# Investigation of factors affecting the price of poultry and poultry meat in Sari city market by Leontif generalized function

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## Abstract

Consumption of chicken and poultry as a source of animal protein in human nutrition has grown significantly in recent years in the world. Based on this, the present study was conducted with the aim of investigating the factors affecting the price of poultry and poultry meat in the market of Sari city by the generalized Leontif function. The statistical population is broiler production units in Mazandaran province (Sari city) with a history of more than ten years. Non-probability sampling and available type were obtained based on 50 production units. This study is equal to the information obtained on final production cost, producer selling price and consumer purchase price (main variables in this study). The price of chicken and poultry was paid. The generalized Leontif function was estimated by seemingly disordered equations (SUR) and Eviews11 software in the period 1991-1999. The results of short-term estimates showed that the intersection of technology and labor, the intersection of capital and labor, and the intersection of capital are 0.486, 0.615 and 1.141, respectively. The results of long-term estimation showed that the intersection of technology and labor, the intersection of capital and labor, the intersection of capital and technology and the intersection of capital in the long run are 0.458, 0.658, 0.451 and 1.125, respectively.

Keywords: Chicken meat price, generalized Leontief function, final production cost, traction
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## 1 Introduction

Food and its supply have always been considered as one of the most important challenges for human processing. Therefore, the existence of food security in any country is considered as one of the important indicators of development of that country, and among these, the supply of animal protein in the food basket is a key criterion in ensuring food security in society. Livestock and poultry products have a special place in human nutrition in terms of energy and protein supply, and in the meantime, the consumption of chicken and poultry meat is much higher than in the past due to the lack of common diseases between humans and poultry. On the other hand, this meat is of special importance due to the high percentage of protein, low drop after slaughter, high digestibility, growth rate and low price compared to other meats [7]. Therefore, chicken and poultry meat for various economic and health reasons has a special place among various items of animal protein [12]. This, in turn, has led to the growth and expansion of the poultry industry in Iran and the world; So that the production of chicken meat in Iran has increased from 1.67 million tons in 2009

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to 3.088 million tons in 2020 and therefore has the sixth rank among the countries producing this product and 2.31 percent Of the total world production (Statistics Center of Iran, 2021).

It is worth mentioning that in recent years, this industry has made extensive technological advances in the field of poultry genetic modification, which has affected the production in terms of quantity and quality. But despite this importance and the government's efforts to support this industry, the products of this sector still do not meet the growing domestic demand [14].

Consumption of chicken and poultry as a source of animal protein in human nutrition has grown significantly in recent years in the world. Broiler farms are one of the most sensitive businesses and for high efficiency, it is necessary to identify the factors that lead to rising prices of poultry and poultry products. Poultry production as part of livestock production is one of the income generation mechanisms for production actors. As a result, in Iran, this industry can play a key role in the development and economic prosperity of the agricultural sector. Poultry production in Iran is associated with two important issues. On the one hand, there is a growing demand for chicken and eggs in urban areas due to the significant increase in the price of beef and mutton. On the other hand, the demand for traditionally processed, informal and raw products continues in most developing countries in general and in Iran in particular, while the demand for quality increases at the higher end of the market. The production of processed chicken, including cold or frozen chicken, as well as other processed products, now accounts for a small share of urban household consumption and a small share of rural consumption. Household consumption and the role of its production in supplying the protein needed by the people, it is important to study the factors affecting the price of poultry and poultry products.

## 2  Literature and research background

In recent decades, the market for agricultural products has been a topic of concern for economic policymakers and market participants. The two main functions of the agricultural market are risk transfer and pricing. In the case of risk transfer, the importance of speculation in the future is simple. Intermediaries provide liquidity in the marketplace and help caregivers find a customer to transfer risk. In the case of pricing, the role of intermediaries is less [3]. Consumers of agricultural products face different prices for these products [9]. Market-based tools may provide a cost-effective approach to agricultural production [10]. In a number of settings, including global and local air pollution and agricultural products, market-based tools for price and environmental management have been implemented that produce agricultural products at a lower cost than prescribed approaches [5].

Gabor and Granger [6] and McConnell [13] argued that consumers believed that high prices were a better indicator of quality. "The more you pay, the more you earn." To determine the choice of consumers to be considered in two ways, as a cost indicator and as a quality indicator. Monroe believes that from a consumer perspective, value reflects the exchange of buyer and seller interests (price versus quality). Therefore, the price ratio with the desired quality (ie high customer value) will increase customer satisfaction. In the markets of goods and services, where the ranking of products based on quality is common, suppliers must be sure that the price they receive from their buyer must reflect the quality of their products. Customers define the value of a product based on two dimensions: their perception of price and quality received, or in other words, the ratio of price to quality. If the quality received from the customer perception is more than the price, the value from the customer's point of view is high and vice versa. Poultry meat, especially chicken, is a strategic commodity and a substitute for red meat, which has seen a significant price increase. As a result, we see a relatively high per capita consumption of chicken among Iranian households. Therefore, in the literature, various studies have been conducted with objectives such as optimal allocation of production resources, increasing efficiency, adopting economic policies tailored to market conditions and increasing the income of poultry farmers.

Garnett et al. [8] showed that changes in meat prices may be one of the levers to increase the consumption of vegetarian meals. Van Rensburg et al. [18] examined the dynamics of red meat prices in South Africa from 2013 to 2017 and concluded that red meat type and red meat classes and carcass type affect red meat prices. Soon and Thompson [17] Analyzed Non-Tariff Barriers to Poultry Imports to Russia: Impact on Production, Trade, and Prices, showing that chicken tariffs depend on consumer demand at 30 to 40 percent. Elimination of tariffs reduces domestic production by 4 to 5 percent and domestic prices by 27 to 34 percent. Bor et al. [4] in a study entitled Asymmetry in the transfer of farm retail prices in the Turkish milk market showed that asymmetry in the transfer of prices from the farm to the sales areas in retail centers, the results showed that the increase in farm prices It transitions to retail prices faster than its decline. Abdullahi [1] in his study entitled Market Mapping to Evaluate Asymmetric Price Transfer in the Swiss Pork Market showed that lateral demand factors are important for structural changes in poultry production, processing and distribution. However, most retailers sell their poultry products to low-income consumers through informal markets. However, increasing urbanization and income increase the length and complexity of poultry and

marketing value chains, and the safety standards required in poultry markets make small business owners compete in these growing markets. These structural changes in the chicken value chain usually involve new actors such as private agricultural companies and thus stimulate organizational and institutional innovation. Despite the traditional use of poultry products, live prices and their products have risen sharply in recent years.

Aghasafari and Karbasi [2] in a study entitled Factors Affecting Consumers' Preference for Chicken Meat with Stability Labels (Case Study: Mashhad) showed that the variables of gender, frequency of purchase of chicken meat per month and reasonable price compared to Quality increases the likelihood of eating chicken labeled green and healthy over chicken labeled organic. Also, the variables of the degree of importance of chicken meat in the household basket, quality, nutritional value, trust and lack of chemicals and drugs increase the likelihood of preferring chicken with organic label to chicken with green label and healthy. Safamanesh et al. [16] examined the qualitative elasticities of demand for different types of meat in the food basket of Iranian households and concluded that the most important variable determining the quality of demand by households is income level and then the level of literacy. In this study, the quality income elasticity for all samples is positive and statistically significant. After income, variables such as gender, age and education of the head of the household have a significant effect on the quality of demand. Jorghani et al. [11] in a study entitled "Spatial price transfer model of Iranian chicken meat and the most important business partner" showed that there is a relationship between the price of chicken meat in Iran and Brazil and the direction is from Brazil to Iran. Price fluctuations in the Brazilian market have affected price fluctuations in the Iranian market, but price fluctuations in the Brazilian market have not affected price fluctuations in the Iranian market.

## 3 research methodology

Research Method In the present study, in terms of data collection, a descriptive correlational type; And in terms of purpose, it is practical. The statistical population is broiler production units in Mazandaran province (Sari city) with a history of more than ten years. Sampling was obtained by non-probabilistic and available sampling method, equal to 50 production units. In this study, based on information about final production cost, producer selling price and consumer purchase price, which are the main variables in this study, based on Leontief's principal cost function models and share factors of demand factors of production to analyze factors affecting product prices. Poultry and poultry were treated.

In this study, the cost function (C), which is defined as a generalized Leontif function, is used. These types of functions can be used in this study because they have good homogeneity in prices and convexity in the product. In this model, the properties of concavity in prices, symmetry and uniformity can be applied and tested [15]. Therefore, to express the cost function, the following formula was used to follow the generalized Leontief function, which represents the total cost of the firm according to the independent variables of production and the price of production inputs.

$$GL^{SR} = Q[\sum_i \sum_j \alpha_{ij} p_i^{0.5} p_j^{0.5} + \sum_i \beta_{it} P_i t^{0.5} + \sum_i p_i \gamma_{tt} t] + Q^{0.5}[\sum_i \theta_{ik} p_i K^{0.5}$$
$$+ \sum_i p_i(\phi_{tk} t^{0.5} K^{0.5})] + \sum_i p_i \phi_{kk} K. \tag{3.1}$$

The system of equations used includes a generalized Leontief principal cost function and the demand functions of the factors of production. Assuming that firms are fully cost-effective in a fully competitive environment, the short-term demand for production input i (Xi) can be derived from the above cost function using the Sheffard lemma function as follows:

$$\frac{X_i}{Q} = \sum_j \alpha_{ij}(\frac{p_i}{p_j})^{-0.5} + \beta_{it} t^{0.5} + \gamma_{tt} t + Q^{-0.5}[\theta_{ik} K^{0.5} + \phi_{tk} t^{0.5} k^{0.5}] + Q^{-1}(\phi_{kk} K) \tag{3.2}$$

Short-term price elasticities of variable inputs can be extracted directly from the above demand function in accordance with the following formula:

$$\epsilon_{ij}^{SR} = \frac{\partial \ln X_i}{\partial \ln P_j} = \frac{\partial X_i}{\partial P_j} \cdot \frac{P_j}{X_i}|_{K=k'}. \tag{3.3}$$

The variables used in the Leontif function are; Total Production Cost ($GL$); Poultry production ($Q$); Labor force ($L$); Capital ($K$); Labor price ($PL$); Capital Price ($PK$); Energy ($E$) and Technology Change Index ($t$). The said variables are extracted directly from the database of economic time series. Finally, the generalized Leontief function presented by the seemingly unrelated equations (SUR) and Eviews11 software is estimated in the period 1991-1999.

# 4 Findings

First, the descriptive parameters of the research variables are examined by central indicators and dispersion. These parameters include information about the central indices of mean, mean, maximum, minimum, as well as information about the scatter indices of standard deviation, skewness coefficient and elongation coefficient. The results of descriptive findings are presented in Table (1). The most important central indicator is the mean, which indicates the equilibrium point and center of gravity of the distribution, and is a good indicator to show the centrality of the data. Also, skewness coefficient and elongation coefficient indicate the normal distribution of data related to variables.

Table 1: Descriptive statistics of research variables

| Variable name | Average | Mid dle | Maxi mum | Mini mum | Devi ation Crite rion | Coeffi cient Chol egi | Coeffi cient Elon gation |
|---|---|---|---|---|---|---|---|
| Total Prod uc- tion Cost (GL) | 14864/42 | 2835/35 | 35333/20 | 391/3 | 12845/82 | 0/163 | 1/377 |
| Poultry produc- tion (Q) | 1295/717 | 1194/50 | 2733/0 | 350/0 | 668/813 | 0/359 | 1/941 |
| Labor force (L) | 22/753 | 23/450 | 30/654 | 14/851 | 4/848 | 0/021 | 1/727 |
| Capital (K) | 39/239 | 40/024 | 45/998 | 34/033 | 2/550 | 0/018 | 3/307 |
| Labor price (Pl) | 191000/9 | 74581 | 816727 | 4426 | 241357/2 | 1/366 | 3/772 |
| Capital Prices (PK) | 12/033 | 10/00 | 18/00 | 9/00 | 3/200 | 0/765 | 1/919 |
| Energy (E) | 19655/79 | 17067/80 | 40851/94 | 3576/0 | 13114/65 | 0/319 | 1/595 |
| Technology Change Index (t) | 0/429 | 0/429 | 0/473 | 0/397 | 0/024 | −0/012 | 1/530 |

# 5 Source: Research Findings

To more accurately examine the normality of the research variables, Jark statistic was used in accordance with Table (2). According to the results, the probability level of Jark statistic for all variables is more than 0.05; Therefore, the null hypothesis is accepted and the distribution of data in all variables is normal.

# 6 Source: Research Findings

In the next step, the significance of the variables was assessed by the generalized Dickey-Fuller (ADF) test according to Table (3). Based on the results, the probability level of ADF test statistics in the capital variable (K) is less than 0.05; Therefore, this variable does not have a single root and is mana or I (0). But in other variables, the level of probability is more than 0.05 and therefore these variables are anonymous or I (1). To prevent false regression, the difference of these variables has been used.

Table 2: Jark statistics for research variables

| Variable name | Jark statistics for | Jark statistics for |
|---|---|---|
| Total Production Cost (GL) | 3/425 | 0/18 |
| Poultry production (Q) | 2/047 | 0/359 |
| Labor force (L) | 2/025 | 0/363 |
| Labor price (Pl) | 2/077 | 0/350 |
| Capital Prices (Pk) | 4/363 | 0/112 |
| Capital (K) | 0/119 | 0/941 |
| Energy (E) | 2/976 | 0/225 |
| Technology Change Index (t) | 2/699 | 0/259 |

Table 3: Results of unit root test of variables

| Variable name | probability level | ADF statistics | Unit root test result |
|---|---|---|---|
| Total Production Cost (GL) | 0/97 | 0/275 | I(1) |
| Poultry production (Q) | 0/99 | 2/359 | I(1) |
| Labor force (L) | 0/90 | 0/330 | I(1) |
| Labor price (Pl) | 0/03 | 3/076 | I(0) |
| Capital Prices (Pk) | 1/00 | 3/342 | I(1) |
| Capital (K) | 0/28 | 2/007 | I(1) |
| Energy (E) | 0/99 | 0/866 | I(1) |
| Technology Change Index (t) | 0/23 | 2/142 | I(1) |

# 7 Source: Research Findings

Then, short-term and long-term SUR regression estimates were performed. Table (4) shows the results of short-term estimates and Table (5) shows the results of long-term estimates. Table (4) shows the short-term stretches obtained from the SUR regression model estimates. As can be seen, the parameters $\alpha_{ij}, \gamma_{tt}$ and $\phi_{tk}$ are not significant at the 5% probability level; Therefore, these parameters are excluded from the analysis. Other parameters are interpreted as follows. The value of the parameter $\beta_{it}$ is equal to 0.486; Which shows the intersection of technology and labor is equal to 0.486. This means that there is a relatively limited alternative between technology input and labor. The value of the parameter $\theta_{ik}$ is equal to 0.615; Which shows the intersection of capital and labor is equal to 0.615. This means that there is a moderate substitution between capital input and labor. The value of the parameter $\phi_{kk}$ is equal to 1.141; Which shows that the elasticity of capital is equal to 1.141. This means that a one percent increase in capital is followed by a 1.141 percent increase in the cost of poultry production. Therefore, capital is one of the inputs of attractive production.

Table 4: Results of short-term SUR regression estimation

| probability level | Amara t | Coefficient | parameters |
|---|---|---|---|
| 0/45 | 0/744 | 0/003 | $\alpha_{ij}$ |
| 0/00 | 3/624 | 0/486 | $\beta_{it}$ |
| 0/16 | −1/415 | −0/180 | $\gamma_{tt}$ |
| 0/00 | 4/097 | 1/615 | $\theta_{ik}$ |
| 0/85 | 0/189 | 0/134 | $\phi_{ik}$ |
| 0/00 | 4/458 | 1/141 | $\phi_{kk}$ |
| R2 = 0.71 | | | |
| DW= 1.6 | | | |
| SSR= 21.68 | | | |

# 8 Source: Research Findings

Table (5) shows the long-run elasticities obtained from estimating the SUR regression model. As can be seen, all long-term tensions except the $\alpha_{ij}$ and $\gamma_{tt}$ parameters are significant at the 5% probability level. Therefore, the significant parameters are analyzed as follows. The value of the parameter $\beta_{it}$ is 0.458; Which shows that the intersection of technology and labor is 0.458, which is not much different from the short-term traction. This means that there is relatively limited long-term substitution potential between technology input and labor. The value of the parameter $\theta_{ik}$ is equal to 0.658; Which shows that the intersection of capital and labor is equal to 0.658, which is slightly higher than the short-term elasticity. This means that there is a moderate substitution between capital input and labor in the long run. The value of the parameter $\theta_{tk}$ is equal to 0.451; Which shows the intersection of capital and technology is 0.451. This means that there is a limited substitution between capital input and technology in the long run. The value of the parameter $\phi_{kk}$ is equal to 1.125; Which shows that the elasticity of capital in the long run is 1.125. This means that a one percent increase in capital leads to a 1.125 percent increase in the cost of poultry production in the long run. Therefore, capital is one of the inputs of production in the long run. Of course, the long-term elasticity of capital is less than its short-term elasticity.

Table 5: Results of long-term SUR regression estimation

| parameters | Coefficient | Amara t | probability level |
|---|---|---|---|
| $\alpha_{ij}$ | 221/0 | 365/1 | 20/0 |
| $\beta_{it}$ | 458/0 | 556/3 | 00/0 |
| $\gamma_{tt}$ | $-332/0$ | 665/1 | 12/0 |
| $\theta_{ik}$ | 658/0 | 801/3 | 00/0 |
| $\phi_{ik}$ | 451/0 | 021/4 | 00/0 |
| $\phi_{kk}$ | 125/1 | 220/4 | 00/0 |
| R2 = 0.75 | | | |
| DW= 1.71 | | | |
| SSR= 20.44 | | | |

# 9 Conclusion and discussion

In different parts of the world, one of the reasons that agricultural and poultry industry activists are unable to improve their living standards is the difficulty of accessing entry and exit markets. Marketing systems play an important role in the economy as a mechanism for both exchanges (essential for specialization and thus leading to higher economic growth), performance functions and proper coordination of exchanges (via price signals), which reflect and shape motivation. Producers and consumers play an interaction between supply and demand. If small domestic producers can benefit from the production system to their consumption, supply chain marketing systems, which connect producers to consumers, to support low-cost and timely delivery of products. Poultry production as part of livestock production is one of the income generation mechanisms for production actors. As a result, in Iran, this industry can play a key role in the development and economic prosperity of the agricultural sector. Based on this, the present study was conducted with the aim of investigating the factors affecting the price of poultry and poultry products in the market of Sari city by the generalized Leontif function.

The results of short-term SUR regression estimation showed that there is a relatively limited possibility of substitution between technology input and labor. Therefore, technology can be used to some extent instead of labor in the agricultural sector. This result shows that the technology used in the agricultural sector and in the poultry and poultry industry of Mazandaran, has not yet reached a sufficient stage of development. Because if technology is to be highly advanced for the industry, its replacement by labor must be greater than the coefficient obtained. Therefore, in terms of technology in the poultry industry, there is still a need for government support and financing or the entry of technology into the country. There is a moderate substitution between capital input and labor. This result shows that capital and labor in Mazandaran poultry industry can replace each other in the short term on average, which is a logical result considering the importance of both factors of production for the poultry industry. Capital is one of the short-term production inputs. This result shows that the total cost of poultry and poultry in Mazandaran is greatly influenced by the capital employed. Therefore, if there is not enough capital to be used in this industry, the amount of production and costs in this sector will be greatly reduced in the short term.

The results of long-term SUR regression estimation showed that there is a relatively limited potential for technology and labor input in the long run. Therefore, in the long run, the poultry industry in Mazandaran province and Sari city is still not able to replace labor and technology. Therefore, to solve this problem, technology must be imported to the country to use the poultry industry. In the long run, there is a moderate substitution between capital input and labor. This result also shows that the substitution between labor and capital is slightly greater in the long run than in the short run. There is limited substitution between capital and technology inputs in the long run. This parameter was not significant in the short run and only in the long run its value is significant. Therefore, it can be said that Mecca in the poultry industry in the short term, there is no possibility of substitution between capital and technology. This could be due to poor technology in the poultry industry, which in the short term cannot be used instead of capital used in this industry. Capital is one of the inputs of production in the long run. Of course, the long-term elasticity of capital is less than its short-term elasticity. This result shows that the cost of poultry production is less affected by capital in the long run than in the short run, but its value is still high. The results obtained in this study are consistent with the results of research by Abdullahi [1], Aghasafari and Karbasi [2] and Jorghani et al. [11].

Based on the results, since the possibility of replacing technology and labor is low, it is suggested that to increase the possibility of substitution between these two factors of production, production technology for the poultry industry should be imported and used from other countries. Considering that the country's labor force in the poultry industry does not yet have the necessary training in the use of new technology, it is recommended that training courses be considered for the labor force in this field. Also, due to the fact that capital and technology cannot be replaced in the short term, it is necessary to use technology instead of capital by importing or learning to build new technology for the poultry industry, the possibility of substitution between these two factors of production in Also provided short-term.

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