The Farm-Retail Price Transmission Elasticity of Iran's Beef Sector

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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 Transmission Elasticity) with respect to determinants of Beef demand, live animal supply, and marketing services supply. Results show that, ten per cent increase in determinants of Beef demand (such as the price of lamb), live animal supply (such as feed price), and marketing services supply will increase the beef price Transmission by 8.4, 0.90 and -0.79.

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 Kazemnejad, 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 and Borimnejad (2005), Nourollahzadeh (1999), Azizi and Torkamani. (2001), 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

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[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.

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 Mousanezhad and Mojaverian (1996), Sedaghat (2000), and Shajari (2002), Hosseini and Khaledi (2004), Hosseini, et al (2004 a,b),Kalantary, et al (2005), Hosseini and Dourandish (2006), Hosseini and Ghahremanzadeh (2006), , Hosseini, et al (2008 a,b), Hosseini and Shahbazi (2009b)and Hosseini, et al (2009).Although past research has not analyzed the affective factors 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. Much research has been conducted on the marketing margin of different productions in Iran. We can refer to Wohlgenant and Haidaicher (1989), Wohlgenant (1999), O'Donnell (1999) and O'Donnell, et al (2004).

In our research, we fallowed very closely the *Piggott, et al* (2000)'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 (Price Transmission Elasticity) 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 (Price Transmission of beef) that derived from the farm, processing, and retail stages. Therefore, this research analyzed the effective factors on the farm-retail marketing margin (Price Transmission Elasticity) 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, et al. (2000) 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), Hall, et al (1979, Heien (1980) and Heiner (1982). 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 are 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, labor, 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 labor 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, we fallowed totally the Piggott, et al. (2000). That is, first, beef production, beef demand, live animal supply, and marketing services supply functions were evaluated. Then, using these functions and their relation to marketing margin (price transmission elasticity), 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 labor etc., substitution between live animal and marketing services is possible. Hosseini et al. (2008 a) 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.

We described the production function of beef as follows:

$$X = f(a,b) \tag{1}$$

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 labor, water, electricity, and rent inputs that are used in the slaughterhouse.

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 separate demand and supply. Here, we assessed retail beef 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. The main target of this study is to assess these determinant effects on the beef marketing margin (price transmission).

Live animal supply function (Cattle)

To assess the live animal market, we should evaluated primary supply. The first primary supply is the live animal supply. We explained this function as follows:

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

In Equation (3), P_a and a are price and quantity supplied of live animals at the farm. W is a determinant of the live animal supply that can shift the supply curve up or inward.

Marketing services supply function

To assess the marketing services market, we should evaluated primary supply. Second primary supply is the marketing services supply that is as fallows:

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

In Equation (4), P_b and b are price and quantity supplied 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.

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 Equations (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).

Changing the marketing margin

According to Piggott, et al (2000), relationship between marketing margin and determinants of live animal supply (*W*), marketing services supply (*T*), and beef demand (*N*) is as fallows in **Table 1**.

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

Elasticity	Increasing 1% in *T*	Increasing 1% in *W*	Increasing 1% in *N*
Price Transmission ($E(\varphi)$)	$(\eta + \sigma)/(e_a + \sigma)$	$\beta_1(e_b - \eta(S_b/\beta_2)) + S_a\sigma/S_a(e_a + \sigma)$	$(S_a/\beta_1)e_b + (S_b/\beta_2)e_a + \sigma/e_a + \sigma$

Reference: Piggott, et al. (2000)

In **Table 1**, elasticities of marketing margin are showed as price ratio ($R = P_x/P_a$), farmer share ($S_a = P_a a/P_X X$) and percentage margin ($\%M = ((P_x - p_a) \times 100/P_a = ((P_x/P_a) - 1) \times 100$) and price transmission elasticity ($E(\varphi) = E_{Pa}/E_{PX}$). Where 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 supplied, marketing services supplied, and beef demanded, respectively. Also, E_{Pa} and E_{PX} are percentage changes in price of live animal supplied in farm and beef demanded in retail.

In Table 1, the β_1 and β_2 parameters are indices of market power. If the live animal and beef 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 as fallows:

$$P_a = (1 + \frac{1}{\eta} \Big/ 1 + \frac{1}{e_a}).P_x.f_a \quad \text{or} \quad P_a = \beta_1.P_x.f_a \tag{5}$$

$$P_b = (1 + \frac{1}{\eta} \Big/ 1 + \frac{1}{e_b}).P_x.f_b \quad \text{or} \quad P_b = \beta_2.P_x.f_b \tag{6}$$

Data

We used monthly data for the period of 1998-2005. All prices (retail, processing, and farm) include beef, lamb, cow, sheep, chicken, slaughter lamb, slaughter beef, and feed were obtained from (IAM, 2007). 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. Labor wages, water and electricity costs, household expenditures (Disposable household 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 and Discussion

Equations 1, 2, 3, 4 were estimated in *Hosseini and Shahbazi* (2009b) study. According to their study production function of beef with considering to constant return to scale and Variable proportion assumptions[1] are as follows:

$$Log(X/a) = Log(A) + \theta_1 Log(b/a) + 0.5\theta_2(Log(b/a))^2 \tag{7}$$

Where *X*, *a*, and *b* are the beef production at the retail level, quantity supplied of live animals at the farm level, and supplied quantity of marketing services at the processing level, respectively. (See **Table 2**)

Table 2. Beef Production Function

σ	Coefficients		
	θ_2	θ_1	Constant
0.59	0.0888*** (0.0012)	-1.5629*** (0.0358)	11.732*** (0.0086)

Source: Hosseini and Shahbazi (2009a,b)
* , ** ,*=Significant in 1%, 5%, and 10
Numbers in Parentheses are Standard Errors.

For the next stage, we evaluated retail beef demand, using Hosseini and Shahbazi (2009b) study as follows:

$$X = A \ P_x{}^{\eta} N^{\eta_N} \tag{8}$$

Where *X* and P_X are quantity demanded and price of beef in tail level. *N* includes the lamb and chicken price, disposable household income, and seasonal and trend factors for beef demand. (See **Table 3**)
Then, we evaluated the live animal supply at the farm level using Hosseini and Shahbazi (2009b) study as follows:

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[1] Hosseini, et al (2008a) demonstrated the constant return to scale and Variable proportion assumption s are valid to beef production in Iran. Other studies are demonstrated it in other counties such as Wohlgenant (1989a) in US.

$$a = A \ P_a{}^{e_a} W^{e_w} \tag{9}$$

Where *a* and P_a are quantity supplied and the price of the live animal in farm level. *W* includes labor wage, capital, feed prices, and seasonal factors for beef. (See **Table 4**)

Finally, we evaluated marketing services supply at the processing level using Hosseini and Shahbazi (2009b) as follows:

$$b = A \ P_b{}^{e_b} T^{e_T} \tag{10}$$

Where *b* and P_b are quantity supplied and price of marketing services in processing level. *T* includes the cow slaughterhouse price, capital price, water and electricity prices, and seasonal and trend factors for beef. (See **Table 5**)

according to an estimation of Equations 7-10 for beef, we estimated the marketing margin elasticity (Price transmission Elasticity) with respect to determinants of beef demand (*N*), live animal supply (*W*), and marketing services supply (*T*). A **Table 6** shows the marketing margin elasticity for beef, respectively.

In this study, we evaluated the determinant effect of beef demand, live animal supply, and marketing services supply on marketing margin (Price transmission). According to **Table 6**, determinants of retail beef demand that are disposable per capita income, the price of lamb and chicken, have same effect on price transmission. Determinants of live animal supply at the farm level that are labor wage, capital and feed price have same effect on price transmission. Determinants of marketing services supply for beef at the processing level that are the price of the cow in slaughterhouse, prices of capital, water and electricity, have same effect on price transmission. **Table 6** shows that, ten per cent increase in determinant of beef demand in retail (such as lamb price) will increase the beef price transmission (marketing margin) by 8.4 per cent, while ten per cent decrease in determinant of live animal supply in farm (such as feed price on the farm) will increase the beef price transmission (marketing margin) by 9.0 per cent.. Also, ten per cent decrease in determinant of marketing services supply in processing level (such as Price of Water and Electricity) will decrease the beef price transmission (marketing margin) by 7.9 per cent.

In general, the result of **Table 6** 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.

When elasticity of price transmission is more than one, then one percent change in price of live animal in farm level can increase price of beef price in retail more than one percent. This matter is called asymmetry of price transmission. Asymmetry of price transmission is of factors that can affect on marketing margin. In case of our study, because of inverse definition of price elasticity, that is $E(\varphi) = E_{Pa}/E_{PX}$, When elasticity of price transmission is less than one, then one percent change in price of live animal in farm level can increase price of beef price in retail more than one percent. Thereby

increasing in determinant of beef demand in retail, price transmissions elasticity will be more than one. This means by increasing in determinant of beef demand in retail, price transmissions will increase but more than one. Finally, marketing margin will increase. This can viewed in determinant of live animal supply in farm. But determinant of marketing services in processing level have negative effect on Price Transmission. That is, by increasing in determinant of marketing services, price transmission will be decrease.

In this study and some other studies such this, we usually eliminate the effect of government policies in related sector or market. It would be useful to test or consider to the government policies on marketing margin (price transmission) in further study.

Table 3. Beef Demand model (Equation 8)

Independent Variables								
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
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)

Source: Hosseini and Shahbazi (2009a,b)
*** , ** ,*=Significant in 1%, 5%, and 10%
Numbers in Parentheses are Standard Errors.

Table 4. Live Animal Supply model (Equation 9)

Independent Variables							
Constant	Dummy Variable of Autumn	Dummy Variable of Summer	Dummy Variable of Spring	Capital Price	Feed Price	Labor wage	Live Animal price
-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)

Source: Hosseini and Shahbazi (2009a,b)
*** , ** ,*=Significant in 1%, 5%, and 10%
Numbers in Parentheses are Standard Errors.

Table 5. Marketing Services Supply model (Equation 10)

Independent Variables							
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
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)

Source: Hosseini and Shahbazi (2009a,b)
*** , ** ,*=Significant in 1%, 5%, and 10%
Numbers in Parentheses are Standard Errors.

Table 6. 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	
-0.79			0.90			0.84			Price Transmission

Source: Own Results

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