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IMPLICIT PRICE OF GOAT ATTRIBUTES IN SELECTED MARKETS OF PUNJAB, PAKISTAN

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ABSTRACT

The study determined the implicit price of goat attributes under the revealed preferences of buyers. Data on breed type, age, sex and live weight were collected for 300 traded goats from three markets of the Punjab province, i.e., Lahore, Faisalabad and Dera Ghazi Khan during 2020. The present study applied semi-logarithmic specification of the hedonic model to identify the impact of goat attributes on its price. The empirical results indicated that traded goats obtained a premium price of Rs. 2302 and Rs. 2412 in Faisalabad and Lahore market relative to Dera Ghazi Khan market. The study showed that an increase in the live weight of goats by one kg resulted in an increase in price by Rs. 494.26. Further, the customers were willing to pay a premium price for attributes such as age, sex, and breed type of traded goats. This study suggests that producers should sell animals in the large markets and produce "Donda" and Chouga" goats to get a premium price.

KEYWORDS: Hedonic pricing; goat characteristics; trait preferences; model; premium; Pakistan

INTRODUCTION

Small ruminants play an important role in the economic development of developing countries (Akinmoladun *et al.,* 2019). These ruminants production represent about 56% of the world's ruminant population and produces approximately 1.5 million tons of meat and 25.6 million tons of milk (FAO, 2016). Globally, there are 2176 million small ruminants (i.e., 1003 million goats and 1173 million sheep) and Asia contributes 55.4 percent and 43.6 percent to the worlds goat and sheep population, respectively (FAO, 2018). The world population of small ruminants is increasing because they are an important asset and source of income for small landholders and landless households in developing countries (Wodajo *et al.,* 2020). They contribute in providing food to growing population and ensure food security. They also contribute to women's empowerment and gender equality as women are more likely to be the owners of small ruminants. Moreover, they can be sold and used to fulfill immediate cash requirements. Further small ruminants have an adaptive capacity to climate change. They transform useless rangeland plants into food for human consumption and emit less greenhouse gases per kilogram of meat than large ruminants. They can also adopt to water-limited areas and harsh environment compared with large ruminants (IFAD, 2021). Small ruminants are also promising because of their short generation interval, low production cost, ability to use crop waste more effectively, and suitability to smallholding (Akinmoladun *et al.,* 2019).

The livestock sector in Pakistan accounted for 60.07 percent of agricultural value addition and 11.53 percent of national GDP during 2020-21 (GoP, 2021). During two census periods (1960 and 2006), the number of cattle increased by 77.81 percent, buffalos 234.95 percent, sheep 113.99 percent and goats 435.41 percent (GoP, 2006). Globally, over 1961-2017, the goat population increased by 196.62 percent compared with 58.32 percent in cattle, 20.94 percent in sheep and 127.54 percent in buffaloes (FAO, 2018). It is evident that the goat population has experienced a much higher growth rate than the cattle, buffaloes and sheep population globally. The possible reason for this is that goats possess many characteristics that make them more suitable than the other livestock species. They are more prolific domesticated ruminants and can use poor quality forages more efficiently, cover longer distances in search of food, survive under prolonged water deprivation, and withstand heat stress (Aziz, 2010). Goats are considered more profitable

than sheep as they are more tolerant to the harsh environment (Alary *et al.,* 2015). Further, poor people can acquire goats by investing a small amount of capital and can satisfy socio-economic needs such as religious rituals, dowry and gifts (Peacock, 2005). In Pakistan, goat meat is considered superior to other meats as it is leaner with less fat waste, low in cholesterol and rich in iron (Solaiman, 2007). The goat meat demand has an increasing trend (Waheed, 2011) because of an increase in the population (Sharif *et al.,* 2003). Further, the income elasticity of goat meat is elastic, which means that an increase in income has a more proportionate impact on demand (Farooq and Ali, 2002). Urbanization and development also have a positive effect on goat meat's demand. It is expected that the gap between demand and supply will widen further due to the rapid growth of the international market for halal goat meat.

Pakistan ranks number four in the world in goat-producing countries and accounts for 7.3 percent of the world's goat population. Nearly 35 million families in the rural areas are involved in raising goats, with 3-4 goats per household. There are 37 goat breeds with a population of 74.1 million heads (GoP, 2018). Most of the goat producers in Pakistan are not business oriented. They sell goats directly or through middlemen in the market (Sharif *et al.,* 2003). Therefore, it is necessary to correctly identify and evaluate various characteristics of goats for efficient resource allocation and better strategies for production and marketing. Developing an appropriate model for the goat industry that helps to explain the price relationship with various characteristics of goats. This is crucial for commercializing a very important subsector of livestock in Pakistan under changing demand and preferences of consumers over time.

As a result, they can target places for sales and other interventions to gain from market opportunities, which could ultimately increase the income of animal producers. The study's main objective is to identify factors affecting the market price for goats using data from three important markets of the Punjab, Pakistan.

MATERIALS AND METHODS

Hedonic price model

Various valuation methods has been used to estimate the value of goat characteristics. For this purpose, two commonly used approaches are revealed preference and stated preference. Revealed preference approach records and analyzed actual payments on traded commodities, while the stated preference approach uses hypothetical choices and prices (Hensher *et al.,* 2005). The revealed preference approach has advantages over stated preference approach because of real-world data, reliability, validity, and embodiment of factual constraints (Haab and McConnell, 2002; Hensher *et al.,* 2005). Revealed preference uses actual prices paid by consumers for the commodity with expected utility. The price that the consumer paid for the goat reflects the utility derived from the attributes of the goat. In this regard, the hedonic price function estimates the price of a good to its various characteristics or attributes embodied in the product. Its methodological approach is based on Lancaster's (1966) theory of demand which states that buyers derive utility from the characteristics of the product rather than from the product itself. Hence, the price of goat that buyer pays reflects the buyer's anticipated utility from the goat's attributes. The marginal price of a good in a competitive market is a function of the product characteristics alone. It implies that any differentiated product can be seen as a bundle of quality characteristics and the "marginal values" buyer attaches to each of the attributes at the time of purchase explain the variation in the price due to that characteristic of the product. Rosen (1974) demonstrated that the observed price of a goat could be taken as the sum of the prices associated with each attribute. Although the market does not explicitly express these prices, they can be estimated by using the hedonic price model. This model expresses the price of a product as a function of its attributes. The general form of a hedonic price function can be given as:

$$P = P(Z) = P(Z_1, Z_2, \ldots..Z_n)$$

Where P the observed price of a product and Z a vector of n attributes (Z_1, Z_2, Z_4,.....Z_n).

The partial derivative of the estimated hedonic price function with respect to the characteristic j is the implicit

$$\frac{\partial P(Z)}{\partial Z_j}$$

price/value of the attribute j. In the case of qualitative attributes, represented by dummy variables, the partial derivative of the hedonic function with respect to a dummy variable shows the impact of the presence or absence of the attribute on its price.

Sources of data

Three markets in Punjab, i.e., Lahore, Faisalabad and Dera Ghazi Khan were purposively selected,

representing diversity prevailing in Punjab. Lahore is the capital city of the Punjab province and is the biggest consumer center in terms of population in the rice-wheat cropping system, while Faisalabad is the second biggest city in Punjab and located in the mixed cropping system. Goats are transported from all the major goat-producing areas to these centers. Dera Ghazi Khan is in the cotton-wheat cropping system and a relatively backward area. However, it is the biggest goat-producing district in Punjab. This district shares 7.73 percent of the total goat population in Punjab.

Shah Pur Kanjra market in Lahore, Neamuana market in Faisalabad and Kot Chuta market in Dera Ghazi Khan were selected for data collection. Both small and large animals were traded in these markets. Various types of buyers purchased small and large ruminants in these markets. All these markets operated for two days. i.e., Wednesday and Saturday. In these markets, as no standardization and grading of goats exist, therefore, bargaining between buyer and seller resulted in a transaction price. The final price paid by the buyer and received by the seller depends on negotiation with each other. The transactional price showed the preference for various goat attributes under given characteristics of the market place. As there were no registered buyers, therefore, data were collected from buyers on 100 traded goats (goats actually marketed through the action of buying and selling between buyers and sellers) from each market i.e., Lahore, Faisalabad and Dera Ghazi Khan, by using convenience sampling. The sample was statistically sufficient to conduct the study and run the model according to Wooldridge (2013). The data collection were done in two rounds, i.e., with and without a religious festival. Data were collected on price, live weight, sex, breed, age for each traded goat from the selected markets. Transactions were normally done by visual appraisal. Bargaining by buyers and sellers were done by making good guesses about the weight of the goat. However, in this study, following Moaeen-ud-Din *et al.* (2006) formula was used to estimate the weight of a goat.

$$\text{Animal weight (in pounds)} = [(\text{heart girth})^2 \text{x (body length)}]$$

Further, the estimated weight was converted in kg. The age of the animal was estimated from its dentition as under:

- Goat has milk teeth (less than one year old), i.e., *Kheera*,
- Goat has one pair of adult incisive (one to two years old), i.e., *Donda*,
- Goat has two pairs of adult incisive (two to three years old), i.e., *Chougha*
- Goat has three pairs of adult incisive (three years old or more), i.e., *Chigha*

Model specification

The attributes that influenced the price of a goat include weight, age, breed, sex and marketplace. The empirical hedonic price model for goats specified as:

$$Ln\ PG_{i} = \beta_{1+} \beta_{2}\, LIVEWT_{i} + \beta_{3j} MARK_{ji} + \beta_{4k}\, DENT_{ki} + \beta_{5l}\, BREED_{li} + \beta_{6m}\, SEX_{mi} + \varepsilon_{i}$$

Where *Ln PG* represents the logarithm of ith goat price, LIVEWT live weight in kg, MARK market location, DENT (dentition type), BREED breed, SEX sex and ε the random residuals. β's are the regression parameters to be estimated. Data in Table 1 describes all variable definitions and their measurements.

RESULTS AND DISCUSSION

This section explains the results of the estimated econometric model. An appropriate functional form is considered the most important issue. The use of a wrong functional form results in biased estimates and misleads the implicit price of attributes. Linear, log-linear and double log are the functions mostly used in empirical work of the hedonic price model. Since in the present study there were many binary variables, therefore, only linear or log-linear functional forms may be used. We estimated these functional forms, but Ramsey's Regression Equation Specification Error Test (RESET) indicated that the computed F value of the simple linear model was greater than the critical value, therefore, considered it an inappropriate specification. However, the RESET value was less than the critical value for the log-linear model, so we concluded that the model has the correct specification. Variance inflation factor (VIF) was used to test the presence of multicollinearity in the estimated model. The mean VIF value was 2.4, which was less than 10, i.e., the rule of thumb threshold (Gujarati and Sangeetha, 2007), and concluded that there is no multicollinearity problem. On the other hand, the computed value of the Chi-square of the Breusch-Pagan/Cook-Weisberg test was highly significant and indicated heteroscedasticity. To resolve the problem of heteroscedasticity in estimated models, White (1980) developed the heteroscedastic-consistent covariance matrix estimator (HC_0). Similarly, Mackinnon and White (1985) suggested other alternative estimators using heteroscedastic consistent standard errors, i.e., HC_1, HC_2, and HC_3. These alternatives perform differently depending on sample size and heteroscedasticity. As HC_1 has a similar finite sample bias as HC_0 (Cai and

Table 1. Descriptive statistics and definition of variables

Variable	Description of variable	Mean	Stand. Dev.
PG	Price per head of goat (rupee)	17652.33	12055.03
LIVEWT	Live weight (Kg)	40.28	16.68
MARK	**Marketplace**		
Faisalabad	Faisalabad =1 if the m**arketplace is** Faisalabad, 0 otherwise	0.33	0.47
Lahore	Lahore =1 if the **marketplace** is Lahore, 0 otherwise	0.33	0.47
Dera Ghazi Khan	Dera Ghazi Khan =1 if the **marketplace** is Dera Ghazi Khan, 0 otherwise	0.33	0.47
DENT	**Dentition type**		
DENT1	1 if the traded goat has milk teeth, i.e., *Kheera*, 0 otherwise	0.24	0.43
DENT2	1 if the traded goat has one pair of adult incisive, i.e., *Donda*, 0 otherwise	0.62	0.49
DENT3	1 if the traded goat has two pairs of adult incisive, i.e., *Chougha*, 0 otherwise	0.06	0.23
DENT4	1 if the traded goat has three pairs of adult incisive, i.e., *Chigha*, 0 otherwise	0.08	0.28
BREED	**Breed type**		
BREED1	1 if the breed of goat is Beetal, 0 otherwise	0.24	0.43
BREED2	1 if the breed of goat is Teddy, 0 otherwise	0.17	0.37
BREED3	1 if the breed of goat is Crossbred, 0 otherwise	0.28	0.45
BREED4	1 if the breed of goat is other thanTeddy, Beetal, and Crossbred, 0 otherwise	0.31	0.46
SEX	**Sex of goat**		
SEX1	1 if the traded goat is male, 0 otherwise	0.73	0.44
SEX2	1 if the traded goat is female, 0 otherwise	0.27	0.44

Hayes, 2008), therefore, HC_2 is superior to test the coefficients than HC_1, while Long and Ervin (2000) suggested that HC_3 performs best when the coefficients are most affected by heteroscedasticity (Long and Ervin, 2000). Hence, the present study used HC_3 to test the coefficients of the model.

The R^2 value shows that 89 percent variation in the price of a goat was due to independent variables. The model results showed that goat price was determined by goat traits (such as live weight, age, breed, sex) and marketplace.

The results of four estimations (OLS, HC_0, HC_2 and HC_3) showed a significant effect of goat traits on goat price (Table 2). Weight had a positive effect on the price of goats in the selected markets. The coefficient showed that if the live weight of a goat increased by one kg, it increased goat price by 2.8 percent, i.e., Rs. 494.26. The findings of this study are like those reported by Dossa *et al.* (2008); Afzal *et al.* (2011); Naanep *et al.* (2012); Doelamo and Assefa (2017).

The dentition was used to estimate the age of a goat. Prices received for goats for "Chigha" category were used as the base category for comparing with other age groups. Prices for "Donda" and "Chougha" were significantly higher than "Chigha". Goats in these categories received a premium of 49.67 percent and 35.66 percent, respectively, relative to "Chigha", indicating buyers' preferences for animals in these categories. However, the coefficient of "Kheera" goat was positive. These results showed that the price per goat increased with age and decreased for older or over matured goats. Results of previous studies showed a mixed pattern of the effect of age on animal prices. For example, Jabbar (1998) indicated the positive effect of age on the price of goat. However, the effect of age square was negative and significant in all-purpose, trading, sacrifice, and festival models. Ayele *et al.* (2006) reported that age positively impacted the price per goat and decreased for older or over matured animals for both goat and sheep. Teklewold *et al.* (2009) concluded that mature goats prices were relatively higher to young and immature goats. Prices associated with the live weight of the goat was the major criterion considered by export abattoirs. Tarekegn (2021) result also shows that sheep premium price increased as the age of sheep increases by one month.

The present study showed that goat price was significantly lower for the Teddy breed relative to other breeds. The Teddy goat breed exhibits a price discount of 15.68 percent than other breeds. However, the results showed that the coefficients of Beetal and Crossbred breeds were negative but insignificant. One possible explanation is that buyers prefer live weight rather than goat breed. Further, Teddy goat meat is considered inferior to the meat of other breeds because of a relatively higher percentage of fat content. Naanep *et al.* (2012); Jabo and Adamu (2018) reported that various breeds have significant price differences, while Jabbar (1998); Ayele *et al.* (2006) and Srinivas *et al.* (2013) reported the non-significant effect of goat breed on price. The results of the study indicated that the buyers had a strong preference for male goats compared to female goats. The reason for this behavior could be that sex influenced meat properties and carcass composition of goats. Another plausible explanation is that on the religious festival, buyers give preference to the male goats. Rodriguez *et al.* (1995) found that male goats received significant

Table 2. Results of ordinary least square (OLS) and heteroscedastic consistent hedonic model

LnPG	Coefficient	P value	HC_3 SE	OLS SE	HC_0 SE	HC_2 SE	Relative impact[a]	
							percent	Rs.
Constant	7.820[c]	0.000	0.106	0.084	0.102	0.103	--	--
LIVEWT	0.028[c]	0.000	0.002	0.001	0.002	0.002	208	494.26
Faisalabad	0.123[c]	0.001	0.038	0.036	0.037	0.037	13.04	2301.99
Lahore	0.129[c]	0.001	0.038	0.037	0.037	0.037	13.66	2411.83
DENT1	0.127	0.203	0.099	0.074	0.095	0.096	12.97	2288.95
DENT2	0.407[c]	0.000	0.082	0.062	0.078	0.079	49.67	8768.34
DENT3	0.308[c]	0.000	0.077	0.078	0.074	0.075	35.66	6295.13
BREED1	-0.003	0.936	0.041	0.039	0.040	0.040	-0.41	-72.29
BREED2	-0.169[c]	0.002	0.054	0.050	0.053	0.053	-15.68	-2768.22
BREED3	-0.011	0.770	0.039	0.039	0.038	0.038	-1.21	-213.73
SEX1	0.342[c]	0.000	0.065	0.041	0.062	0.063	40.47	7143.43
R^2 = 88% Mean VIF= 2.40 $F_{(10, 289)}$ = 197.70 P value = 0.0000		RESET $F_{(2, 287)}$ = 2.35[b] P value = 0.0977 Breusch-Pagan / Cook-Weisberg: $X^2_{(1)}$ = 8.31[c] P value = 0.0039						

[a] The relative impact (percent, Rs) estimates the individual attribute percentage/price impact evaluated at the sample mean on the goat price (Kennedy, 1981).
[b] and [c] show significant at 10 percent and 1 percent level of significance based on HC_3 SE., SE = Standard Error; OLS = Ordinary Least Square,
HC_0 = Heteroscedasticity consistent -0, HC_2 = Heteroscedasticity consistent -2; HC_3 = Heteroscedasticity consistent -3.,

Table 3. Comparing and testing mean prices of attributes in different markets (in rupees)

Attributes	Faisalabad market	Lahore market	Dera Ghazi Khan market	F value from ANOVA Table[a]
LIVEWT	18098	23265	11594	19.58[b]
DENT1	6290.48	6946.15	8756.41	6.69[c]
DENT2	24203.33	27850.72	13373.21	35.79[c]
DENT3	21050.06	26250.00	19903.34	0.66
DENT4	9420.0	10450.0	-----	0.49
BREED1	22569.44	28233.33	18800.00	2.45
BREED2	5765.0	5527.27	8889.47	11.41[c]
BREED3	15310.34	14717.65	11129.73	3.57[b]
BREED4	29200.0	27788.89	11491.18	35.39[c]
SEX1	23386.36	27088.61	11995.95	40.81[b]
SEX2	7832.35	8880.95	10450.0	3.85[c]

[a] Note instead of reporting many ANOVA tables, only F value is reported, [b] and [c] means are different at 1 and 5 percent significance levels, respectively

premium prices relative to female goats. Jabo and Adamu (2018) and Tarekegn (2021) also confirmed that buyers generally pay a significantly higher price for male sheep than female sheep. Jabbar (1998) reported that the price for male goats was higher than females, but the difference was insignificant. However, Doelamo and Assefa (2017) reported insignificant price differences between the male and female goats.

The determinant of goat price other than traits of a goat was the market location. The market place had a significant effect on goat price. Among market location dummies, goats in the Faisalabad and Lahore markets earned significantly higher prices than Dera Ghazi Khan. Goat obtained a premium of 13.04 percent (i.e., Rs. 2301.99) and 13.66 percent (i.e., Rs. 2411.83) in Faisalabad and Lahore markets, respectively than Dera Ghazi Khan market. Possible explanation is that the people of Faisalabad and Lahore have higher purchasing power due to high income levels than Dera Ghazi Khan. These results imply that goat producers could increase their profitability by selecting the appropriate market. Jabbar (1998); Knights *et al.* (2005); Srinivas *et al.* (2013) and Tarekegn (2021) also reported a significant difference in prices across markets.

An important question relating to goat marketing was how the prices of various attributes vary by market location. To answer it, Tukey-Kramer Post Hoc Test, a multiple comparison procedure was used to find out whether the mean prices of various attributes differ significantly in the selected market (Rafter *et al.,* 2002). As there were three markets, in the first stage, ANOVA was used to test the hypothesis that mean prices were the same for each attribute in different markets. Results obtained using ANOVA are reported in Table 3, along with the mean prices of various attributes in the three markets. Mean prices were different for all attributes except for DENT3, DENT4 and BREED1.

CONCLUSION

Various characteristics such as live weight, age, breed type, and sex significantly influenced the prices paid for animals. Market place also played a significant role in influencing goat prices. Results showed that

an increase in live weight had a significant positive influence on price. Thus to improve the live weight of animals, goat producers should apply appropriate production technologies and select proper breeding bucks. The price per goat showed an increasing trend with dentition and showed decreasing trend for over matured goats as indicated by significant positive coefficients for "Donda" and "Chougha" only. These findings imply that producers should sell their "Donda" and "Chougha" goat animals to get premium prices, and accordingly, they should design market strategies. The market place is an important determinant of goat prices and a significant difference in goat prices across markets is present. Provision of information about goat prices across markets by attributes can improve the competitiveness and profitability of goat producers.

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