HEDONIC PRICE FOR CATFISH: AN ANALYSIS FOR *PANGASIUS* PRICE IN BANGLADESH.

MANZURA KHAN

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The Norwegian College of Fishery Science
University of Tromso, Norway
&
Nha Trang University, Vietnam

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ABSTRACT

Stable market price is an important factor for the people practicing aquaculture management for fish production. Quality attributes of fish is a key indicator explaining different price levels in the market. Thus quality improvement becomes a vital factor in fish production due to the consciousness among the consumers. In the present study, a hedonic model was used to estimate price increments or discount of catfish (*Pangasius sp.*) due to quality attributes in a domestic market named Natunbazar in Barishal district of Bangladesh. Using price and attribute data obtained by a questionnaire survey from the Barishal Natunbazar fish market, a linear hedonic price model was estimated which includes both continuous variable and dummy explanatory variables. The continuous variables were weight and standard length of *Pangasius* fish. Dummy variables represented the qualitative attributes which includes organoleptic factors, such as: freshness in terms of gill color; market related product characterization, such as origin of product; attributes related to time of day such as: morning or evening; day factors such as: weekday or weekend; attributes related to marketing and transportation cost, which are captured in variables such as mode of sale and type of preservation. The estimated result shows a clear and significant price fluctuation due to the changes of different quality attributes of fish including size, freshness, origin of production, preservation method, time of day and types of day. Larger fish with bright gill color representing freshness were highly valued. Icing was more preferred among the other forms of preservation. Fish produced from local aquaculture practice and weekend day receives discount where fish sold in morning showed the price premium. The empirical finding of this study can explain some implications for those who not only involve with fisheries marketing and management including handling, transportation and preservation procedure but also involving in fish production by intensive or semi-intensive aquaculture practice. For producer, the main concern reflects the influence of the size of the fish on the market price. The second concern was pointed on the freshness factor where involving people can be more conscious during handling, preserving or transporting. And thus, this hedonic approach explained in this study demonstrates the indicators of price fluctuation in fish market about what the fish farmers claimed on.

Keywords: Attributes, fish price, fish quality, hedonic models, Pangasius, Bangladesh.

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Chapter 1
Introduction

1.1 Background of the study

Hedonic price analysis is the most customary approach to uncover the effect of change in quality attributes on price of a good. The transformation of quality with time elapsed become a vital factor to determine the price of a good. So fish farmers and fish managers now-a-days become more concentrated on the fish price characteristics. The concept of hedonic price was first given by Frederick V. Waugh in 1928. His paper on fluctuation of vegetable (asparagus) price for its three different quality factors: color, size and uniformity were the first attempt to do hedonic model analysis. His purpose was to discover consumer valuations based on these three factors that ultimately drive the producer to make decision about their product. Similar approach was done later in case of automobiles on 1939 and 1961 by Court and Griliches. They mainly explored consumer's interest with purchased automobile in order to clarify the price change. Study on the price change of computer was done with a similar method and purpose by Chow (1967) and Cole et al. (1986) and Berndt and Griliches (1990). Later on, this concept used to find out fish price analysis also. In 1999, Salayo *et al.* conducted a study on hedonic approach to determine the marketable characteristics of prawn and shrimp in a domestic market in Philippines. McConnel and Strand (2000) exploited a dataset on the auction price of tuna fish sold in Hawaii to estimate a hedonic model that provides empirical estimates of price increments due to species, quality of the fish such as size or fat content, method of handling and market conditions.

In Bangladesh, Fisheries and aquaculture segment recognized as an imperative sub-sector of agriculture producing above 2.6 million tons fish at 2008 which ranks the sixth position among biggest aquaculture producing country (BBS, 1996, p.477). Now, 39% of the total production is produced by aquaculture practice (Belton *et al*., 2011). More than 50% of the total inland fish production (capture and culture) indicating the importance of aquaculture in the fish eating nation Bangladesh for food security. (DoF 2008). About 22% of daily dietary required protein comes from animal sources. Fish alone contributes about 74% of total animal protein consumed (Alam, 2001).

Pangasianodon hypophthalmus was first introduced in Bangladesh from Thailand in 1989 (Belton *et al*., 2011). In Bangladesh, Pangasianodon hypophthalmus is commonly known as Pangas. It belongs to the family pangasiidae, under Siluriformes order. Mekong river of Vietnam to Chao Phraya river of Thailand is the origin of this catfish species. Subsequently, it was spread over other countries such as Malaysia, Indonesia and China. (Roberts and Vidthayanon, 1991). *Pangasius sp*. is highly tolerant to salinity, pH, dissolved oxygen, temperature or even pollution. So, it achieves huge popularity in case of commercial culture due to its suitable biological feature.

1.2 Present status

In 2008, the total catfish production was 300,000 tonnes (H. Ali and M. M. Haque, 2011) in Bangladesh which are mainly demanded at the domestic market. *P. hypophthalmus* as catfish is well accepted by a wide range of people and therefore, it has been a good source of protein and calorie for poor, medium and better-off people in rural as well as urban areas (David, 1962). The majority of poor people prefer *Pangasius sp.* for its high fat content, taste and more importantly, for lower price which ultimately leads a huge demand in local market. Hence, it indicates the huge scope of Pangasius culture practice as well as production in future. (Monir *at el.,* 2011)

Regionally, the north central part of Bangladesh, Mymensingh plays the vital role for inland aquaculture production. Among the other districts, *Pangasius* produced from this region identified as more preferable to the consumers for its rapid growth rates as well as high productivity, high survival rates and strong characteristics compared to other species. Production expanded rapidly from the mid 1990s causing market value to fall to a point where the fish came within reach of many lower income bracket consumers in urban and peri-urban areas (Belton *et al*., 2011).

1.3 Research issue

According to Belton *et al.* (2011), the total aquaculture production in Mymensingh was about 163,000 MT in 2008 (16% of total country's aquaculture production) of which 80% accounted for *Pangasius*. But, Growth in output plateau during 2005 to 2008. Fish farmers claimed that they don't have the stable market price which leads an ultimate negative influence on the aquaculture practice and production as well. Assume that, there are some indicators that may affect the price in any particular local market and hence, the demand and price for it. The study is aimed to find out, if there is any relationship between the quality attributes and the price and how this quality attribute affects the price of catfish in a market. In this study, the hedonic approach is used because of its reliability for estimating the influences of changes on quantity of attributes on the price of the product. This quantity of attributes reflects the change of quality. From this approach, it is also possible to identify the price-quantity relationship. Thus, hedonic price function can indicates the factors influencing consumer preference or on the other hand, exclusively with factors reflecting production cost and determine price premium or discount which can explain the possible cause and alternatives of the existing problem about what the fish farmers claimed on.

Although fish is the main protein source in Bangladeshi diet and fish quality attributes are assumed to affect the price significantly, so far, no previous studies were found in context of Bangladesh as well as south Asian region on the web to examine the fish price by the hedonic approach. As far as I know, this study will be the first of its kind to explore the different fish price due to its different quality attributes in Bangladesh.

1.4 Hypothesis setting

The null hypothesis can be settled as there is no significant relationship between market price and quality attributes of the *Pangasius* fish in Barishal Natunbazar fish market, Bangladesh.

The study was based on the following objectives:

1. To estimate hedonic price functions for catfish (*Pangasius*).
2. To uncover information about the values of fish characteristics.
3. To study the local *Pangasius* fish consumer market in general.

1.5 Methodology

In this thesis, a model is estimated using primary data which explains a functional relationship between price of *Pangasius* fish, its qualitative attributes and quantitative attributes. These primary data is based on measured and observed characteristics of *Pangasius* fish samples which collected from a local consumer market named Natunbazar in Barisal district of Bangladesh.

1.6 Structure of the thesis

Next to this introduction chapter, chapter two will include the related literature review on different hedonic approach. Chapter three will correspond to theory and model based on hedonic approach for this study. Methods and procedures will also be illustrated in this chapter explaining the methods in detail used to investigate the problem. Types of data, process of data collection, instruments and software used in this investigation will also be described there. After that, chapter four will represent results from the data analysis. Discussion, summary and conclusion will be explained in chapter five. This chapter will cover the issues related to the findings, its implications and conclusion.

Chapter 2
Literature review

There is a wide range of information existing on the hedonic modeling and price analysis as well, but a little information available on fisheries basis. Especially, in context of Bangladesh, this type of information is very scarce.

2.1 The early history of hedonic study

According to Nerlove (1995), the concept of hedonic price was first given by Frederick V. Waugh in 1928. But still, to identify the "father" of hedonic concept is not that easy. Sirmans *et al.* (2003) pointed out that a study by Court (1939) is often cited as the beginning of hedonic modeling, although this study actually developed a hedonic price index for automobiles. According to Goodman (1998), although popularized by Griliches (1958) in his work on the demand for fertilizer, the term "hedonic" dates back to the 1939 Court article emphasizing with purchased automobile to clarify price change and Court is generally cited in most articles. His hedonic model described price included three variables: dry weight, wheelbase, and horsepower that includes the uses of a semi log form which would be now considered as modern. But, Colwell and Dillmore (1999) described that it is highly unlikely that Court is the original source of hedonics. Later on, the important hedonic studies includes Lancaster (1966) modeling who provided a microeconomic foundation for estimating the utility-generating characteristics value. Rosen (1974) focused on the characteristics on price determination where less emphasis given on utility. Rosen's work considered as the basic foundation for nonlinear hedonic pricing models.

2.2 Hedonic studies on various fields

Ethridge and Davis (1982) conducted a study based on a model of hedonic price. Implicit price of embodied quality attribute was developed for cotton lint and the relative importance of various quality attributes were estimated with regression analysis from sample data on observed sales of cotton. Results indicated that, producer prices were sensitive to variation in fiber length, micronaire and trash content. Results also revealed differences in relative importance and sensitivity between years.

Brachinger (2002) developed the statistical foundations of hedonic price indices. After a short overview on well-known functional forms of hedonic equations, first, precise hedonic notions of a good and its price were specified. These specifications allow a clear-cut definition of true hedonic price indices. Then, the problem of estimating hedonic price indices was treated. It is shown, first, that the usual hedonic price index formulae result from estimating certain true indices in a special way and, second, that the techniques used in practice for estimating hedonic indices were just first approaches.

Nerlove (1995) estimated a hedonic price function for wine using Swedish data from 1989 to 1991. According to this paper, implicit prices for quality attributes are determined not from a regression of variety price on a vector of quality attributes, but rather from a regression of quantity sold (adjusted for weeks of availability) on price and quality attributes. Price elasticity was estimated to be about - 1.65 holding quality constant, showing that Swedish consumers are highly sensitive to price. Estimates of the implicit valuations of quality attributes are shown to differ greatly from those obtained from the more usual hedonic regression with price as the dependent variable.

Pearson *et al*. (2002) conducted a study that deals with the valuation of a national park in an urban area. The hedonic price method was used to estimate the impact of the headland section of Noosa National Park (NPP) on nearby unimproved land values. The study found that, a glimpse of NNP generates an increase of 7% in the land value.

Tuttle and Heintzelman (2011) conducted a study to explore how property owners value lake water quality using fixed effects hedonic analysis. They found that multiple measures of water quality have significant effects on property values including lake acidity, clarity, and impairment classification. It was also found that the presence of loons and fish on the nearest lake positively impacts property values by 8% and 12%, respectively. This research provided valuable insight into the factors that property owners value most, and as interesting, those factors which they do not value.

2.3 Hedonic Studies on Fisheries

According to Houston *et al.* (1989), a seemingly unrelated regressions price-modeling framework was used to forecast contemporaneous price effects of the composition of shrimp landings in closely associated market regions. Price responses to U. S. regional shrimp landings and to imports were significantly related to differentiated markets by species and location. Regional consumer income impacts on average ex-vessel prices for each species were also significantly different.

Salayo *et al.* (1999) used the hedonic approach to determine the marketable characteristics of prawn and shrimp in a domestic market that prioritizes export of quality products to a more lucrative market. Using price and attribute data for prawn and shrimp purchased from the Philippine domestic market, a log-linear hedonic price model was estimated with combined continuous and dummy explanatory variables. The estimation results showed significant implicit prices of attributes, such as: tail length, freshness, product form, species, color, size, ease of preparation, discoloration, protein, and carbohydrate content. Longer tails and banana species were highly valued. Peeling and breading to ease preparation obtained a high premium. Freezing, although commonly practiced, received the highest discount among forms of preservation.

McConnell and Strand (2000) exploited a dataset on the auction price of tuna sold in Hawaii to estimate a hedonic model. The model provided empirical estimates of price increments due to species, quality of fish such as size or fat content, method of handling and market conditions.

From the literature reviewed above, there was no hedonic study done in the context of Bangladesh with the field of fisheries. Moreover, hedonic analysis particularly for catfish pricing were not studied. Therefore, the present study has the motivational argument to assess the hedonic price analysis for catfish in Bangladesh.

Chapter 3
Materials and Methods

3.1 Conceptual framework

The hedonic price model for fish can be is characterized by a continuous dependent price variable and multiple independent variables representing the characteristics. Among the multiple independent variables, both continuous and dummy variable can be included. If each individual is characterized by the set of all its characteristics, it can be denoted as:

$x = (x_1, . . . , x_k)$.

For any given good, it assumed that, the functional relationship between price (p) and characteristics (x) is:

$$p = f(x) \qquad (3.1)$$

This function specifies the hedonic relationship or hedonic regression typical for the good. Based on the functional relationship (3.1), the important concept of hedonic prices can be introduced. These prices are defined to be the partial derivatives of the hedonic function (1), i.e., they are defined through:

$$\frac{\partial p}{\partial x_k} = \frac{\partial f(x)}{\partial x_k} \qquad (3.2)$$

The hedonic price $\partial p/\partial x_k$ indicates how much the price *p* of a good change if this good is endowed with an additional unit of the characteristic *x*.

In hedonic approaches to price index problems, four different functional forms have been employed in the past. Thereby, the vector **x** stands for a particular variant or model of a good considered. The simplest approach is the ordinary linear approach could be given as:

$$p = \beta_0 + \sum_{k=1}^{K} \beta_k x_k + \varepsilon \qquad (3.3)$$

Where, ε is error term and β_0 is constant.

With hedonic prices

$$\frac{\partial p}{\partial x_k} = \beta_k$$

The regression coefficient β_k (k = 1, . . . , K) indicates the marginal change of the price with respect to a change of the k-th characteristic x_k of the good.

Relating to functional form, the log-log model is also widely used in hedonic price analyses. In this case logarithms of continuous variables and price are taken. Here, fish can be also characterized by a continuous dependent price variable and multiple independent variables representing the characteristics. Therefore, the price attribute relationship could be expressed as:

$$\ln p = \beta_0 + \sum_{j=1}^{m_1} \beta_j \ \ln x_j + \sum_{k=1}^{m_2} \gamma_k \ D_k + \varepsilon\,, \quad i = 1,2, \ldots, n$$

where, $\ln p$ is the logarithm of price p; $\ln x$ are logarithms of the continuous variables, $j = 1, \ldots, m1$, with $m1$ being the number of continuous variables; and D are the dummy variables representing qualitative variable, $k = 1, \ldots, m2$, with $m2$ being the number of qualitative variables. The coefficient β_0 is the intercept; β's are the coefficients of the continuous variables, $j = 1, \ldots, m1$; γ's are the coefficients of the dummy variables, $k = 1, \ldots, m2$; and ε is an error term satisfying the classical regression assumptions. The final model selection depends on the types of data available.

3.2 Data

3.2.1 Collection and characteristics

The present study was targeted on the catfish (*Pangasius sp.*) price in Barishal districts in Bangladesh. The cross-sectional data of this study is based on a questionnaire conducted in Barishal district from January 26th to March 17th, 2012. The data was obtained by carrying out a survey among the current fish seller in a local fish market named Natunbazaar in Barishal district. The questionnaire consisted of 22 question based on the research question and the number of observation were 220.

3.2.2 Market attributes

The studied fish market consists of 24 shops and located at the centre of the Barishal city. It was a retail market where various kinds of fish species are available in different price. A wide range of attributes was also noted based on the variety of *Pangasius* originated from, marketable sizes, product forms, degree of freshness, methods of preservation, color, and other physically observable characteristics. There were 18 *Pangasius* shops where the catfish of different quality attributes sold at different price. The shops were opened from morning to evening. However, the market become important one among that region because of the diversity of product attributes that encouraged the domestic market to meet the demand of various consumer groups.

3.2.3 Variable definitions and selection

The model consists of two types of explanatory variable; continuous variables and dummy variables. Weight and standard length of catfish were considered as main or continuous variable where other quality attributes were taken as dummy. The variables are explained in Table 3.1

Table 3.1. Characteristics of *Pangasius* sold in Barishal sadar market.

Variable	Description	Mean	Standard Deviation
P	Market price in BDT (Bangladeshi Taka) per kilogram of catfish	115.14	7.566
SL	Standard length of individual fish, in cm	43.166	8.573
WGT	Whole weight of individual fish, in kilogram	2.386	1.113
OR1	1 if the origin of fish is locally (in Barishal) cultured, otherwise 0	0.086	0.281
OR2	1 if the cultured fish brought from Mymensingh region, otherwise 0	0.913	0.281
FR1	1 if fresh in terms of bright gill, otherwise 0	0.650	0.478
FR2	1 if pale gill, otherwise 0	0.350	0.478
TD1	1 if time of day is morning at 9.00 am, otherwise 0	0.800	0.400
TD2	1 if time of day is evening 4 pm, otherwise 0	0.200	0.400
PR1	1 if preseravtion method is ice, otherwise 0	0.163	0.370
PR2	1 if preserved by normal water, otherwise 0	0.836	0.370
DW1	1 if the day is weekday, otherwise 0	0.818	0.386
DW2	1 if the day is weekend day, otherwise 0	0.181	0.386

Table 3.1 presents the summary statistics for price, the measurable length and weight related attributes derived from the sample data. The qualitative attributes represented as dummy

variables which includes organoleptic factors, such as: freshness in terms of gill color; market related product characterization, such as origin of product; attributes related to time of day such as: morning or evening; day factors such as: weekday or weekend; attributes related to marketing and transportation cost, which are captured in variables such as mode of sale and type of preservation. In this case, the whole market was a retail market. So, this variable was finally excluded. In case of organoleptic factors, 5 attributes was selected to define the freshness such as: eye color, skin color, gill color, odour and flesh color. Finally gill coloration was taken into consideration because of its strong identification characteristics.

3.2.4 Specification of models

"Observed product prices of differentiated goods define a set of implicit or hedonic prices associated with each characteristic of the differentiated goods" (Rosen, 1974: 34). According to the Rosen's hedonic theory, implicit prices are estimated by the first-step regression analysis (regressing product price on characteristics) in order to construct hedonic price indexes.

A simple linear form makes the result on price transparent. Also the characteristics of fish tend to be measured quite well compared with other hedonic markets, and the large number of observation reduces the influence of errors in measurement. So, the linear form is chosen in this study. Hedonic equation for this study which is subject to the regression analysis is written as:

$$P = \beta_0 + \beta_1 SL + \beta_2 WGT + \beta_3 OR_1 + \beta_4 FR_1 + \beta_5 TD_1 + \beta_6 PR_1 + \beta_7 DW_1 + \varepsilon \qquad (3.4)$$

Where,

P = Price in BDT (Bangladeshi Taka)

β_0 = Constant term

β_1 = Coefficient representing standard length

β_2 = Coefficient representing individual weight

β_3 = Coefficient representing locally cultured fish

β_4 = Coefficient representing freshness in terms of bright gill

β_5 = Coefficient representing morning time of the day

β_6 = Coefficient representing preserved fish by ice

β_7 = Coefficient representing selling on weekday

ε = Error term

3.2.5 Expected signs of the coefficients

Before estimating the hedonic price model, it is important to assume the expected signs of the coefficients. For the quantitative data, the variables SL and WGT were specified. Standard length of catfish is important because it indicate how well the size of fish influences its price. The big sized fish should have higher price than the smaller one. Thus the coefficient was expected to be positively related. Similarly, weight of fish also related to size and thus the coefficient also assumed to be positive. That means price should be increase with increase of length and weight of fish.

In case of dummy variables, the coefficient representing locally cultured fish expected to be negatively related. Because, locally produced *Pangasius* sometimes were not of good quality and have bad odor which reduce consumer preference compared to *Pangasius* brought from the Mymsengh region. The coefficient on freshness in terms of bright gill was expected to be positive because consumer always prefers fresh fish and thus the more fresh fish should have the higher price. Coefficient representing morning time of the day was assumed to be positive as in morning the fish remain fresh and the price also should be higher compared to evening. Coefficient representing preserved by ice was also expected to be positive as iced fish remains in good condition. Finally, Coefficient representing weekday was expected to be negative because normally, at the weekend day the market price become higher compared to weekday.

3.3 Data processing, analysis and interpretation

Data processing and analysis was done for interpretation of the results. Initially data were entered in Microsoft Excel. Errors were detected and necessary corrections were made accordingly after data entry. Finally, there were 218 observations for analysis. Data were analyzed by using SHAZAM (windows version 10.2), which offered statistical tools suitable for hedonic price research. Descriptive statistics including mean, standard deviation, percentage, frequencies etc. were generated and presented in graphical and tabular forms.

Chapter 4

Results

With the application of hedonic price model, hedonic price were estimated in order to discover the significant quality attributes that causes the price fluctuation in fish market.

4.1 Hedonic price estimation

By employing the data collected from the studied fish market, the hedonic equation (3.4) was estimated with the OLS estimation method. Result shows that all variable have the expected signs as those were hypothesized on the previous chapter. Estimated results are presented in Table 4.1

Table 4.1. Linear hedonic model for *Pangasius* prices.

Variable Name	Estimated coefficient	T-Ratio	P- value	Elasticity at means
WGT	1.798	8.965	0.000	0.037
OR1	-6.048	-7.694	0.000	-0.004
FR1	12.205	6.160	0.000	0.068
TD1	3.275	1.736	0.084	0.022
PR1	7.229	3.833	0.000	0.010
DW1	-4.907	-8.942	0.000	-0.035
Constant	103.65	133.2	0.000	0.900

The coefficient describes the direct effect of the quality attributes on the price of the *Pangasius* fish. It can also be said as marginal value of the quality attributes. Here, the variable WGT was considered as continuous explanatory variable. The elasticity at means for this continuous variable is 0.037 which indicates that, a 1% increase of weight will lead, on average 0.04% increase of price. Dummy variables are used for capturing qualitative characteristics of fish. To illustrate, the coefficient on OR1 explains the locally cultured fish available in market. For this variable, there is a discount which is USD 0.07 where other variables keep constant. The coefficient on FR1 represents the price premium for freshness in terms of bright gill color which is USD 0.15. Time of day showing the coefficient of TD1 corresponding to the increase in price at morning which is USD 0.04. The coefficient of PR1 also represents the increase of price for fish preserved with ice which is USD 0.09. The coefficient on DW1 represents the discount of price for weekdays which is USD 0.06. Here, prices are converted from BDT to USD. (According to moneyowl, 1 USD = BDT 81.8).

4.2 Model summery

At the significance level of 10% and 215 degree of freedom the critical value is 1.282. For all variables, the test statistics are greater than the critical value which confirms the overall significance of the estimated hedonic model. In case of P- value, all are less than 0.10 so; the null hypothesis of the model is rejected.

Table 4.2. Model summary

R	R^2	Adjusted R^2	Standard error of estimate sigma
0.9144	0.8363	0.8316	3.1172

Table 4.2 shows the coefficient of determination. Here, the R^2 value describe that 83.6% of variation in price is explained by this model.

4.3 Length-weight relationship

In case of fish, length is highly related with weight. The figure shows the length weight relationship of *Pangasius* fish. (Figure 4.1)

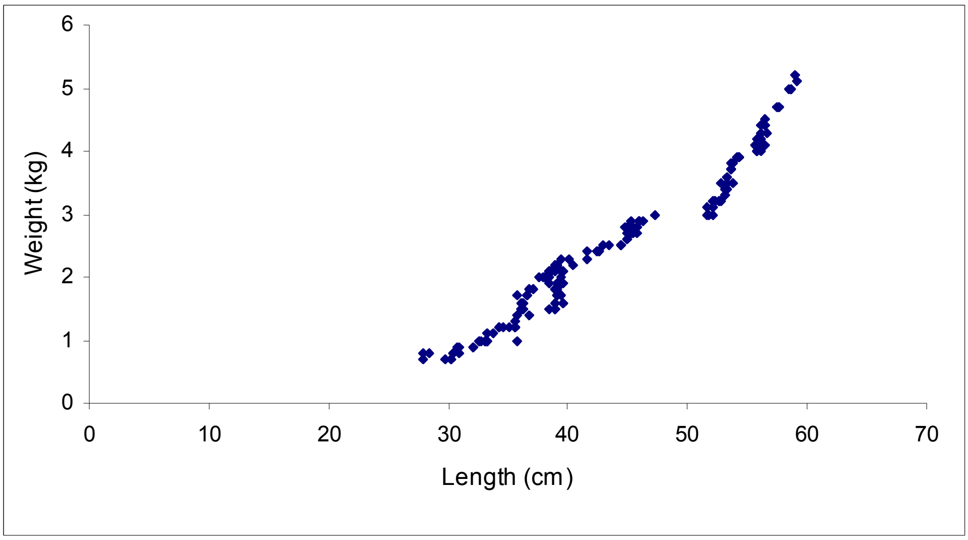

Figure 4.1. Length-weight relationship of *Pangasius* fish.

Another variable named SL was also considered as one of continuous explanatory variable which represented standard length of the fish. But in this hedonic model this variable was excluded and only weight was included as continuous variable because of the strong correlation between length and weight that causes multicollinearity in this model. The table shows the estimation of standard length squared.

Table 4.3. Parameter estimation for standard length squared.

Variable Name	Estimated coefficient	Standard error	T-Ratio 215 DF	Partial correlation
SL	0.061872	0.02372	2.609	0.175
SL^2	0.000747	0.00026	2.818	0.189
Constant	-1.7128	0.5135	-3.335	-0.222

Table 4.4. Model summary for standard length squared estimation.

R	R^2	Adjusted R^2	Standard error of estimate sigma
0.978	0.957	0.956	0.232

4.4 Price-weight relationship

In the Price-weight relationship of obtained data, it shows that the price of fish is increased with the increase of individual fish weight (Figure 4.2). Where as, some observation also shows the same price even with increased weight. This issue will be discussed on next chapter.

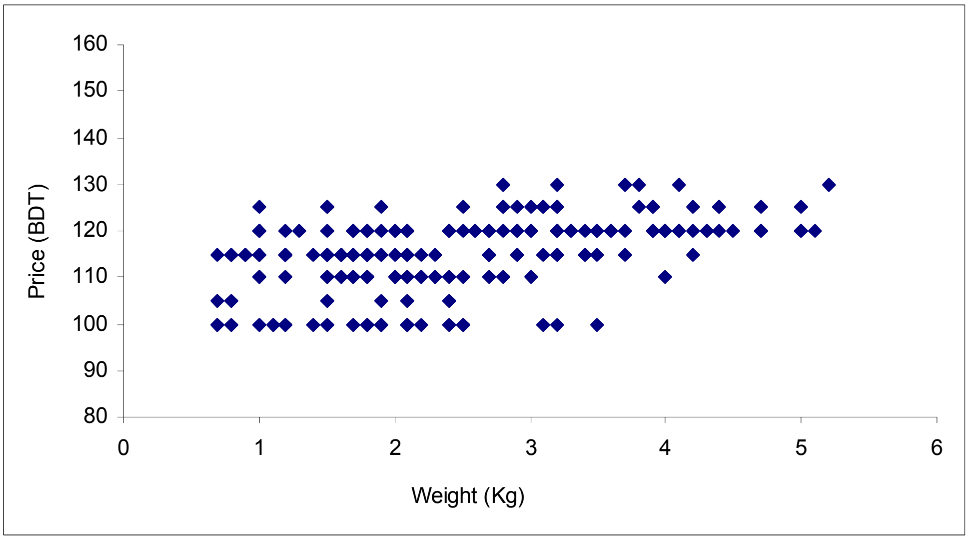

Figure 4.2. The relationship between price and individual fish weight.

Chapter 5
Discussion and Conclusion

The present study was an attempt to determine the impacts on price of *Pangasius* fish based on the individual's characteristics including weight, standard length, origin of production, freshness, mode of preservation time of day fish sold in market and types of day. The overall discussions based on the results derived from the present study are summarized below.

5.1 Continuous explanatory variables

In case of *Pangasius* fish, length and weight shows strong linear correlation. (Yusof *et at*., 2011). For this, in this hedonic analysis, standard length and weight was not taken at the same model rather taken separately on two different estimations and finally, weight was included because of its high coefficient value. However, both two estimations are included on appendix 2. The result shows significant increase of price with increasing fish weight. From the result, since the estimated weight elasticity is less than 1, thus it can be classified as a "necessity" rather than a "luxury". (Hill *et al.*, 2008). However, the relationship between price and individual fish weight (Figure 4.2.) represents a moderately linear diagram. Some observation shows the same price even with increased weight. This is because, the seller quickly try to sell big sized fish even with lower price when the freshness starts to going down in evening. Another reason is, in the wholesale market, from where the retail seller buys fish, fish auction sold with a very fix price. This price fixing does not always depend on size rather depend on the fish supply on that day. So, Sometimes, the retail seller only consider the wholesale price they paid per kilogram of fish.

5.2 Dummy Variables

5.2.1 Origin

Pangasius fish available in the studied market mainly supplied from different aquaculture farm. Major portion comes from the aquaculture farm in Mymensingh where the rest were from local farm. Mymensingh region is situated at the north in Bangladesh which is exclusively famous for high quality *Pangasius* production by intensive and semi-intensive culture practice. Thus the locally produced fish of low quality have lower price describes discount by representing the negative coefficient on OR1 which is 0.074 USD.

5.2.2 Freshness

Freshness is very important consideration for health conscious consumer as it is an important indicator of good quality product. Freshness can be measured in terms of bright gill color, eye color, skin color, and odor. In this study, gill color was considered as a good indicator for identifying freshness. Coefficient of freshness in terms of bright gill (FR1) shows very high price premium which is USD 0.15. Because consumer always prefers fresh fish and thus the more fresh fish have the higher value.

5.2.3 Time of day

Results of this hedonic study have clearly indicated the significance of time when the fish sold. Fish is a perishable product. So, time elapsed has a direct relationship with freshness of fish and so, price as well. In morning all fishes are fresh enough to satisfy consumer demand compared to evening. As a result, the price become high at the morning which consequence price premium for the coefficient corresponding to fish sold at morning expressed as TD1 which is USD 0.04.

5.2.4 Preservation method

In the studied market, normal water or ice is used for temporary preservation. Fish preserved with ice normally can be kept for long time and become fresher compared to those preserved with normal water. And fresh fish are more valuable than the others. As it has a direct relationship with freshness, the estimated result shows the price premium for the coefficient of fish preserved with ice expressed as PR1 in this study.

5.2.5 Day factors

Normally, at the weekend day the price increases if compared with other weekdays. At weekend days, people go to market to buy fish sometimes for whole week and thus the demand increase. This may lead to higher price on that day. Same thing can be happen if the day declared as road strike day or holiday. So, the coefficient of representing weekday (DW1) shows discount.

5.3 Limitation of the study

The data was collected from a local fish market at Barishal district in Bangladesh. As the seller seems very busy at morning while selling fish, it was quite difficult to measure the individual weight and length. Sometimes, the sellers also didn't want to give the permission to measure their fish and hesitate to tell the exact price. It was also normal to them to sell the fish more than the actual price to the rich people.

5.4 Conclusion

The present study has explored that, in a manner consistent with hedonic prices, the individual fish characteristics influences market price. The qualitative and quantitative characteristics of fish including size, freshness, origin etc. determine the price. In this study, the numerical values are intuitively sound and also the characteristics have the right qualitative impacts. In the fish market, the existence of hedonic effect is an empirical finding which is trustworthy with the motto that quality really matters. Anyway, the specific finding can explain some implications for those who not only involve with fisheries marketing and management including handling, transportation and preservation procedure but also production by intensive or semi-intensive aquaculture practice. For producer, the main concern reflects the influence of the size of the fish on the market price. As fish become large size, the price per kilogram increases. The second specific finding is that the freshness factor where involving people can be more conscious when handling, preserving or transporting. And thus, this hedonic approach explained in this study demonstrates the indicators of price fluctuation in fish market about what the fish farmers claimed on. Future research can be done to determine the hedonic effect on different market with different fish species which can play a dramatic role in developing the overall fisheries sector in Bangladesh.

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APPENDIX 1

Survey questionnaire

Questionnaire for Hedonic price Analysis for Catfish

1. Date:

2. Market Attributes: (It's a retail market opened everyday with number of catfish seller. Here other fish species also found)

a. Name of the Market: Barishal sadar market

b. Location (address): Barishal Town.

c. Type of Market: retail/ Wholesale

d. Other remarkable attributes of the market

(I keep it as if I can found any other remarkable attribute. It is just for and additional option.)

-

-

-

-

-

3. Name of the seller:

4. Age:

5. Address/ contact number:

6. How you fix the price of *Pangasius* fish? (price /kg):

7. From which area the fish come from?

8. In case of cultured fish, types of feeding (if he knows):
9. Variables (main):

Sample number	Price/kg (BDT)	Weight (gm)	Length (cm)	Number of fish per Kg
1				
2				

3				
4				
5				
6				
7				
8				
9				
10				

10 . Dummy Variables:

a. Mode of selling: retail/ wholesale

b. Origin of production: Cultured/ wild captured (from river)

c. Mode of preservation: fresh (just delivered) / iced / preserved in normal water (some times they preserved fish alive in a big drum with sufficient water)

d. Quality attributes:

Sample number	Species	Quality Attributes				
		Eyecolor-	Skin color	Gill color	Odor	Flesh color
1		bright/pale	bright/pale	Bright red, clean/ pale	No / yes	Reddish/ whitish
2		bright/pale	bright/pale	Bright red, clean/ pale	No / yes	Reddish/ whitish
3		bright/pale	bright/pale	Bright red, clean/ pale	No / yes	Reddish/ whitish
4		bright/pale	bright/pale	Bright red, clean/ pale	No / yes	Reddish/ whitish
5		bright/pale	bright/pale	Bright red, clean/ pale	No / yes	Reddish/ whitish
6		bright/pale	bright/pale	Bright red, clean/ pale	No / yes	Reddish/ whitish
7		bright/pale	bright/pale	Bright red, clean/ pale	No / yes	Reddish/ whitish
8		bright/pale	bright/pale	Bright red, clean/ pale	No / yes	Reddish/ whitish
9		bright/pale	bright/pale	Bright red, clean/ pale	No / yes	Reddish/ whitish
10		bright/pale	bright/pale	Bright red, clean/ pale	No / yes	Reddish/ whitish

- Overall quality (freshness): Good □ □ □ □ □ Spoiled

e. Day attributes: working day/ holiday/ day of strike

f. Time of day: Morning/ afternoon/ evening

g. Availability of fresh fish in market: low/ sufficient/ huge

11. Total amount of fish the seller bring to sell in kg (supply):

12. Total amount of fish the seller able to sell in kg (demand):

13. Other remarkable quality attributes that may affect the price of *Pangasius* fish such as:

- Price of other fish

- Availability of other fish

- Weather of that day: Rainy or Sunny

- Excess Supply of *Pangasius*

- Demand of *Pangasius* that day

- Time of the day : morning/ late morning/ evening/ night (sometimes prices differs at morning and evening)

- Social conflict……

- sold by head on/ head less

- Feeding ingredients in case of cultured fish (if he know)

APPENDIX 2

SHAZAM results for hedonic model

```
Welcome to SHAZAM - Version 10.0 -  JUL 2004 SYSTEM=WIN-NT   PAR= 11000
 CURRENT WORKING DIRECTORY IS: D:\pora\NTU\DATAAN~1\SHAZAM
 |_* catfish
 |_sample 1 220
 |_read no PRICE SL WGT OR1 OR2 FR1 FR2 TD1 TD2 PR1 PR2 DW1 DW2 MS1 MS2
   16 VARIABLES AND      220 OBSERVATIONS STARTING AT OBS       1

 |_stat / all
 NAME         N    MEAN         ST. DEV      VARIANCE     MINIMUM      MAXIMUM
 NO           220   110.50       63.653       4051.7       1.0000       220.00
 PRICE        220   115.14       7.5688       57.287       100.00       130.00
 SL           220   43.166       8.5739       73.511       27.940       63.720
 WGT          220   2.3868       1.1130       1.2389      0.70000       5.2000
 OR1          220  0.86364E-01  0.28154     0.79265E-01   0.0000       1.0000
 OR2          220  0.91364      0.28154     0.79265E-01   0.0000       1.0000
 FR1          220  0.65000      0.47806     0.22854       0.0000       1.0000
 FR2          220  0.35000      0.47806     0.22854       0.0000       1.0000
 TD1          220  0.80000      0.40091     0.16073       0.0000       1.0000
 TD2          220  0.20000      0.40091     0.16073       0.0000       1.0000
 PR1          220  0.16364      0.37079     0.13748       0.0000       1.0000
 PR2          220  0.83636      0.37079     0.13748       0.0000       1.0000
 DW1          220  0.81818      0.38657     0.14944       0.0000       1.0000
 DW2          220  0.18182      0.38657     0.14944       0.0000       1.0000
 MS1          220   1.0000       0.0000       0.0000       1.0000       1.0000
 MS2          220   0.0000       0.0000       0.0000       0.0000       0.0000
 |_* no PRICE SL WGT OR1 OR2 FR1 FR2 TD1 TD2 PR1 PR2 DW1 DW2 MS1 MS2
 |_stat OR1 OR2 / pcor
 NAME         N    MEAN         ST. DEV      VARIANCE     MINIMUM      MAXIMUM
 OR1          220  0.86364E-01  0.28154     0.79265E-01   0.0000       1.0000
 OR2          220  0.91364      0.28154     0.79265E-01   0.0000       1.0000

  CORRELATION MATRIX OF VARIABLES -      220 OBSERVATIONS


 OR1        1.0000
 OR2       -1.0000       1.0000
             OR1          OR2
 |_stat FR1 FR2  / pcor
 NAME         N    MEAN         ST. DEV      VARIANCE     MINIMUM      MAXIMUM
 FR1          220  0.65000      0.47806     0.22854       0.0000       1.0000
 FR2          220  0.35000      0.47806     0.22854       0.0000       1.0000

  CORRELATION MATRIX OF VARIABLES -      220 OBSERVATIONS


 FR1        1.0000
 FR2       -1.0000       1.0000
             FR1          FR2
 |_stat TD1 TD2 / pcor
 NAME         N    MEAN         ST. DEV      VARIANCE     MINIMUM      MAXIMUM
 TD1          220  0.80000      0.40091     0.16073       0.0000       1.0000
 TD2          220  0.20000      0.40091     0.16073       0.0000       1.0000

  CORRELATION MATRIX OF VARIABLES -      220 OBSERVATIONS

 TD1        1.0000
 TD2       -1.0000       1.0000
             TD1          TD2
 |_stat PR1 PR2 / pcor
 NAME         N    MEAN         ST. DEV      VARIANCE     MINIMUM      MAXIMUM
 PR1          220  0.16364      0.37079     0.13748       0.0000       1.0000
 PR2          220  0.83636      0.37079     0.13748       0.0000       1.0000
```

```
 CORRELATION MATRIX OF VARIABLES -      220 OBSERVATIONS


PR1        1.0000
PR2       -1.0000       1.0000
             PR1          PR2
|_stat DW1 DW2 / pcor
NAME        N    MEAN        ST. DEV      VARIANCE     MINIMUM      MAXIMUM
DW1         220  0.81818     0.38657     0.14944       0.0000       1.0000
DW2         220  0.18182     0.38657     0.14944       0.0000       1.0000

 CORRELATION MATRIX OF VARIABLES -      220 OBSERVATIONS


DW1        1.0000
DW2       -1.0000       1.0000
             DW1          DW2
|_stat MS1 MS2 / pcor
NAME        N    MEAN        ST. DEV      VARIANCE     MINIMUM      MAXIMUM
MS1         220   1.0000      0.0000      0.0000       1.0000       1.0000
MS2         220   0.0000      0.0000      0.0000       0.0000       0.0000

 CORRELATION MATRIX OF VARIABLES -      220 OBSERVATIONS


MS1        1.0000
MS2        0.0000       1.0000
             MS1          MS2
|_* find and remove 2 outliers
|_genr D1=DUM(SL.GT.45).AND.(WGT.LT.1.5)
|_genr D2=DUM(SL.GT.60).AND.(WGT.LT.3)
|_genr D=DUM(D1.EQ.1).OR.(D2.EQ.1)
|_*graph WGT SL
|_* Relationship between weight and size
|_skipif (d.eq.1)
OBSERVATION    12 WILL BE SKIPPED
OBSERVATION    15 WILL BE SKIPPED
|_genr SL2=SL*SL

|_ols WGT SL SL2

REQUIRED MEMORY IS PAR=      46 CURRENT PAR=   11000
 OLS ESTIMATION
      218 OBSERVATIONS     DEPENDENT VARIABLE= WGT
...NOTE..SAMPLE RANGE SET TO:      1,    220
 R-SQUARE =   0.9570     R-SQUARE ADJUSTED =   0.9566
VARIANCE OF THE ESTIMATE-SIGMA**2 =  0.54023E-01
STANDARD ERROR OF THE ESTIMATE-SIGMA =  0.23243
SUM OF SQUARED ERRORS-SSE=   11.615
MEAN OF DEPENDENT VARIABLE =   2.3894
LOG OF THE LIKELIHOOD FUNCTION =  10.2816

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      0.54766E-01
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =  -2.9047
 SCHWARZ (1978) CRITERION - LOG SC =              -2.8581
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =          0.54777E-01
 HANNAN AND QUINN (1979) CRITERION =              0.55806E-01
 RICE (1984) CRITERION =                          0.54787E-01
 SHIBATA (1981) CRITERION =                       0.54746E-01
 SCHWARZ (1978) CRITERION - SC =                  0.57377E-01
 AKAIKE (1974) INFORMATION CRITERION - AIC =      0.54766E-01

                    ANALYSIS OF VARIANCE - FROM MEAN
```

```
                      SS          DF             MS                F
REGRESSION        258.55          2.         129.28           2392.972
ERROR             11.615        215.        0.54023E-01        P-VALUE
TOTAL             270.17        217.         1.2450              0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS          DF             MS                F
REGRESSION        1503.2          3.         501.07           9275.162
ERROR             11.615        215.        0.54023E-01        P-VALUE
TOTAL             1514.8        218.         6.9488              0.000


VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR     215 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
SL        0.61872E-01 0.2372E-01   2.609     0.010 0.175     0.4706     1.1145
SL2       0.74787E-03 0.2654E-03   2.818     0.005 0.189     0.5084     0.6023
CONSTANT  -1.7128     0.5135      -3.335     0.001-0.222     0.0000    -0.7168
|_* Hedonic price model
|_* use this

|_ols PRICE wgt OR1 FR1 TD1 PR1 DW1  / coef=b1

REQUIRED MEMORY IS PAR=      53 CURRENT PAR=   11000
 OLS ESTIMATION
      218 OBSERVATIONS     DEPENDENT VARIABLE= PRICE
...NOTE..SAMPLE RANGE SET TO:      1,    220

 R-SQUARE =   0.8363     R-SQUARE ADJUSTED =   0.8316
VARIANCE OF THE ESTIMATE-SIGMA**2 =   9.7172
STANDARD ERROR OF THE ESTIMATE-SIGMA =   3.1172
SUM OF SQUARED ERRORS-SSE=   2050.3
MEAN OF DEPENDENT VARIABLE =   115.11
LOG OF THE LIKELIHOOD FUNCTION = -553.626

MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
 AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      10.029
    (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
 AKAIKE (1973) INFORMATION CRITERION - LOG AIC =   2.3055
 SCHWARZ (1978) CRITERION - LOG SC =               2.4142
MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
 CRAVEN-WAHBA (1979)
    GENERALIZED CROSS VALIDATION - GCV =           10.040
 HANNAN AND QUINN (1979) CRITERION =               10.479
 RICE (1984) CRITERION =                           10.051
 SHIBATA (1981) CRITERION =                        10.009
 SCHWARZ (1978) CRITERION - SC =                   11.180
 AKAIKE (1974) INFORMATION CRITERION - AIC =       10.029

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS          DF             MS                F
REGRESSION        10472.          6.         1745.3            179.610
ERROR             2050.3        211.         9.7172            P-VALUE
TOTAL             12522.        217.         57.706              0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS          DF             MS                F
REGRESSION      0.28993E+07       7.        0.41418E+06      42623.767
ERROR             2050.3        211.         9.7172            P-VALUE
TOTAL           0.29013E+07     218.         13309.              0.000


VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
  NAME    COEFFICIENT   ERROR     211 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
WGT        1.7986     0.2006       8.965     0.000 0.525     0.2642     0.0373
OR1       -6.0483     0.7861      -7.694     0.000-0.468    -0.2251    -0.0046
FR1        12.205      1.981       6.160     0.000 0.390     0.7697     0.0686
TD1        3.2752      1.887       1.736     0.084 0.119     0.1734     0.0227
PR1        7.2292      1.886       3.833     0.000 0.255     0.3542     0.0104
```

```
 DW1       -4.9071     0.5488      -8.942     0.000-0.524    -0.2506    -0.0348
 CONSTANT   103.65     0.7783       133.2     0.000 0.994     0.0000     0.9004

 DURBIN-WATSON = 0.7567    VON NEUMANN RATIO = 0.7602    RHO =  0.62185
 RESIDUAL SUM = -0.16946E-11  RESIDUAL VARIANCE =   9.7172
 SUM OF ABSOLUTE ERRORS=   501.78
 R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.8363
 RUNS TEST:   59 RUNS,   77 POS,    0 ZERO,  141 NEG  NORMAL STATISTIC = -6.1843
 COEFFICIENT OF SKEWNESS =   1.4684 WITH STANDARD DEVIATION OF 0.1648
 COEFFICIENT OF EXCESS KURTOSIS =   2.4048 WITH STANDARD DEVIATION OF 0.3281

 JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=  126.2702 P-VALUE= 0.000

      GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 20 GROUPS
 OBSERVED  0.0  0.0  0.0  0.0  2.0  5.0 14.0 45.0 42.0 33.0 21.0  9.0 10.0 10.0
8.0  5.0  5.0  2.0  2.0  5.0

 EXPECTED  0.8  1.0  2.1  3.9  6.7 10.5 15.0 19.7 23.5 25.7 25.7 23.5 19.7 15.0
10.5  6.7  3.9  2.1  1.0  0.8

 CHI-SQUARE =  105.4729 WITH 11 DEGREES OF FREEDOM, P-VALUE= 0.000
 |_* but this is similar

 |_ols PRICE sl OR1 FR1 TD1 PR1 DW1  / coef=b2

 REQUIRED MEMORY IS PAR=      53 CURRENT PAR=   11000
  OLS ESTIMATION
       218 OBSERVATIONS     DEPENDENT VARIABLE= PRICE
 ...NOTE..SAMPLE RANGE SET TO:      1,    220

  R-SQUARE =   0.8368     R-SQUARE ADJUSTED =   0.8322
 VARIANCE OF THE ESTIMATE-SIGMA**2 =   9.6843
 STANDARD ERROR OF THE ESTIMATE-SIGMA =   3.1120
 SUM OF SQUARED ERRORS-SSE=   2043.4
 MEAN OF DEPENDENT VARIABLE =   115.11
 LOG OF THE LIKELIHOOD FUNCTION = -553.257

 MODEL SELECTION TESTS - SEE JUDGE ET AL. (1985,P.242)
  AKAIKE (1969) FINAL PREDICTION ERROR - FPE =      9.9953
     (FPE IS ALSO KNOWN AS AMEMIYA PREDICTION CRITERION - PC)
  AKAIKE (1973) INFORMATION CRITERION - LOG AIC =   2.3021
  SCHWARZ (1978) CRITERION - LOG SC =               2.4108
 MODEL SELECTION TESTS - SEE RAMANATHAN (1998,P.165)
  CRAVEN-WAHBA (1979)
     GENERALIZED CROSS VALIDATION - GCV =           10.006
  HANNAN AND QUINN (1979) CRITERION =               10.444
  RICE (1984) CRITERION =                           10.017
  SHIBATA (1981) CRITERION =                        9.9753
  SCHWARZ (1978) CRITERION - SC =                   11.143
  AKAIKE (1974) INFORMATION CRITERION - AIC =       9.9951

                     ANALYSIS OF VARIANCE - FROM MEAN
                      SS         DF           MS                 F
 REGRESSION       10479.         6.        1746.5             180.339
 ERROR            2043.4       211.        9.6843             P-VALUE
 TOTAL            12522.       217.        57.706               0.000

                     ANALYSIS OF VARIANCE - FROM ZERO
                      SS         DF           MS                 F
 REGRESSION      0.28993E+07     7.      0.41418E+06        42768.409
 ERROR            2043.4       211.        9.6843             P-VALUE
 TOTAL           0.29013E+07   218.        13309.               0.000


 VARIABLE   ESTIMATED  STANDARD   T-RATIO        PARTIAL STANDARDIZED ELASTICITY
   NAME    COEFFICIENT   ERROR     211 DF   P-VALUE CORR. COEFFICIENT  AT MEANS
 SL         0.24131    0.2675E-01   9.020     0.000 0.528     0.2696     0.0902
 OR1       -5.7531     0.7920      -7.264     0.000-0.447    -0.2141    -0.0044
```

```
 FR1        12.217      1.978       6.178     0.000 0.391     0.7705     0.0686
 TD1        3.1407      1.883       1.668     0.097 0.114     0.1663     0.0218
 PR1        7.0999      1.885       3.767     0.000 0.251     0.3478     0.0102
 DW1       -4.9620     0.5475      -9.064     0.000-0.529    -0.2534    -0.0352
 CONSTANT   97.700      1.251       78.07     0.000 0.983     0.0000     0.8487

 DURBIN-WATSON = 0.7763    VON NEUMANN RATIO = 0.7799    RHO =  0.61191
 RESIDUAL SUM =  0.40750E-11  RESIDUAL VARIANCE =   9.6843
 SUM OF ABSOLUTE ERRORS=   513.07
 R-SQUARE BETWEEN OBSERVED AND PREDICTED = 0.8368
 RUNS TEST:   53 RUNS,   69 POS,    0 ZERO,  149 NEG  NORMAL STATISTIC = -6.6450
 COEFFICIENT OF SKEWNESS =   1.4616 WITH STANDARD DEVIATION OF 0.1648
 COEFFICIENT OF EXCESS KURTOSIS =   2.5276 WITH STANDARD DEVIATION OF 0.3281

 JARQUE-BERA NORMALITY TEST- CHI-SQUARE(2 DF)=  130.7439 P-VALUE= 0.000

      GOODNESS OF FIT TEST FOR NORMALITY OF RESIDUALS - 20 GROUPS
 OBSERVED  0.0  0.0  0.0  2.0  2.0  2.0  6.0 41.0 64.0 32.0  6.0 13.0 12.0 11.0
11.0  2.0  5.0  1.0  2.0  6.0

 EXPECTED  0.8  1.0  2.1  3.9  6.7 10.5 15.0 19.7 23.5 25.7 25.7 23.5 19.7 15.0
10.5  6.7  3.9  2.1  1.0  0.8

 CHI-SQUARE =  179.9850 WITH 11 DEGREES OF FREEDOM, P-VALUE= 0.000
 |_print b1 b2
 B1
    1.798601      -6.048272       12.20478       3.275207       7.229220
   -4.907115       103.6490
 B2
   0.2413078      -5.753114       12.21748       3.140683       7.099932
   -4.961974       97.69980
 |_stop
```

APPENDIX 3

Data sheet for hedonic model

sample no	PRICE	SL	WGT	OR1	OR2	FR1	FR2	TD1	TD2	PR1	PR2	DW1	DW2	MS1	MS2
1	120	42.67	2.4	0	1	1	0	1	0	0	1	1	0	1	0
2	120	57.66	4.7	0	1	0	1	0	1	0	1	1	0	1	0
3	115	30.48	0.8	0	1	1	0	1	0	0	1	1	0	1	0
4	120	54.36	3.9	0	1	1	0	1	0	0	1	1	0	1	0
5	115	39.62	1.6	0	1	1	0	1	0	0	1	1	0	1	0
6	100	30.23	0.7	0	1	0	1	0	1	0	1	1	0	1	0
7	115	35.56	1.2	0	1	1	0	1	0	0	1	1	0	1	0
8	100	34.29	1.2	0	1	0	1	0	1	0	1	1	0	1	0
9	115	45.21	2.7	0	1	0	1	0	1	1	0	1	0	1	0
10	100	38.86	1.8	0	1	0	1	0	1	0	1	1	0	1	0
11	120	53.34	3.6	0	1	1	0	1	0	0	1	1	0	1	0
12	120	63.72	2.8	0	1	1	0	1	0	0	1	1	0	1	0
13	120	55.88	4	0	1	1	0	1	0	0	1	1	0	1	0
14	120	38.1	2	0	1	1	0	1	0	0	1	1	0	1	0
15	115	49.56	1.4	0	1	1	0	1	0	0	1	1	0	1	0
16	115	30.73	0.9	0	1	1	0	1	0	0	1	1	0	1	0
17	110	56.13	4	0	1	0	1	0	1	1	0	1	0	1	0
18	115	32.51	1	0	1	1	0	1	0	0	1	1	0	1	0
19	110	45.72	2.8	0	1	0	1	0	1	1	0	1	0	1	0
20	100	27.94	0.8	0	1	0	1	0	1	0	1	1	0	1	0
21	120	54.36	3.9	0	1	1	0	1	0	0	1	1	0	1	0
22	120	52.58	3.2	0	1	1	0	1	0	0	1	1	0	1	0
23	115	38.86	1.8	0	1	1	0	1	0	0	1	1	0	1	0
24	115	33.02	1	0	1	1	0	1	0	0	1	1	0	1	0
25	115	29.72	0.7	0	1	1	0	1	0	0	1	1	0	1	0
26	115	53.59	3.7	0	1	0	1	1	0	1	0	1	0	1	0
27	110	40.39	2.2	0	1	0	1	1	0	1	0	1	0	1	0
28	110	38.1	2	0	1	0	1	1	0	1	0	1	0	1	0
29	100	53.34	3.5	0	1	0	1	0	1	0	1	1	0	1	0

30	100	33.78	1.1	0	1	0	1	0	1	0	1	1	0	1	0
31	125	54.1	3.9	0	1	1	0	1	0	0	1	0	1	1	0
32	125	56.39	4.4	0	1	1	0	1	0	0	1	0	1	1	0
33	125	52.83	3.2	0	1	1	0	1	0	0	1	0	1	1	0
34	120	39.12	1.8	0	1	1	0	1	0	0	1	0	1	1	0
35	120	35.56	1.3	0	1	1	0	1	0	0	1	0	1	1	0
36	120	33.02	1	0	1	1	0	1	0	0	1	0	1	1	0
37	115	53.09	3.4	0	1	0	1	1	0	1	0	0	1	1	0
38	115	45.97	2.9	0	1	0	1	1	0	1	0	0	1	1	0
39	105	28.45	0.8	0	1	0	1	0	1	0	1	0	1	1	0
40	105	27.94	0.7	0	1	0	1	0	1	0	1	0	1	1	0
41	120	56.39	4.1	0	1	1	0	1	0	0	1	1	0	1	0
42	120	53.34	3.4	0	1	1	0	1	0	0	1	1	0	1	0
43	120	38.86	2.1	0	1	1	0	1	0	0	1	1	0	1	0
44	115	36.58	1.7	0	1	1	0	1	0	0	1	1	0	1	0
45	115	36.32	1.6	0	1	1	0	1	0	0	1	1	0	1	0
46	115	35.05	1.2	0	1	1	0	1	0	0	1	1	0	1	0
47	115	45.47	2.7	0	1	0	1	1	0	1	0	1	0	1	0
48	110	33.27	1	0	1	0	1	1	0	1	0	1	0	1	0
49	100	39.37	1.9	0	1	0	1	0	1	0	1	1	0	1	0
50	100	38.36	2.1	0	1	0	1	0	1	0	1	1	0	1	0
51	120	53.59	3.7	0	1	1	0	1	0	0	1	1	0	1	0
52	120	55.88	4	0	1	1	0	1	0	0	1	1	0	1	0
53	120	37.85	2	0	1	1	0	1	0	0	1	1	0	1	0
54	120	43.43	2.5	0	1	1	0	1	0	0	1	1	0	1	0
55	115	36.07	1.5	0	1	1	0	1	0	0	1	1	0	1	0
56	115	30.48	0.8	0	1	1	0	1	0	0	1	1	0	1	0
57	115	53.34	3.4	0	1	0	1	1	0	1	0	1	0	1	0
58	115	38.35	2.1	0	1	0	1	1	0	1	0	1	0	1	0
59	110	47.24	3	0	1	0	1	0	1	0	1	1	0	1	0
60	100	33.27	1	0	1	0	1	0	1	0	1	1	0	1	0
61	125	54.36	3.9	0	1	1	0	1	0	0	1	0	1	1	0
62	125	57.4	4.7	0	1	1	0	1	0	0	1	0	1	1	0
63	125	45.47	2.8	0	1	1	0	1	0	0	1	0	1	1	0
64	120	39.37	1.9	0	1	1	0	1	0	0	1	0	1	1	0

65	120	33.27	1	0	1	1	0	1	0	0	1	0	1	1	0
66	120	35.81	1.7	0	1	1	0	1	0	0	1	0	1	1	0
67	120	52.32	3.2	0	1	0	1	1	0	1	0	0	1	1	0
68	120	44.96	2.6	0	1	0	1	1	0	1	0	0	1	1	0
69	110	35.56	1.2	0	1	0	1	0	1	0	1	0	1	1	0
70	110	36.07	1.5	0	1	0	1	0	1	0	1	0	1	1	0
71	120	52.32	3.2	0	1	1	0	1	0	0	1	1	0	1	0
72	120	44.96	2.7	0	1	1	0	1	0	0	1	1	0	1	0
73	120	55.88	4	0	1	1	0	1	0	0	1	1	0	1	0
74	115	34.55	1.2	0	1	1	0	1	0	0	1	1	0	1	0
75	115	32.766	1	0	1	1	0	1	0	0	1	1	0	1	0
76	115	39.116	1.9	0	1	1	0	1	0	0	1	1	0	1	0
77	110	38.862	1.8	0	1	0	1	1	0	1	0	1	0	1	0
78	110	33.274	1	0	1	0	1	1	0	1	0	1	0	1	0
79	100	36.83	1.4	0	1	0	1	0	1	0	1	1	0	1	0
80	100	38.608	2.1	0	1	0	1	0	1	0	1	1	0	1	0
81	120	58.42	5	0	1	1	0	1	0	0	1	1	0	1	0
82	120	56.388	4.5	0	1	1	0	1	0	0	1	1	0	1	0
83	120	53.34	3.5	0	1	1	0	1	0	0	1	1	0	1	0
84	120	55.88	4.1	0	1	1	0	1	0	0	1	1	0	1	0
85	120	45.72	2.7	0	1	1	0	1	0	0	1	1	0	1	0
86	115	38.862	1.6	0	1	1	0	1	0	0	1	1	0	1	0
87	115	32.004	0.9	0	1	1	0	1	0	0	1	1	0	1	0
88	115	35.814	1	0	1	1	0	1	0	0	1	1	0	1	0
89	115	56.134	4.2	0	1	0	1	1	0	1	0	1	0	1	0
90	100	33.274	1.1	0	1	0	1	0	1	0	1	1	0	1	0
91	120	42.672	2.4	0	1	1	0	1	0	0	1	1	0	1	0
92	120	54.356	3.9	0	1	1	0	1	0	0	1	1	0	1	0
93	120	57.658	4.7	0	1	1	0	1	0	0	1	1	0	1	0
94	115	39.624	1.6	0	1	1	0	1	0	0	1	1	0	1	0
95	115	35.56	1.2	0	1	1	0	1	0	0	1	1	0	1	0
96	115	30.948	0.8	0	1	1	0	1	0	0	1	1	0	1	0
97	115	45.212	2.7	0	1	0	1	1	0	1	0	1	0	1	0
98	110	38.862	1.8	0	1	0	1	1	0	1	0	1	0	1	0
99	100	34.29	1.2	0	1	0	1	0	1	0	1	1	0	1	0

100	100	30.226	0.7	0	1	0	1	0	1	0	1	1	0	1	0
101	120	53.34	3.6	0	1	1	0	1	0	0	1	1	0	1	0
102	120	56.134	4.4	0	1	1	0	1	0	0	1	1	0	1	0
103	120	39.37	2.1	0	1	1	0	1	0	0	1	1	0	1	0
104	115	36.068	1.5	0	1	1	0	1	0	0	1	1	0	1	0
105	115	35.56	1.2	0	1	1	0	1	0	0	1	1	0	1	0
106	115	30.988	0.9	0	1	1	0	1	0	0	1	1	0	1	0
107	115	45.974	2.9	0	1	0	1	1	0	1	0	1	0	1	0
108	110	44.45	2.5	0	1	0	1	1	0	1	0	1	0	1	0
109	110	39.37	2.3	0	1	0	1	1	0	1	0	1	0	1	0
110	100	38.86	2.2	0	1	0	1	0	1	0	1	1	0	1	0
111	120	58.674	5	0	1	1	0	1	0	0	1	1	0	1	0
112	120	55.88	4.1	0	1	1	0	1	0	0	1	1	0	1	0
113	120	52.578	3.2	0	1	1	0	1	0	0	1	1	0	1	0
114	115	45.466	2.7	0	1	1	0	1	0	0	1	1	0	1	0
115	115	37.592	2	0	1	1	0	1	0	0	1	1	0	1	0
116	115	53.34	3.5	0	1	0	1	1	0	1	0	1	0	1	0
117	110	42.418	2.4	0	1	0	1	1	0	1	0	1	0	1	0
118	110	39.37	2.1	0	1	0	1	1	0	1	0	1	0	1	0
119	100	38.862	1.8	0	1	0	1	0	1	0	1	1	0	1	0
120	100	32.512	1	0	1	0	1	0	1	0	1	1	0	1	0
121	120	55.88	4	0	1	1	0	1	0	0	1	1	0	1	0
122	120	52.07	3.2	0	1	1	0	1	0	0	1	1	0	1	0
123	120	44.704	2.8	0	1	1	0	1	0	0	1	1	0	1	0
124	115	38.354	1.5	0	1	1	0	1	0	0	1	1	0	1	0
125	115	38.862	1.8	0	1	1	0	1	0	0	1	1	0	1	0
126	110	40.132	2.3	1	0	1	0	1	0	0	1	1	0	1	0
127	110	39.624	2.1	1	0	1	0	1	0	0	1	1	0	1	0
128	110	38.354	2	1	0	1	0	1	0	0	1	1	0	1	0
129	100	52.578	3.2	0	1	0	1	0	1	0	1	1	0	1	0
130	100	39.37	1.7	0	1	0	1	0	1	0	1	1	0	1	0
131	120	59.182	5.1	0	1	1	0	1	0	0	1	1	0	1	0
132	120	56.642	4.3	0	1	1	0	1	0	0	1	1	0	1	0
133	120	51.816	3	0	1	1	0	1	0	0	1	1	0	1	0
134	115	39.624	1.9	0	1	1	0	1	0	0	1	1	0	1	0

135	115	38.862	1.5	0	1	1	0	1	0	0	1	1	0	1	0
136	115	52.07	3.2	0	1	0	1	1	0	1	0	1	0	1	0
137	110	39.116	1.7	1	0	1	0	1	0	0	1	1	0	1	0
138	110	39.37	2	1	0	1	0	1	0	0	1	1	0	1	0
139	100	44.45	2.5	0	1	0	1	0	1	0	1	1	0	1	0
140	100	51.562	3.1	0	1	0	1	0	1	0	1	1	0	1	0
141	125	56.388	4.4	0	1	1	0	1	0	0	1	0	1	1	0
142	125	53.594	3.8	0	1	1	0	1	0	0	1	0	1	1	0
143	125	42.926	2.5	0	1	1	0	1	0	0	1	0	1	1	0
144	120	39.116	1.7	0	1	1	0	1	0	0	1	0	1	1	0
145	120	45.974	2.9	0	1	0	1	1	0	1	0	0	1	1	0
146	120	51.562	3	0	1	0	1	1	0	1	0	0	1	1	0
147	115	38.608	2.1	1	0	1	0	1	0	0	1	0	1	1	0
148	115	36.068	1.6	1	0	1	0	1	0	0	1	0	1	1	0
149	105	42.672	2.4	0	1	0	1	0	1	0	1	0	1	1	0
150	105	39.116	1.9	0	1	0	1	0	1	0	1	0	1	1	0
151	120	56.134	4.3	0	1	1	0	1	0	0	1	1	0	1	0
152	120	53.086	3.3	0	1	1	0	1	0	0	1	1	0	1	0
153	120	45.974	2.9	0	1	1	0	1	0	0	1	1	0	1	0
154	115	37.084	1.8	0	1	1	0	1	0	0	1	1	0	1	0
155	115	36.322	1.5	0	1	1	0	1	0	0	1	1	0	1	0
156	110	38.862	2.2	1	0	1	0	1	0	0	1	1	0	1	0
157	110	36.576	1.7	1	0	1	0	1	0	0	1	1	0	1	0
158	110	33.02	1	1	0	1	0	1	0	0	1	1	0	1	0
159	100	41.656	2.4	0	1	0	1	0	1	0	1	1	0	1	0
160	100	38.354	1.9	0	1	0	1	0	1	0	1	1	0	1	0
161	125	52.832	3.2	0	1	1	0	1	0	0	1	1	0	1	0
162	125	52.07	3	0	1	1	0	1	0	0	1	1	0	1	0
163	120	37.084	1.8	0	1	1	0	1	0	0	1	1	0	1	0
164	120	33.274	1	0	1	1	0	1	0	0	1	1	0	1	0
165	120	44.958	2.6	0	1	0	1	1	0	1	0	1	0	1	0
166	115	36.576	1.7	1	0	1	0	1	0	0	1	1	0	1	0
167	115	33.02	1	1	0	1	0	1	0	0	1	1	0	1	0
168	115	32.004	0.9	1	0	1	0	1	0	0	1	1	0	1	0
169	105	38.862	2.1	0	1	0	1	0	1	0	1	1	0	1	0

170	105	36.322	1.5	0	1	0	1	0	1	0	1	1	0	1	0
171	130	52.578	3.2	0	1	1	0	1	0	0	1	1	0	1	0
172	130	53.594	3.7	0	1	1	0	1	0	0	1	1	0	1	0
173	130	44.958	2.8	0	1	1	0	1	0	0	1	1	0	1	0
174	125	36.068	1.5	0	1	1	0	1	0	0	1	1	0	1	0
175	125	39.37	1.9	0	1	1	0	1	0	0	1	1	0	1	0
176	125	52.07	3.1	0	1	0	1	1	0	1	0	1	0	1	0
177	120	36.83	1.8	0	1	1	0	1	0	0	1	1	0	1	0
178	120	35.56	1.2	0	1	1	0	1	0	0	1	1	0	1	0
179	110	45.212	2.7	0	1	0	1	0	1	0	1	1	0	1	0
180	110	36.322	1.6	0	1	0	1	0	1	0	1	1	0	1	0
181	120	56.134	4.2	0	1	1	0	1	0	0	1	1	0	1	0
182	120	52.832	3.5	0	1	1	0	1	0	0	1	1	0	1	0
183	120	38.354	2.1	0	1	1	0	1	0	0	1	1	0	1	0
184	115	36.322	1.6	0	1	1	0	1	0	0	1	1	0	1	0
185	115	35.814	1.4	0	1	1	0	1	0	0	1	1	0	1	0
186	115	52.324	3.2	0	1	0	1	1	0	1	0	1	0	1	0
187	110	38.862	1.8	1	0	1	0	1	0	0	1	1	0	1	0
188	110	36.068	1.5	1	0	1	0	1	0	0	1	1	0	1	0
189	100	39.624	2.1	0	1	0	1	0	1	0	1	1	0	1	0
190	100	39.37	1.9	0	1	0	1	0	1	0	1	1	0	1	0
191	120	53.086	3.3	0	1	1	0	1	0	0	1	1	0	1	0
192	120	45.212	2.9	0	1	1	0	1	0	0	1	1	0	1	0
193	120	42.418	2.4	0	1	1	0	1	0	0	1	1	0	1	0
194	115	38.862	1.8	0	1	1	0	1	0	0	1	1	0	1	0
195	115	35.56	1.2	0	1	1	0	1	0	0	1	1	0	1	0
196	115	33.02	1	0	1	1	0	1	0	0	1	1	0	1	0
197	115	41.656	2.3	0	1	0	1	1	0	1	0	1	0	1	0
198	115	52.07	3.1	0	1	0	1	1	0	1	0	1	0	1	0
199	100	36.068	1.5	0	1	0	1	0	1	0	1	1	0	1	0
200	100	44.45	2.5	0	1	0	1	0	1	0	1	1	0	1	0
201	125	58.674	5	0	1	1	0	1	0	0	1	1	0	1	0
202	125	55.88	4.2	0	1	1	0	1	0	0	1	1	0	1	0
203	125	45.72	2.8	0	1	1	0	1	0	0	1	1	0	1	0
204	120	39.116	1.7	0	1	1	0	1	0	0	1	1	0	1	0

205	120	38.862	1.5	0	1	1	0	1	0	0	1	1	0	1	0
206	120	33.02	1	0	1	1	0	1	0	0	1	1	0	1	0
207	120	53.848	3.5	0	1	0	1	1	0	1	0	1	0	1	0
208	115	38.354	2.1	1	0	1	0	1	0	0	1	1	0	1	0
209	115	36.83	1.8	1	0	1	0	1	0	0	1	1	0	1	0
210	110	39.116	2.2	0	1	0	1	0	1	0	1	1	0	1	0
211	130	58.928	5.2	0	1	1	0	1	0	0	1	0	1	1	0
212	130	55.626	4.1	0	1	1	0	1	0	0	1	0	1	1	0
213	130	53.848	3.8	0	1	1	0	1	0	0	1	0	1	1	0
214	125	38.862	1.5	0	1	1	0	1	0	0	1	0	1	1	0
215	125	33.02	1	0	1	1	0	1	0	0	1	0	1	1	0
216	125	52.07	3.1	0	1	0	1	1	0	1	0	0	1	1	0
217	125	46.226	2.9	0	1	0	1	1	0	1	0	0	1	1	0
218	115	36.576	1.7	1	0	1	0	1	0	0	1	0	1	1	0
219	115	39.116	2.2	1	0	1	0	1	0	0	1	0	1	1	0
220	110	36.322	1.6	0	1	0	1	0	1	0	1	0	1	1	0