The Farm-Retail Iran's Beef Marketing Margin Model

Hosseini. S. S
Associate Professor of Agricultural Economics Department
Agriculture and Natural Resource Campus
University of Tehran, Karaj, Iran
hosseini_safdar@yahoo.com
Ghorbani. M
Associate Professor of Agricultural Economics Department
Agricultural College
Ferdowsi University of Mashhad, Mashhad, Iran.
ghorbani@ferdowsi.um.ac.ir

Shahbazi. H
Graduated of Agricultural Economics
Agriculture and Natural Resource Campus
University of Tehran, Karaj, Iran
Habib_Susa@yahoo.com

Abstract
Agricultural production marketing has a long history in agricultural economics and marketing literature. Planners, politicians, and agricultural economists have investigated and analyzed market structure, marketing margin, and efficiency in all levels of food markets to improve the function of agriculture and food markets and to increase the farmers' share in consumer food expenditure. Food marketing literature propounds two main necessities: the important role of protein in nourishment and the economic efficiency of marketing levels to investigate market efficiency and marketing margin and to evaluate the livestock production marketing process, especially for beef. In this study, we selected beef product. We estimated marketing margin elasticity (price ratio, farmer's share, and percentage margin) with respect to determinants of meat demand, live animal supply, and marketing services supply. Results show that, for example, ten per cent increase in the price of lamb (as a good substitution for beef) will increase the beef price ratio (marketing margin) by 0.35 per cent, and ten per cent increase in the farm feed price will increase the beef price ratio (marketing margin) by 0.37 per cent. This applies to other determinants and indexes of marketing margin

Keyword: Marketing Margin, Beef, Determinant Factors, Price Ratio, Farmer's Share, Percentage Margin.

Introduction

The study and research of agricultural production marketing have a long history in agricultural economy and marketing literature. Planners, politicians, and agricultural economists have investigated and analyzed market structure, marketing margin, and efficiency in all levels of food markets to improve the function of agriculture and food markets and to increase the farmers' share in consumer food expenditure. Researchers have attended to the existence of quantity and price fluctuations in agricultural productions and marketing margin enlargement with respect to economic, social, and political problems.

The livestock industry occupies a special situation in Iran's national economy because of its important role in agriculture added value, economic growth, and supplying the consumer demand for protein. The necessity of meat for household consumption, the reduction of real income, and

increasing meat prices imply that attending to the development of the meat industry is necessary (Nourollahzaheh, 1999). Investigating the marketing margin and conditions of market efficiency on food production such as Beef is necessary because of population growth, the demand for increased food production, the great difference between producer and consumer price (farm and retail price), and dissatisfaction.

Agricultural production marketing is of extreme necessity because of the extension of urbanity in the last decade, crossing from traditional agriculture to the modern era, and also the increasing market share of supplied agricultural production in the country's total production (Najafi and et al, 2005). Food marketing literature propounds the important role of protein for nourishment and of economic efficiency of marketing levels to investigate market efficiency and marketing margin and to evaluate the livestock production marketing process, specifically for beef.

Based on the international standard, fitted consumption of red meat per head in a year is 35.486 kg, while fitted consumption of red meat per head in developed countries is 26.7 kg and in developing countries is 6.4 kg (FAO, 2005). In Iran in 2004, the quantity of red meat consumption was 367.1 thousand tons, with 332.8 thousand tons of it produced in Iran. During 1990-2004, research on the red meat production and consumption trend implied growth equivalent to 3.2 and 1.2, respectively. Despite increasing red meat consumption per head in Iran, the quantity of this product's consumption differs greatly to its international standard (35.5 kg).

Research on beef marketing conditions in Iran revealed that this commodity has a different situation relative to competition goods (i.e. lamb). Monthly price analysis of beef during 1998-2005 indicated that the mean producer price (live animals on farm) of the surveyed beef is 20,396 Rials (local currency) per kilogram while the mean retail price (butchers) of beef, was 25,675 Rials per kilogram. Therefore, the marketing margin of beef, on average, is 5281.4 from farm to retail. This indicates that 20 per cent of final consumer payments are marketing margin share, which means that 20 per cent of the beef price paid by the final consumer -retail- are marketing costs -market margin-(LAPO, 2007).[1] Based on the great gap between prices, marketing margin, producer and consumer dissatisfaction of cost and retail prices, and asymmetric transmission of prices (Hosseini and Ghahremanzadeh, 2006), investigating the red meat marketing margin and recognizing the affective factors that arise from the farm, processing, and retail stages are necessary.

Any of the disparate research that has been done on agricultural production, and specifically on red meat in Iran, didn't analyze these affective factors on marketing margin Ghoreishi, at al (1999), Nourollahzadeh (1998), Azizi, et al. (2001), Ghoreishi, et al. (2005) investigated the supply and demand functions of red meat in Iran. In this research, they attended to the effective factors on the supply and demand of red meat at the retail level. None analyzed market conditions (conditions of market structure efficiency) and red meat marketing, especially the marketing margin.

Much research has been conducted on the marketing margin of different productions in Iran. we can refer to Kalantary, et al. (2005), Hosseini, et al. (2007).Sedaghat (2000); Mousanezhad, et al. (1996); Hosseini and Nikoukar. (2006); Hosseini, et al (2006); and Hosseini and Hassanpoor, et al. (2007). Although past research has not analyzed the affective factors

[1] For calculation of beef marketing margin, we deduce retail price of beef from farm price of live animal. For transformation of farm prices of live animal to farm prices of beef, we use 0.522 as transforming multiplier. These multipliers are educed form Khaldari (2005) study.

on marketing margin derived from different marketing levels in Iran, much research about this topic has been done elsewhere.

In U.S, Gardner (1975) researched the price margin of farm to retail in the food industry in relation to competitive market theories. He used applied research models to make quantity predictions about selecting different effective determinants of production demand function, input supply function, and processing on the marketing margin (price ratio and farmer share).

Holloway (1991) adjusted Gardner's model in monopoly competition market conditions. In Holloway's model, each firm assumed that production function has two inputs: farm and marketing. The number of firms can change from one (monopoly) to numerous (competition). In monopoly, one firm charges for all of the industry production. Holloway also assumed that the supply of marketing input is perfectly elastic and the supply of farm input is perfectly inelastic, so the marketing margin function is under effectiveness of production demand function determinants. Wohlgenant (1987, 1989) proposed another model that can be used for competition analysis in the food marketing sector. In his model, firms have different production functions, which is opposite to Gardner and Holloway's model.

Piggott, et al. (2000) conducted research on management variation in the food chain and treatment of marketing margin by selecting different scenarios (structure markets) of various marketing levels (farm and retail), and estimated the value of market power in these considered levels. In this research analyzing the agricultural production market margin, the elasticity of marketing margin in these different scenarios was estimated based on price ratio, farmer share, percentage margin, and price transmission elasticity relative to determinants of farm and non-farm (marketing services) input supply and retail production demand. Their research results are similar to Gardner's in that assumed agricultural markets are competitive as Australian agricultural production firms are competitive at different marketing levels.

In our research, we fallowed very closely the Piggott's theoretical model as well as theoretical and empirical research of the last decade because the livestock marketing margin model and the beef market empirical model corresponds to Iran's conditions. The main target of our present research to analyze the marketing margin of beef based on an appropriate farm to retail model. In addition to estimating the marketing margin of beef, we evaluated and analyzed effective factors on the marketing margin that derived from the livestock farm, processing, and retail stages. Therefore, this research analyzed the effective factors on the farm-retail marketing margin of beef.

Materials and Methods

Marketing costs are an important factor in determining marketing margin (the price received by the producer at the farm level and the price paid by the consumer at the retail level). Agriculture researchers and economists use the term "marketing margin" to summarize the aggregated costs of moving agricultural goods forward along the successive levels of the farm to retail marketing margin chain. For animal products, a farm to retail marketing margin is the price difference between what the farmer receives for the live animal and what the consumer pays for a finished beef product. Marketing margin thus includes the cost of converting a live animal to a retail product — costs of assembly, cutting, processing, packing, transport, and distribution — captured in a farm to retail margin.

Observing marketing margin over time provides insight into the distribution of consumer food dollars among the producer, processor, and retailer. Further, marketing margin indicates how the retail price responds to changes in farm price and consumer demand.

Over the past four decades in the world, Gardner's (1975) model has been used to indicate the price changing effect of several marketing margins. In the last few years, Piggott, et al. (2000) presented a model that appropriates market structure on marketing margin.

In this study, we fallowed closely the Piggott model to assess the beef marketing margin and determine its market power in Iran.

Mathematical model of marketing margin

Theoretical work on processor margins for agriculture commodities has centered on the work of Gardner (1975) and Hein (1980). In the last few years, Piggott et al. (2000) assessed the agriculture commodity marketing margin in several market structures as market power and reviewed Gardner's model. In this study, we used Piggott's approach for Iranian meat.

The Iranian beef production system has two stages (levels). In the second chain, beef production is a function of live animal production. Other input in beef production includes marketing services. In Iran, marketing services in beef production are done in slaughterhouses. Thereby, the marketing services input is equal to the processing input.

Live animal production and marketing services are produced in the first chain. These production factors have their own special markets. Also, these inputs are produced using other inputs. Live animals are produced in farm and are a function of feed, water, labour, capital, etc. This intermediate input (the live animal) is traded in the live animal market. Marketing services are a function of water, electricity, capital and labour in the slaughterhouse, transportation, packing, etc. For these services, we have the marketing services market and the retail meat market.

To assess the beef marketing margin, first, beef production, beef demand, live animal supply, and marketing services supply functions were estimated. Then, using these functions and their relation to marketing margin, the marketing margin model is presented.

Beef production function

According to the two stages of the beef production system, beef production is a function of live animal and marketing services. Following live animal production at the farm, this good is supplied to the processing level (slaughterhouse). Here, marketing services transform the live animal to beef. Therefore, the produced beef supplied at the retail level is a summation of live animal and marketing services. Substitution capability between live animal and marketing services in beef production is limited. For reasons of wastage, non-skilled labour etc., substitution between live animal and marketing services is possible. Hosseini et al. (2007) evaluated this for beef, lamb, and chicken. Accordingly, the beef production function is a variable proportion model, in that proportion inputs in production are variable, so there is substitution possibility in input.

For this study, we tested several functional forms like Leontief. This functional form has a constant return to scale assumption (Gardner 1975). We described the production function of meat as follows:

$$X = f(a,b) \qquad (1)$$

where *X*, *a*, and *b* are quantities of beef, live animals, and marketing services, respectively. The quantity of live animals is their weight in the slaughterhouse. The quantity of marketing services is a summation of actions that are done in the slaughterhouse. In marketing literature, the marketing services quantity is the weight summation of labour, water, electricity, and rent inputs that are used in the slaughterhouse.

In this study, according to a 70 per cent share of labour costs in the marketing cost of beef, we used labour wage in the slaughterhouse as the marketing services price and the summation of slaughtering and security indices as marketing services quantities. From the estimated production function (equation (1)), first, we calculated elasticity substitution between live animal and marketing services (σ). Secondly, the live animal marginal product (f_a) and marketing services marginal product (f_b) were used to determine the live animal and marketing services derived demand.

Beef demand function

According to the preceding mathematical approach, retail beef productions is a function of marketing services and live animal production, in that every input has its own special market, and every good (beef, live animal, and marketing services) has autonomous and separate demand and supply. Here, we assessed retail meat demand and described primary beef demand as follows:

$$X = D(P_x, N) \tag{2}$$

where X and P_x are quantities of beef demanded and the retail price, respectively. *N* is a determinant of meat demand that can shift the demand curve up or inward. One of this study's goals was to assess these determinant effects on the beef marketing margin. From estimated demand, we calculated price elasticity (*N*) and determinant elasticity (e_N) to determine their effects on marketing margin.

Live animal supply function (Cattle)

To assess the live animal market, we estimated primary supply. The first primary supply is the live animal supply, which was estimated as autonomous. We explained this function as follows:

$$P_a = h(a, w) \tag{3}$$

In Equation (3), P_a and a are price and supplied quantity of live animals at the farm. *W* is a determinant of the live animal supply that can shift the supply curve up or inward. From an estimated live animal supply, we calculated price elasticity (e_a) and determinant elasticity (e_w) to determine their effects on marketing margin.

Marketing services supply function

To assess the marketing services market, we estimated primary supply. Second primary supply is the marketing services supply, estimated as autonomous. We explained this function as follows:

$$P_b = g(b, T) \tag{4}$$

In Equation (4), P_b and b are price and supplied quantity of marketing services at the processing level. *T* is a determinant of the live animal supply that can shift the supply curve up or inward. From an estimated marketing services supply, we calculated price elasticity (e_b) and

determinant elasticity (e_T) to determine their effects on the marketing margin.

Marketing margin

We assessed and evaluated the relationship between the marketing margin and the determinants of live animal supply, marketing services supply, and beef demand. Using an estimation of equation (1), (2), (3), and (4), we calculated the price elasticity of meat demand (η), live animal supply (e_a), marketing services supply (e_b); the substitution elasticity between live animals and marketing services (σ); the determinant elasticity of beef demand (e_N), live animal supply (e_w), and marketing services supply (e_T); and finally, the live animals and marketing services marginal product (f_a, f_b).

Changing the marketing margin

In this section, we assessed the relationship between marketing margin and determinants of live animal supply, marketing services supply, and beef demand. We assumed a variable proportion and a constant return to scale conditions. In the previous section, we estimated live animal and marketing supply. To complete the live animal and marketing services market factor, we determined the live animal and marketing services derived demand. With a variable proportion assumption, the derived demand of live animal and marketing services supply maximizes beef production profits. Therefore, live animal derived demand in a non-competitive market derives from equality of the marginal factor cost (MFC_a) and the marginal revenue (MRP_a) of live animals in beef production. We explained this as follows:

$$MFC_a = MRP_a \quad (5)$$

where MFC_a and MRP_a are the marginal factor cost and the marginal revenue of the live animal supply in beef production, respectively. Similarly, we described derived demand marketing services as follows:

$$MFC_b = MRP_b \quad (6)$$

where MFC_b and MRP_b are the marginal factor cost and the marginal revenue of marketing services in meat production, respectively. According to economic theory, marginal revenue of i_{th} input is equal to multiplying marginal revenue and marginal product (of i_{th} input). We described this condition as follows:

$$MFC_a = MR.f_a \quad (7)$$
$$MFC_b = MR.f_b \quad (8)$$

where MFC_a and MFC_b are the marginal factor costs of live animal supply and marketing services in beef production, respectively. f_a and f_b are the marginal products of live animal and marketing services. According to economic theory, the marginal revenue of j_{th} product and the marginal factor cost of i_{th} input are calculated as follows:

$$MR = P_j.(1+1/\eta) \quad (9)$$
$$MFC_i = P_i.(1+1/e_i) \quad (10)$$

where P_j and P_i are the price of j_{th} product j and i_{th} input, respectively; and their own price elasticity of j_{th} product demand and i_{th} input supply, respectively. With synchronization of equations (9) and (10) for live animal, marketing services, and meat, we transferred equations (7) and (8) to (11) and (12).

$$P_a.(1+1/e_a) = P_x.(1+1/\eta).f_a \quad (11)$$

$$P_b.(1+1/e_b) = P_x.(1+1/\eta).f_b \quad (12)$$

where η, e_a, and e_b are their own price elasticity of meat demand, live animal supply, and marketing services supply, respectively. P_a, P_b, and P_x are the prices of live animal supply, marketing services, and beef, respectively. Also, f_a and f_b are the marginal products of live animal supply and marketing services in beef production. In equations (13) and (14), we moderated equations (11) and (12).

$$P_a = (1+\frac{1}{\eta}\Big/1+\frac{1}{e_a}).P_x.f_a \quad \text{or} \quad P_a = \beta_1.P_x.f_a \quad (13)$$

$$P_b = (1+\frac{1}{\eta}\Big/1+\frac{1}{e_b}).P_x.f_b \quad \text{or} \quad P_b = \beta_2.P_x.f_b \quad (14)$$

Equations (13) and (14) are derived demand of live animal and marketing services, respectively. The β_1 and β_2 parameters are indices of market power. If the live animal and meat markets are competitive, price elasticity of live animal supply (e_a) and beef demand (η) is infinite; thereby, β_1 will be equal to one. Similarly, if marketing services and the meat market are competitive, price elasticity of marketing services supply (e_b) and beef demand (η) are infinite; β_1 will be equal to one. If any beef, live animal, or marketing services markets are not competitive, β_1 and β_2 will not equal one. Thereby, β_1 and β_2 will indicate market power. We also determined market power in the beef production industry.

After estimation of equations (1), (2), (3), and (4) and determination of equations (13) and (14), we arrived at six equations with six variables (P_x, P_a, P_b, X, a, and b). Substitution equation (2) in equation (1) will be gotten equation (15) that variable X is eliminated on it. Substitution equation (3) in equation (13) will be gotten equation (16) that variable P_a is eliminated on it Substitution equation (4) in equation (14) will be gotten equation (17) that variable P_b is eliminated on. Equation (15), (16) and (17) are shown as follows:

$$D(P_x, N) = f(a,b) \quad (15)$$

$$P_x f_a = h(a,w) \quad (16)$$

$$P_x f_b = g(b,T) \quad (17)$$

In equations (15), (16) and (17), we reduced six equations to three. These three equations indicate a system of equation that shows the equilibrium in the beef (retail), live animal (farm), and marketing services (processing) markets. We assessed the effect of a shift in retail meat demand on marketing margin. With differentiations from equations (15), (16), and (17)

with respect to N and writing as matrix, we arrived at the following matrix (18):

$$\begin{bmatrix} -(\frac{S_b}{\beta_2\sigma}+\frac{1}{e_a}) & \frac{S_b}{\beta_2\sigma} & 1 \\ \frac{S_a}{\beta_1\sigma} & -(\frac{S_a}{\beta_1\sigma}+\frac{1}{e_b}) & 1 \\ \frac{S_a}{\beta_1} & \frac{S_b}{\beta_2} & -\eta \end{bmatrix} \begin{bmatrix} E_{a,N} \\ E_{b,N} \\ E_{p_x,N} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ \eta_N \end{bmatrix} \quad (18)$$

According to the definition of farm share and non-farm share (equations (19) and (20)), and substituting equation (13) on equation (19) and (20), we got the right-hand side of equation (19) and (20).

$$S_a = \frac{P_a a}{P_x x} = \frac{\beta_1 P_x f_a a}{P_x x} = \beta_1 \chi_a \quad (19)$$

$$S_b = \frac{P_b b}{P_x x} = \frac{\beta_2 P_x f_b b}{P_x x} = \beta_2 \chi_b \quad (20)$$

where S_a and S_b are farmer and non-farmer shares, respectively. P_x, P_a and P_b are the price of beef, live animal supply, and marketing services, respectively. *a*, *b*, and *X* are the quantity of live animal supply, marketing services supply, and beef demand, respectively. Finally, χ_a and χ_b[1] are the production elasticity of live animal supply and marketing services. Substituting equation (19) and (20) in matrix (20) yielded the following new matrix:

$$\begin{bmatrix} -(\frac{\chi_b}{\sigma}+\frac{1}{e_a}) & \frac{\chi_b}{\sigma} & 1 \\ \frac{\chi_a}{\sigma} & -(\frac{\chi_a}{\sigma}+\frac{1}{e_b}) & 1 \\ \chi_a & \chi_a & -\eta \end{bmatrix} \begin{bmatrix} E_{a,N} \\ E_{b,N} \\ E_{p_x,N} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ \eta_N \end{bmatrix} \quad (21)$$

To solve matrix (21), we calculated the total elasticity of live animal supply, marketing services, and total price elasticity of beef demand with respect to *N*. To assess the price elasticity of live animal supply, marketing services supply, and beef demand with respect to *N*, we substituted equations (19) and (20) in matrix (21), described as follows:

[1] Production elasticity of live animal and marketing services is calculated as follows:

$$\chi_{a,b} = \frac{f_{a,b}}{AP_{a,b}}$$

where $\chi_{a,b}$, $f_{a,b}$, and $AP_{a,b}$ are the production elasticity of live animal supply and marketing services, the marginal product of live animal supply and marketing services, and the average product of live animal supply and marketing services, respectively.

$$\begin{bmatrix} \eta & -\frac{S_a e_a}{\beta_1} & -\frac{S_b e_b}{\beta_2} \\ 1 & -(\frac{S_a}{\beta_1 \sigma}+\frac{1}{e_b}) & -(\frac{S_a e_b}{\beta_1 \sigma}+1) \\ 1 & -(\frac{-S_b e_a}{\beta_2 \sigma}+1) & -\frac{S_b e_b}{\beta_2 \sigma} \end{bmatrix} \begin{bmatrix} E p_{x,N} \\ E p_{a,N} \\ E p_{b,N} \end{bmatrix} = \begin{bmatrix} -\eta_N \\ 0 \\ 0 \end{bmatrix} \quad (22)$$

where $E p_{x,N}$, $E p_{a,N}$, and $E p_{b,N}$ are total elasticity of beef demand, live animal supply, and marketing services supply, respectively. On substituting equations (19) and (20) in matrix (21), we got the following matrix:

$$\begin{bmatrix} \eta & -\chi_a e_a & -\chi_b e_b \\ 1 & \frac{\chi_a e_a}{\sigma} & -(\frac{\chi_a e_b}{\sigma}+1) \\ 1 & -(\frac{\chi_b e_a}{\sigma}+1) & \frac{\chi_b e_b}{\sigma} \end{bmatrix} \begin{bmatrix} E p_{x,N} \\ E p_{a,N} \\ E p_{b,N} \end{bmatrix} = \begin{bmatrix} -\eta_N \\ 0 \\ 0 \end{bmatrix} \quad (23)$$

Matrix (21) and (23) provide solutions to total elasticity for three prices and quantities. From matrix (21) and (23), we can use *N*, *W*, and *T* (determinants of beef demand, live animal supply, and marketing services supply). According to Gardner, price ratio[1], farmer share[2], and percentage margin[3] elasticity are calculated as follows:

$$E_{R,N} = E p_{x,N} - E p_{a,N} \quad (24)$$

$$E_{S_x,N} = E p_{a,N} - E_{a,N} - E p_{x,N} - E_{x,N} \quad (25)$$

$$E_{\%M,N} = E_{R,N}(R/(R\text{-}1)) \quad (26)$$

In the above equations, $E_{R,N}$, $E_{S_a,N}$ and $E_{\%M,N}$ are price ratio, farmer's share, and percentage margin elasticity with respect to *N*. To solve matrix (21) and (23) with respect to *N*, *W*, and *T*, we calculated price ratio, farmer's share, and percentage margin elasticities, which are shown in table (1)

Based on our study targets, we calculated the effects of *N*, *W,* and *T* (determinants of beef demand, live animal supply, and marketing services supply, respectively) on marketing margin (price ratio (*R*), farmer's share (S_a), and percentage margin (*%M*)). Marketing margin was evaluated via the β_1 and β_2 parameters.From table (1), in general, we arrived at the impact of *N*, *W,* and *T* on marketing margin. We estimated the effect of *N*, *W,* and *T* on marketing margin for beef and evaluated the market power of these two goods:

[1] $R = P_x / P_a$

[2] $S_a = P_a a / P_x x$

[3] $\%M = ((P_x - P_a) \times 100) / P_a = ((P_x / P_a) - 1) \times 100$

Table 1: Marketing margin elasticity with respect to N, T, W*

Elasticity	Increasing 1 per cent in *T*	Increasing 1 per cent in *W*	Increasing 1 per cent in *N*
Price Ratio (*R*)	$\beta_1 e_T e_b S_b (e_a - \eta)/D$	$\beta_1 e_w e_a S_b (\eta - e_b)/D$	$\beta_1 \eta_N S_b (e_a - e_b)/D$
Farmer's Share (S_a)	$\beta_1 e_T e_b S_b (e_a - \eta)(\sigma - 1)/D$	$\beta_1 e_w e_a S_b (\eta - e_b)(\sigma - 1)/D$	$\beta_1 \eta_N S_b (e_a - e_b)(\sigma - 1)/D$
Percentage Margin (*%M*)	$E_{R,T} R/(R-1)$	$E_{R,W} R/(R-1)$	$E_{R,N} R/(R-1)$
Price Transmission	$(\eta + \sigma)/(e_a + \sigma)$	$e_b - \eta(S_b/\beta_2)) + S_a \sigma / S_a (e_a + \sigma)$	$S_a/\beta_1) e_b + (S_b/\beta_2) e_a + \sigma / e_a + \sigma$

Reference: Piggott, et al. (2000)

$* D = -\eta(\beta_1 S_b e_a + \beta_2 S_a e_b) + \beta_1 \beta_2 e_a e_b + \sigma(\beta_1 S_b e_a + \beta_2 S_a e_b)$

Data

We used monthly data for the period of 1997-2005. All prices (retail, processing, and farm) include beef, lamb, cow, sheep, chicken, slaughter lamb, slaughter beef, and feed were obtained from (Iranian Agriculture Ministry). Because Iranian Agriculture Ministry data is reported daily, we used a monthly average of prices. The Iranian Agriculture Ministry provided beef and lamb quantities, both farm and retail. Labour wages, water and electricity costs, household expenditures (income), and the marketing cost index of meat were provided by the Iranian Central Bank. Prices in retail and farm were deflated by *CPI* and *PPI*, respectively.

Results[1]

Equations 28, 29, 30, 31 were estimated by Shazam software. To determine multi-collinearity relation, hetroskedasticity, and autocorrelation, we used the variance decomposition test, Breush-Pagan test, and Durbin-Watson, respectively. We used the t test for the significance level of variable determination. Also, we use unit root test for stationery test[2]. The estimated equations are presented in fallows.

First, we estimate production function of beef. On comparing several models, specifically the Leontief and CES models, and using AIC (Akaike Index Criteria), SIC (Schwarz Index Criteria and JB (Jarque-Bera) indices, the translog production function was selected as the best model (equation (27)). We described it as follows:

$$Log(X) = Log(A) + \alpha_1 Log(a) + \beta_1 Log(b) + 0.5\alpha_2 (Log(a))^2 + 0.5\beta_2 (Log(b))^2 + \gamma_1 Log(a) Log(b) \quad (27)$$

where *X*, *a*, and *b* are beef production in retail, supplied live animals in farm, and supplied marketing services in processing, respectively. According to the constant return to scale (Gardner 1975), we transformed equation (27) to equation (28) as follows:

$$Log(X/a) = Log(A) + \beta_1 Log(b/a) + 0.5\beta_2 (Log(b/a))^2 \quad (28)$$

[1] In several research like Gardner (1975) and Piggott et al (2000), equations 28, 29, 30 and 31 were estimated simultaneously. But according to Xin Xian (2006), we can estimate these equations in single equation method. Also, we estimate equations 28, 29, 30 and 31 as single equation.

[2] Result of Unit Root test of residual of equations 28, 29, 30, 31 reveal that residuals are stationary.

Hosseini, et al (2007) demonstrated the constant return to scale in beef production. With a substitution relation between the live animal supply (farm input) and marketing services (non-farm input) in beef production (final output), the translog production function will be valid. Hosseini, et al. (2007) evaluated this assumption, and their results revealed that, in beef production, farm and non-farm inputs are valid.

Table (2) reveals the results of estimating equation (28) and shows a substitution possibility between farm and non-farm inputs in beef production. These results are confirmed by the results of Hosseini, et al. (2007). By estimating this production function, we can calculate the elasticity of substitution.

Table 2: Estimation of Equation (28)

Goods	Coefficients			R^2 / $\overline{R}^2$	DW	σ
	Constant	β_1	β_2			
Beef	11.732*** (0.0086)	-1.5629*** (0.0358)	0.0888*** (0.0012)	0.99 0.98	1.84	0.59

Source: Results of running empirical models
*** , ** ,*=Significant in 1%, 5%, and 10
Numbers in Parentheses are Standard Errors.

For the next stage, we evaluated retail meat demand, using the empirical model for meat demand as follows:

$$X = A\ P_x^{\eta} N^{\eta_N} \qquad (29)$$

where X and P_x are quantities demand and price of beef. N is a determinant that can shift the meat demand curve. *N* includes the lamb and chicken price, disposable household income, and seasonal and trend factors for beef demand.. Also, η and η_N are price and determinant elasticities of demand.

The log-log form Estimation of equation (29) for beef is presented in table (3). Multipliers showed in table (3) indicated the elasticity of variables. Results show the negative relation between price and demanded quantities for beef. We also observed a positive relation between per capita disposible income and chicken and lamb prices (as substitution goods). Seasonal impacts on beef demanded quantities revealed a decreased demand in the spring and summer. In March and April, which is Nourooz or New Year in Iran, the demand for beef is decreased because of its increased price. Next, we estimated the live animal supply at the farm level as follows:

$$a = A\ P_a^{e_a} W^{e_w} \qquad (30)$$

where a and P_a are quantities supplied and the price of the live animal, and W is a determinant that can shift the live animal supply curve. W includes labor wage, capital, feed prices, and seasonal factors for beef. Also, e_a and e_w are own price and determinant elasticity of supply. The log-log form estimation of equation (30) for beef is presented in table (4).

Results in table (4) show a positive relation between price and quantities supply for beef in farm level. We also observed a negative relation labor wage, capital, feed prices. At the farm level (beef), an important input in live animal production is feed, as it is the biggest expenditure in beef production. For this study, we used the average weight of several feeds with the percentage of nutrition expenditure weight. Note that capital price is average weight of interest rate of long run and short run deposit in Iranian governmental bank. Table (4) also shows the negative effect of spring and autumn on the cow supply (live animal). Finally, we estimated marketing services supply at the processing level as follows:

$$b = A\ P_b^{e_b} T^{e_T} \qquad (31)$$

where b and P_b are quantities supplied and price of marketing services, and T is determinants that can shift the marketing services supply curve. *T* includes the cow slaughterhouse price, capital price, water and electricity prices, and seasonal and trend factors for beef. e_b and e_T represent the own price and determinant elasticity of marketing services supply. The log-log form estimation of equation (31) for beef is presented in table (5).

Results revealed the positive relation between price and quantities marketing services supply for beef and lamb. We also observed a negative relation between water and electricity prices on the price of marketing services. The price of the beef at the slaughterhouse has a positive and insignificant impact on its marketing services price. We also observed a negative impact of capital price on supplied marketing services for beef. Seasonal factors like spring, summer and autumn for beef have a positive impact on the price of marketing services at the processing level. According to the log-log form estimation of equation (31), multipliers showed in table (5) indicated the elasticity of variables.

Based on equations (13) and (14), we evaluated the market power of beef. Under the assumption that firms are price takers in both input and output markets and are equal to one, the elasticity of retail demand and input supply are viewed as infinite. We concluded that both will range between 0 and 1 (Piggott, et al. 2000), with zero as perfect monopoly and one as perfect competitive. Quantities of β_1 and β_2, according to equations (24)-(32) and its estimations, are presented in table (6). Results show that there are market power from farm to retail and farm slaughterhouse to retail for beef processing.

Finally, according to an estimation of equations (29)-(31) for beef, we estimated the marketing margin elasticity (price ratio, farmer's share, and percentage margin) with respect to determinants of meat demand (*N*), live animal supply (*W*), and marketing services supply (*T*). A table (7) shows the marketing margin elasticity for beef, respectively.

Table 3: Estimation of Meat Demand model for beef (equation 29)

DW	R^2 / $\bar{R}^2$	Independent Variables									Goods
		Constant	Dummy Variable of March and April	Dummy Variable of Autumn	Dummy Variable of Summer	Dummy Variable of Spring	Per Capita Income	Chicken Price	Lamb Price	Beef Price	
1.78	0.56 0.52	2.13 (1.91)	-0.06** (0.02)	0.003 (0.03)	-0.05* (0.03)	-0.13*** (0.04)	0.10 (0.14)	0.27** (0.08)	0.71*** (0.35)	-1.24*** (0.33)	Beef

Source: Results of running empirical models
*** , ** ,*=Significant in 1%, 5%, and 10%
Numbers in Parentheses are Standard Errors.

Table 4: Estimation of Live Animal Supply model for beef (equation 30)

DW	R^2 / $\bar{R}^2$	Independent Variables								Goods
		Constant	Dummy Variable of Autumn	Dummy Variable of Summer	Dummy Variable of Spring	Capital Price	Feed Price	Labor wage	Live Animal price	
1.98	0.77 0.75	-2.60*** (0.61)	-0.008 (0.02)	0.007 (0.02)	-0.08* (0.02)	-0.04 (0.03)	-0.21** (0.09)	-0.11* (0.06)	0.23*** (0.06)	Beef

Source: Results of running empirical models
*** , ** ,*=Significant in 1%, 5%, and 10%
Numbers in Parentheses are Standard Errors.

Table 5: Estimation of Marketing Services Supply model for beef and lamb (equation 31)

DW	R^2 / $\bar{R}^2$	Independent Variables								Goods
		constant	Dummy Variable of Autumn	Dummy Variable of Summer	Dummy Variable of Spring	Price of Capital	Price of Water and Electricity	Price of Beef (Slaughterhouse)	Price of Marketing Services	
1.97	0.99 0.98	0.009** (0.004)	0.001 (0.001)	0.003 (0.02)	0.006*** (0.002)	-0.06 (0.12)	-0.002** (0.0007)	0.56*** (0.14)	0.11*** (0.04)	Beef

Source: Results of running empirical models
*** , ** ,*=Significant in 1%, 5%, and 10%
Numbers in Parentheses are Standard Errors.

Discussion

According to table (6), we can observe market power or, in other words, market interference in the beef market process from farm to retail and farm to slaughterhouse. Existence of more than 24760 retailer (IVO,2005) and more than 18860 farmer(ISC, 2005) reject the market power in beef market. But from 477 slaughterhouses, 441 slaughterhouses are under control of government-that is, about 92 per cent of Iranian slaughterhouses are governmental slaughterhouse–(IAM, 2005). As a result, existence of market power in beef and lamb market is reasonable.

In this study, we evaluated the determinant effect of meat demand, live animal supply, and marketing services supply on marketing margin (price ratio, farmer share, and percentage margin). According to table (7), determinants of retail beef demand are disposable per capita income, the price of lamb and chicken and seasonal factors. Determinants of cow supply at the farm level are labor wage, capital and feed price, and seasonal factors. Determinants of marketing services supply for beef at the processing level are the price of the cow in slaughterhouse; prices of capital, water and electricity; and seasonal factors. Table (7) shows that, for example, ten per cent increase in the lamb price (as a good substitution for beef) will increase the beef price ratio (marketing margin) by 0.35 per cent, while ten per cent decrease in the feed price on the farm will increase the beef price ratio (marketing margin) by 0.35 per cent. This applies to other determinants and indexes of marketing margin.

In general, the result of table (7) shows the exogenous effect of several marketing levels' supply and demand on marketing margin. Determinants or exogenous factors indicate that other markets such as capital, feed, and water can affect the beef market. Thereby, with moderation and maintaining the related beef and lamb markets, we can control and moderate the price of beef.

Table 6: Lamb and Beef Market Power Determination (equations 14 and 15)

Slaughterhouse to retail	Farm to retail	Goods
$\beta_2 \neq 1$	$\beta_1 \neq 1$	
0.17	0.33	Beef

Source: Results of running empirical models

Table 7: Beef Marketing Margin Elasticity

1% change in									Marketing Margin Elasticity
(T)			(W)			(N)			
T_3	T_2	T_1	W_3	W_2	W_1	N_3	N_2	N_1	
Price of Beef (Slaughterhouse)	Price of Capital	Price of Water and Electricity	Price of Capital	Labor wage	Feed Price	Per Capita Income	Lamb Price	Chicken Price	
0.099	-0.012	-0.0004	0.013	0.451	0.037	0.013	0.092	0.035	(R)Price Ratio
-0.041	0.005	0.0002	0.006-	-0.030	-0.015	-0.005	-0.038	-0.014	(S_a) Farmer Share
0.483	0.059	-0.002	0.065	2.19	0.179	0.062	0.446	0.169	($M\%$)Percentage Margin
-0.79			0.90			0.84			Price Transmission

Source: Results of running empirical models

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