonic price model, which are two levels of weight per unit, shape (SHAPE), non-residue product (NR), the Royal Project product (RP), season (SEASON), imported product (IMPORT), and three marketplaces. Only one negative variable in the model is the product of the Royal Project, this means that for the same quality its price is less than the other brand names by 17.90 baht per kg. Marginal effect of imported product variable is much higher than domestic product, which is equal to 178.02 baht per kg. Hygiene of product is also important for tomato, 50% of tomato brand names sold in the market are non-chemical residue product and its marginal effect is 29.28 baht per kg. For dummy variable of marketplace, selling in Bangkok is positively significant with the marginal effect at 27.66 baht per kg. while the

variables of selling in supermarkets and big supermarkets are not significant, but the sign are positive, prices in both places are higher than selling in the fresh market. The marginal effect of seasonal is equal to by 16.33, price of common tomato in rainy season is higher than in summer 16.33 baht per kg..

The result from the restriction test of season on product's quality showed that quality of common tomato changes by season. Some physical characteristics such as shape, and weight per fruit of common tomato are associated to the price. The variable of weight per fruit of tomato is not significant but its sign is positive. The price of common tomato whose weight per unit is between 150 and 200gram (WEIGHT1) is higher than the other by 8.79 baht per kg., and the price of weight per fruit at more than 200 gram (WEIGHT2) is higher than the other 15.97 baht per kg. Price of round - flat shape of tomato sold in each marketplace is higher than the long shape by 6.52 baht per kg.

### 5.11 Cherry Tomato

Table 5.11 Least Squares Estimated Hedonic Price Equation of Cherry Tomato

Variable	Coefficient	t-Statistic
Constant	33.19***	3.02
WEIGHT	9.33**	2.12
NR	-4.36	-0.90
SEASON	29.39***	2.79
IMPORT	182.44***	4.66
FBA	33.23**	2.31
SUPERMARKET	-13.72	-1.35

$R^2 = 0.5775$       Adjust- $R^2 = 0.5597$        $F(6, 142) = 32.36$       Prob = 00

Estimated by using LIMDEP version 7.0

Corrected Heteroskedasticity Problem by White method

\*\*\* Significant at 1% level, \*\* Significant at 5% level

The average prices of cherry tomato sold in Chiang Mai and Bangkok are equal to 48.06 and 55.70 baht per kg., while the retail price of imported product is equal to 312.50 baht per kg.. All cherry tomato characteristics checked are the same as common tomato,



6 variables associate to the price. Some chemical and physical variables such as acid, sweetness, color, and firmness do not associate to the price and were omitted from the model. The variables of marketplace, selling in Bangkok (BKK), and product of the Royal Project (RP) correlating to some selected variables, were excluded from the model.

Dummy variables of selling in foreigner-business-area supermarket and supermarket were selected to be included in the model, the first one is positively significant with marginal effect at 33.23 baht per kg., while the variable of selling in supermarkets is not significant but its negative sign implies that price in supermarket is lower than in fresh market. Dummy variable of weight per unit, 6-10 gram per fruit (WEIGHT), is positively significant at the marginal effect of 9.33 baht per kg.. Imported product variable associates to the price with the highest marginal effect, 182.44 baht per kg and it is significant at 1% level. Hygiene product variable (NR) is not significant, and its sign is negative, price of non-chemical residue product is not higher than normal product. The last significant variable in the model is season, marginal effect of rainy season (SEASON) is 29.39 baht per kg, retail price in rainy season is higher than in summer by this amount. And from the restriction test, it was found that quality of this product varies by season. Season affects both quality and retail price of cherry tomato.

### **5.12 Japanese Pumpkin**

There were 5 brand names of Japanese pumpkin sold in Bangkok and price ranged from 27 to 65 baht per kg. In Chiang Mai there was only the Royal Project's product sold in supermarket with the prices ranged from 15 to 30 baht per kg.. There was no Japanese pumpkin sold in the fresh market. From a total of 14 characteristics, five variables were selected to include in hedonic price model those are selling in the foreigner-business-area supermarket (FBA), the Royal Project's brand name (RP), two variables of weight per unit (WEIGHT1, WEIGHT2), and season (SEASON).

Table 5.12 OLS Estimated Hedonic Price Equation of Japanese Pumpkin

Variable	Coefficient	t-Statistic
Constant	40.02***	14.37
WEIGHT1	1.37	0.63
WEIGHT2	-4.72	-1.49
RP	-16.72***	-9.56
SEASON	4.84**	2.56
FBA	20.18***	8.97

$R^2 = 0.9434$     Adjust- $R^2 = 0.9246$      $F(5, 15) = 50.08$     Prob = 00

Estimated by using LIMDEP version 7.0

No serious heteroscedasticity problem detected

\*\*\* Significant at 1% level, \*\* Significant at 5% level

There were 5 brand names of Japanese pumpkin sold in Bangkok and price ranged from 27 to 65 baht per kg. In Chiang Mai there was only the Royal Project's product sold in supermarket with the prices ranged from 15 to 30 baht per kg.. There was no Japanese pumpkin sold in the fresh market. From a total of 14 characteristics, five variables were selected to include in hedonic price model those are selling in the foreigner-business-area supermarket (FBA), the Royal Project's brand name (RP), two variables of weight per unit (WEIGHT1, WEIGHT2), and season (SEASON).

From the model it was found that the variable of the Royal Project product is negatively significant at 1% level with the marginal effect at -16.72 baht per kg., its price is less than other brand names by this amount. The variables of selling in the foreigner-business-area supermarket and season are positively significant at level 1% and 5%. The price in rainy season is higher than in summer season at 4.84 baht while, the price of product sold in the Bangkok foreigner-business-area supermarket is higher than Chiang Mai by 20.18 baht per kg.. The result of season on quality from the restriction test represents that season does not affect the quality of Japanese pumpkin. Weight per fruit of pumpkin is not significant but the price of the weight that is heavier than 1 kg. (WEIGHT1) per fruit is higher than the smaller one (WEIGHT2). The other characteristics such as meat thickness, percentage of damage, color, and firmness does not associate to the price, and they are not included in the model. From the model,

quality do not much associate to the price, but marketplace is more important for selling at the higher price.

### 5.13 Japanese Cucumber

Table 5.13 Least Squares Estimated Hedonic Price Equation of Japanese Cucumber

Variable	Coefficient	t-Statistic
Constant	11.80	1.73
Light1	5.16	0.808
Light2	9.25	1.578
Length	2.73	1.099
NR	8.54	0.943
Time	-7.03**	-2.120
FBA	36.58***	4.136
BKK	38.99***	10.65

$R^2 = 0.8571$       Adjust- $R^2 = 0.8424$        $F(7, 68) = 58.31$       Prob = 00

Estimated by using LIMDEP version 7.0

Corrected Heteroskedasticity Problem by White method

\*\*\* Significant at 1% level, \*\* Significant at 5% level

There are 7 variables associated to cucumber price, two dummy variables of marketplace, color, length of fruit, hygienic product, and season. Some variables were omitted such as the variable of the Royal Project due to their correlation to non-chemical residue, also weight per unit, freshness, meat firmness, percentage of damaged did not associate to the price. Selling in the foreigner-business-area supermarkets (FBA) and selling in Bangkok (BKK) are positively significant to the price, the price will be higher than selling in supermarket and selling in Chiang Mai at 36.58 baht and 38.99 baht per kg. respectively. The variable of season (SEASON) is negatively significant to the price. In the rainy season, price will be lower than summer by 7.03 baht per kg. Season also affects quality of cucumber due to the significance of restriction test season on its quality. The signs of light color, length, and non-chemical residue are positive but they are not significant. However the price of longer shape, brighter color, and non-residue products get the higher price.

## 5.14 Zucchini

Table 5.14 Least Squares Estimated Hedonic Price Equation of Zucchini

Variable	Coefficient	t-Statistic
Constant	45.85***	9.243
WEIGHT1	5.02	0.900
WEIGHT2	-8.20	-1.210
FRESH	0.0082	1.741
WIDTH	-10.71	-1.583
SEASON	-12.67	-1.921
IMPORT	56.44***	4.359
FBA	98.85***	13.831

$R^2 = 0.8928$     Adjust- $R^2 = 0.8789$      $F(7, 54) = 64.26$     Prob = 00

Estimated by using LIMDEP version 7.0

Corrected Heteroskedasticity Problem by White method

\*\*\* Significant at 1% level, \*\* Significant at 5% level

There were 8 brand names including imported zucchini sold in Bangkok with the average price at 143.84 baht per kg and three brand names were sold as non-chemical residue product. In Chiang Mai, only one brand name was found in the sampling places with an average price at 32.83 baht per kg. Dummy variables of selling in supermarket (SUPER) and foreigner-business-area supermarket (FBA) were omitted due to zucchini not being sold in the fresh market and it correlated to the selected variable. The variable of the Royal Project product correlated to the variable of selling in Bangkok, there was no zucchini from the Royal Project sold in the sampling places in Bangkok, and the dummy variable of the Project product was omitted from the model.

All of the associated variables to the price are, selling in Bangkok (BKK), imported product (IMPORT), season (SEASON), freshness (FRESH), width of fruit (WIDTH), and weight per unit. The first three variables are significant while the last one is not. Market segmentation plays an importance role in the price. The marginal effect of selling in foreigner-business-area supermarket in Bangkok is 98.85 baht per kg.. Imported product is another variable that highly influences the price, its marginal effect is 56.44 baht per kg.. In the rainy season, selling price is higher than in summer, 12.67 baht per kg. and the result from the restriction test of season shows that quality of this

product is harmonious throughout the year. The variables of weight per unit are not significant, however the price of product, whose weight per unit is between 110-160 gram per fruit (WEIGHT1), is higher than the other size and if weight per unit is more than 160 gram (WEIGHT2), selling price will decrease. Freshness of product and season are not significant. The sign of freshness variable is positive, the fresher product, the higher price. The sign of seasonal variable is negative, price in rainy season is lower than summer.

### 5.15 Snap Bean

Table 5.15 Least Squares Estimated Hedonic Price Equation of Snap Bean

Variable	Coefficient	t-Statistic
Constant	36.05***	14.18
WEIGHT1	-2.49	-1.66
WEIGHT2	-3.20	-2.14
LENGTH	3.41**	2.41
Chroma	5.51***	3.92
Hue	-3.76***	-2.85
Firm1	-2.67	-1.82
Firm2	-1.45	-0.97
RP	-8.06***	-4.21
Time	-6.82***	-5.83
FBA	12.85***	7.39
BKK	26.74***	12.22

$R^2 = 0.8841$     Adjust- $R^2 = 0.8767$      $F(10, 175) = 125.16$     Prob = 00

Estimated by using LIMDEP version 7.0

Corrected Heteroskedasticity Problem by White method

\*\*\* Significant at 1% level, \*\* Significant at 5% level

There were in total 6 and 11 brand names of snap bean sold in the sampling market places in Chiang Mai and Bangkok respectively. Almost of them were sold as non-chemical residue product, seven brand names in Bangkok and four brand names in Chiang Mai. Snap bean's prices ranked from 12 to 87 baht per kg., the mean of the price is equal to 48.47 baht per kg.. The average retail price in Bangkok and Chiang Mai were 67.59 and 27.57 baht per kg.. Eleven characteristic variables are in snap bean's hedonic price. Eight are positively and three are negatively significant in the model. Selling

price of the Royal Project product is less than other brand names by 8.06 baht per kg. and in the rainy season, retail price decreases by 6.82 baht per kg. compared to summer season, both variables are significant at 1% level.

The result of the restriction test of seasonal quality shows that not only retail price but season also affect quality of snap bean. Similar to other vegetable marketplace variables are highly associated to selling price, in Bangkok the price is higher than in Chiang Mai by 26.74 baht per kg. and if products are sold in big supermarket the price will be added to by 12.85 baht per kg.. Weight per pod and length are significant at 5% and 1% level. The price of longer pods will be higher than the shorter ones. Contrary to the length, the price of weight per pod which is less than 6 gram is higher than the heavier one. The marginal effect of the length which is longer than 16 cm. (LENGTH) is 3.14 baht per kg., and marginal effect of weight per pod which are equal to 6-8 gram (WEIGHT1) and more than 8 gram (WEIGHT2) are -2.49 and -3.20 baht per kg.. Chroma represents the darker color, the less value of chroma, the brighter of color. The price of greenish is higher than the darker color product. From the model, the marginal effect of chroma, which is more than 25.31 is higher than the others 5.5 baht per kg. Another color characteristic significant at 1% level is Hue. This variable represents yellow and blue color, the more value of Hue, the darker blue. Therefore the sign of Hue is negative with the marginal effect equal to 3.76, price of green-yellowish snap bean is higher than green-blueish by 3.76 baht per kg..

#### Discussion and Implications

From the results of hedonic price model analysis, the important characteristics of vegetables that highly associate to the price of this vegetable are; imported product, market place, brand name of the Project, season. Only some physical characteristics of vegetable associate to the retail price in the market. This could be concluded that the retail price of vegetable was mainly dependent on the place that it was sold and the source of the product.

### Imported product

From 15 studied vegetables, there were 9 imported products, which were head lettuce, cos lettuce, celery, baby carrot, carrot, red cabbage, common tomato, cherry tomato, and zucchini. The retail price of each imported vegetable was higher than the local product at 61.31, 53.84, 39.91, 70.55, 13.43, 129.87, 178.02, 182.45, and 56.44 baht per kg. respectively. The results from the models review that the retail prices of all imported vegetables were positively significant at 1% level. Almost all of them sold in the super market in Bangkok, especially in the foreigner-business-area supermarket. Moreover some imported vegetables contain characteristics that positively associate to the prices as shown in table 5.16.

Table 5.16. The Positively Associated Characteristics of Imported Vegetables to the Price

Vegetable	Characteristic	Local Vegetable	Imported Vegetable
Carrot	Length	16.11cm.	19.91 cm.
Common tomato	Average weight per fruit	103.19 gram	328.50 gram
Head Lettuce	Average weight per head	259.76 gram	366.67 gram

Source: Calculated

The marginal effects of the length of carrot which is between 18.1 to 20 cm. and longer than 20 cm. were equal to 3.62 and 6.34 baht per kg, while the average length of imported carrot was 19.91 cm (Table 5.16). The marginal effect of weight per fruit variable which is more than 200 grams of common tomato is 15.94 baht per kg., while the average weight of imported common tomato was 328.50 gram (Table 5.16). The local product has to improve some characteristics, which were associate to the price in the market, to get the higher price.

### Market Place

Apart from imported product, marketplace is the most important variable associated to the retail price. The retail prices of most vegetables sold in Bangkok are higher than in Chiang Mai, especially in the foreigner-business-area supermarkets. From

15 studied vegetables there are 8 vegetables where the retail prices in the foreigner - business-area supermarket are significant at 1% and 5% level, higher than the other market places. Those vegetables are head lettuce, carrot, Chinese cabbage, cherry tomato, Japanese pumpkin, Japanese cucumber, and snap bean, their retail prices per kg. are higher than the other markets as shown in table 4.17. From the models, 10 vegetables e.g. cos lettuce, celery, baby carrot, carrot, michilli, Chinese cabbage, common tomato, Japanese cucumber, zucchini, and snap bean, sold in supermarkets in Bangkok are significantly positive to the retail prices with the marginal effects shown in Table 5.17. However the products of the Royal Project were seldom found in the foreigner-business-area supermarkets and the amount of the Project's products sold in Chiang Mai is more than in Bangkok. The Project has to segment the market and use the results from hedonic pricing, to discriminate the price in each market place, by selling the same basic product in different segments that are greater than the differences of the cost of servicing the market. For price discrimination to work, the market must be separable, so that a purchaser cannot act as trader, buying in the cheaper market and selling in the higher-price market (Schaffner *et al.* 1998).

Table 5.17 The Marginal Effects of Vegetables in Market Places

<i>Vegetable</i>	<i>Foreigner-business-area supermarket in Bangkok</i>	<i>Supermarket in Bangkok</i>	<i>Supermarket in Chiang Mai</i>
Head lettuce	40.92		23.32
Cos lettuce		46.56	
Carrot	39.92	15.10	8.84
Chinese cabbage	28.74	10.59	
Cherry tomato	33.23,		
Japanese pumpkin	20.18,		
Japanese cucumber	75.57	38.99	
Snap bean	12.85		
Celery		51.02	23.65
Baby carrot		58.03	
Michilli		31.97	
Red cabbage			18.92
Common tomato		27.67	
Snap bean		26.74	
Zucchini		98.85	

Source: Calculated



## Season

The retail prices of 8 vegetables in the rainy season are higher than summer, as shown in Table 5.18, and the last three vegetables, e.g. Japanese cucumber, zucchini, and snap bean have prices in summer that are higher than in the rainy season.

Table 5.18 The Marginal Effects of the Rainy Season on the Retail Prices

<i>Vegetable</i>	<i>Marginal effects of rainy season</i>
1. Head lettuce	16.00
2. Celery	18.58
3. Baby carrot	15.20
4. Carrot	8.09
5. Red cabbage	26.09
6. Common tomato	16.33
7. Cherry tomato	29.39
8. Japanese pumpkin	4.83
9. Japanese cucumber	-7.03
10. Zucchini	-12.67
11. Snap bean	-6.82

Source: Calculated

The prices of vegetables related to the supply in the market. The vegetable sold in summer were grown in winter, when the temperature is suitable for producing temperate vegetable therefore there were more amounts of some temperate vegetables in summer. On the contrary to the rainy season, the products sold in the rainy season were grown in summer, which lacked water and had unsuitable temperatures, this caused the lower supply. The Project might preserve the product in summer season in cool storage and sell them in rainy season, however the cost of storage has to be considered.

### The Characteristics of Vegetables

The important characteristics of vegetables, which are associated to the retail prices, are weight per unit, number of leaves to be culled out, length, and hygiene of product.

Weight per unit of vegetable affects both increasing and reducing retail prices. For some vegetables, such as head lettuce, carrot, michilli, Chinese cabbage, and snap bean, the retail prices of the lighter product is more expensive than the heavier product. While the prices of common tomato and sweet pepper will be more expansive if weight per unit is heavier. The price of cherry tomato will be higher if the weight per unit of product is between 6 to 10 gram.

The number of leaves, to be culled out of leaf vegetables, is another variable that affects the retail price. The prices of head lettuce will be lower if the leaves to be culled out are more than 2 leaves.

The prices of the longer carrot and baby carrot are higher than the shorter products. The length is one of the criteria used to categorize the grade of carrot and baby carrot, the longer product is the better grade. From the hedonic price analysis the price of carrot that the length is more than 20 cm. and the price of baby carrot where the length is more than 12 cm. are higher than the others. The length of both products that are classified to be the best grades by the Project are, longer than 15 cm., and between 10-12 cm. respectively.

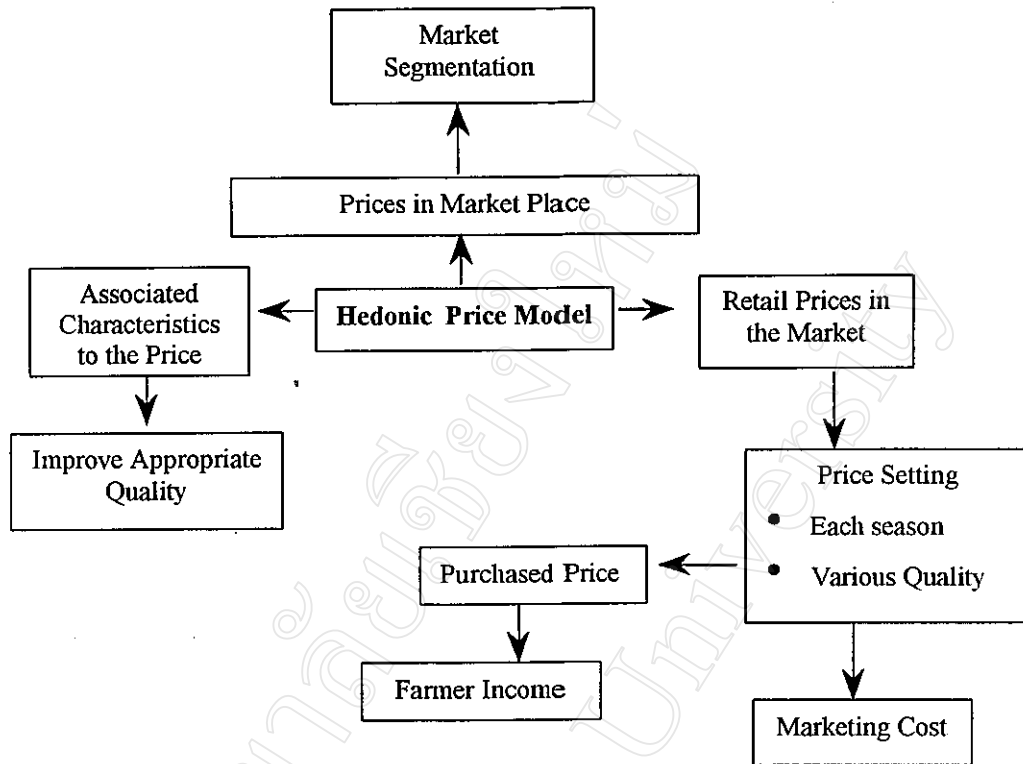
Product hygiene is another important characteristic associated to the retail prices of vegetable. From 15 studied vegetables, there are 4 vegetables that the prices of non-chemical residue product are significantly associated to a price higher than normal, these are, head lettuce, common tomato, red cabbage, and Chinese cabbage. The competition of those products in the market is high, there are many brand names found in the same market place. This can conclude that when there are more supply in the market, the price of the vegetables will be determined by characteristics, which distinguish the product from the others.

### **Retail price of the Royal Project in the market**

From 15 vegetables, it was found that 4 products of the Project, have retail prices in the market, which are higher than the other brand names, e.g. carrot, baby carrot, sweet pepper, and celery. The products where the retail prices of the Project are lower than the other brand names are, common tomato, Japanese pumpkin, head lettuce, snap bean, and Chinese cabbage. However almost all of the Project's products were found in Chiang Mai, those prices are used in comparison to other brand names sold in the supermarkets in Chiang Mai. From the model, the retail prices of michilli and sweet pepper of the Project are mostly the same as the other brand names. The market of the products, where the Project's prices are lower than the other brand names can be expanded by using the strategy of lower prices for competition in the market. While for some products where the Project's prices are higher than the other brand names, those products have to have improved quality and be sold in supermarkets or foreigner-business-area supermarkets in Bangkok. The dummy variables of the Project's product of the remaining 5 vegetables, cos lettuce, red cabbage, cherry tomato, Japanese cucumber, and zucchini, were omitted from the models as they it correlated to the variable of market places. There were not samplings of these vegetables from supermarket and foreigner-business-area supermarkets in Bangkok.

The hedonic price analysis in this study could provide the main results, which are the associated characteristics of vegetables to the prices, the difference of price in each marketplaces, season and qualities of vegetable (Figure 5.1).

Figure 5.1 Chart of the Hedonic Price Analysis



The information of the different prices in each marketplace can help the Project to make decisions in distributing their products to the various markets. The result of characteristics associated to the price of the vegetables will guide the Project to improve their products, to meet the consumer demand. And the information of the retail prices of various product qualities in each marketplace and season, will guide the Project to set the appropriate prices to compete in the market. More over this will help the Project to consider their costs and purchasing prices, which relate to the farmer income