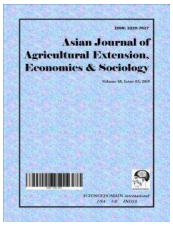

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Estimating Supply and Demand Functions for Dairy Cows Milk Production

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Author's contribution

The sole author designed, analyzed and interpreted and prepared the manuscript.

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ABSTRACT

The aim of this study was to estimate supply and demand functions for dairy cows milk production and to suggest recommendations to overcome problems related to the supply and demand of milk. A sample of 90 respondents was selected from Ad Dulay area. Multiple regression technique was used in this study Log-log demand and supply functions for raw milk production, milk price, and number of milking animals. The variable cost were considered to be the most influential variables in raw milk supply function, while milk price and consumer's income were the variables to be considered in the demand function. Therefore, encouraging farmers to establish dairy industry is needed to accommodate surplus milk.

Keywords: Supply; demand; regression; livestock; dairy cows.

1. INTRODUCTION

Milk is important food goods that need to be available in the market without any shortage, because it plays a key role in human nutrition and alleviate food poverty in all other age groups, and it is an excellent source of protein. Also, milk products contain many nutrients, and provided a

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quick and easy way to supplying these nutrients to the diet with relatively few calories.

The consumers knew that milk is an important source of nutrients; especially calcium, which is good for the health of bones and teeth [1]. Therefore, it is advisable to consume a sufficient quantity of milk and dairy products for a healthy lifestyle [2]. Consumption of a sufficient quantity of milk and milk products is recommended for a healthy life style of humans, and milk consumption preferences may vary between countries. There is a significant gap between countries in terms of milk consumption [3].

Although most of dairy production in Jordan is considered as a family operated production units with a small scale [4], livestock sector is one of the important agricultural sectors in Jordan for its contribution to employment. Its revenue is considered as the main source of income for a huge number of rural and nomad populations [5]. It also provides citizens with basic product; which contributes about 60% in the agricultural output and considered a major source of income to 250,000 people. Dairy cattle sector ranked as the second, regarding small ruminant, it has a vital social significance. About 50 percent of the Badia rangeland adopts it in their livelihood. Women play a major role in production activities through assisting in raising livestock, feeding, milking, and product processing. Moreover, small ruminants occupy the highest rank concerning the added value. Statistics available indicates that, self sufficiency in livestock products is about 30% for red meat, and 53 % for milk and dairy products [6]. The share of the agricultural sector in the GDP of Jordan was 2.9%, as well as, livestock contribute in about 0.85% in the GDP in 2015 [7].

Livestock sector provides two of the most important food products which are milk and meat. To overcome the lack of both products in the country, it was necessary to involve the private sector in this enterprise. Since most major problems facing cattle farmers are rising feed prices, high inputs cost in production like the electricity, diesel, expats, containers, packaging, high milk powder price and tax, it was important to estimate supply and demand functions for dairy cows milk production and to suggest policy recommendations to overcome problems related to supply and demand of milk.

The main objective of this study was to estimating supply and demand functions for dairy cows milk production and to suggest recommendations to overcome problems related to supply and demand of milk.

2. METHODS AND PROCEDURES

2.1 Cows Milk Production

According to the records of the Department of Statistics [8], the number of cows was 69 740 heads in 1211 farms. Also, the total quantity of milk production in the country was 236773 tons in 2013. The total amounts of milk produced in Jordan since 2005 are presented in Graph 1.

Sampling and data collection: This study was conducted in Ad Dulay area, Jordan. The study population totaled 135 milk cows producers, only 90 questionnaires were retrieved in the study area. For the collection of primary data, a comprehensive questionnaire was constructed. The questionnaire was finalized after pre-testing procedure. After pre-testing and revising the questionnaire, the farmers were interviewed individually at their farms gate. Interviews were conducted during year 2015. The data was collected for different variables i.e. total milk production, total quantity of milk consumed, retail prices of dairy cows, and population of milking animals.

Regression Model: The dairy cows supply function was specified in log-log form as follows:

$$\ln MS = \alpha + \beta 1 \ln X_1 + \beta 2 \ln X_2 + \beta 3 \ln X_3 + \beta 41 n X_4 + \mu t$$

Where;

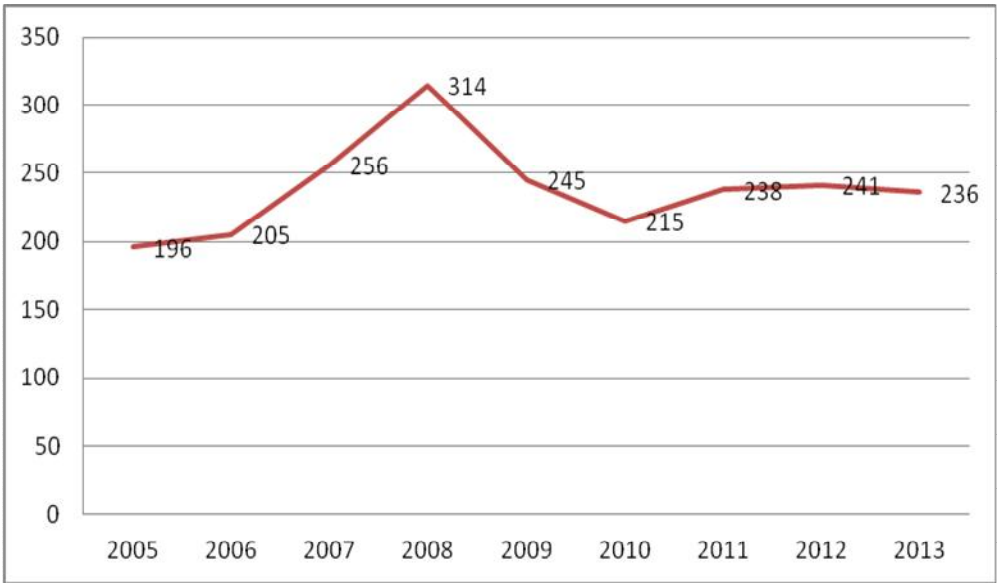
lnQm = Quantity of milk supplied (tons) as Dependent Variable.

And Independent Variables:

$Ln X_1$ = Price of milk (JD /Liter)
$Ln X_2$ = Number of milking animals.
$Ln X_3$ = Price of animals.
$Ln X_4$ = Variable cost of milk production.
α = Constant term.
β1, β2, β3 and β4 = Regression Coefficients of the independent variables to be estimated.
μt = Random error term.

The dairy cows demand function was specified in log log form as follows:

$$\ln Qc = \alpha + \beta 1 \ln X_1 + \beta 2 \ln X_2 + \beta 3 \ln X_3 + \mu t$$



Graph 1. Amounts of cow's milk produced in Jordan since 2005

lnMC = Quantity of milk consumed per capita per year as a dependent variable.

And Independent Variables:

ln X_1 = Price of milk (JD /Liter).
ln X_2 = Per capita income (JD/capita per month.)
ln X_3 = Household number.
α = Constant term.
β1, β2, and β3 = Regression Coefficients of the independent variables to be estimated.
μt = Random error term.

3. RESULTS AND DISCUSSION

The supply and demand functions of dairy cows were using ordinary least squares regression analysis. As the per capita income and population was increasing, the demand of dairy cows was also increasing continuously. Similarly the adoption of modern milk production technologies had enormous potential to enhance the milk supply. A log-log multiple regression analysis was used to estimate the supply and demand functions between the dependent variable and independent variables.

Table 1 shows, the estimated coefficients of supply and demand functions.

The estimated coefficients of supply function are presented in Table 1 (part 1). The F-test value was 4.87 which are significant at ($p \leq 0.01$). This suggests that the independent variables i.e. number of milking animals, price of milk and

Table 1. The coefficients of the estimated function of milk

1. Supply function			
Variables	**Coefficients**	**T-values**	**Significance**
Constant	1.304	0.400	0.692N.S
X1 (price of milk)	0.564	2.081	0.048*
X2 (number of milking animals)	1.754	14.601	0.000**
X3 (price of animals)	-0.241	-0.938	0.357N.S
X4 (variable cost)	-0.885	-7.353-	0.000**
2. Demand function			
Constant	1.733	6.543	0.000**
X1 (price of milk)	-1.135	3.197	0.002**
X2 (per capita income)	0.442	2.195	0.031*
X3 (household number)	0.847	1.227	0.223N.S

** = ($p \leq 0.05$), ** = ($p \leq 0.01$), N.S. = Non-significant*

variable and cost of milk production in the model were significantly affecting the milk supply (dependent variable). The value of R^2 was 0.61 which shows that all the independent variables explain 61 percent of the total variation in dependent variable.

The estimated coefficient of milk price (X_1) was 0.564 indicating that if milk price increases by 1 percent, milk supply was increasing by 0.564 percent. This coefficient of milk price found to be significant ($p \leq 0.05$).

The value of coefficient of number of milking animals (X_2) was 1.75 and was significant ($p \leq 0.01$). This indicates that one percent increase in the number of milking animals causes an increase in milk supply by 1.75 percent. The increase in price elasticity of milk indicates that consumption has become more prices responsive and price may have become an important feature of milk sale [9].

The value coefficient of price of animals was -0.241, and was not significant at ($p \leq 0.05$). This shows that one percent increase in the price of animals causes a decline in milk supply by 0.241 percent. In the same way the estimated coefficient of variable cost was -0.885 and significant ($p \leq 0.01$). It was revealed that if variable cost is increased by one percent, milk supply will decrease by 0.885 percent.

Milk production has increased substantially due to the use of hay and grains as animal feed [10,11]. As the energy (fuel and electricity) prices were kept on going up resultantly also pushing up the variable cost, consequently, the cost of production was increasing. The green fodder which was an important component of variable cost plays a significant role in milk production [12]. The feeding of optimal level of feed and fodder performed a substantial role in milk production [13].

Moreover, Table 1 (part 2) shows that the F-test value was 5.722 which was significant ($p \leq 0.01$). This suggests that overall model was correctly specified. The estimated value of R^2 was 0.56. It clarify that all the independent variables included in the model explains 56 percent of the total variation in dependent. The estimated coefficient of milk price was -1.135, indicating that if milk price increases by 1 percent, the demand for milk decreases by 1.135 percent. It was shown that milk consumption has become more price' responsive. When dairy cows price rises, people may be using close substitutes of milk for example dry milk. The coefficient of milk price was found to be significant ($p \leq 0.01$).

The estimated coefficient of per capita income was 0.442 which was significant ($p \leq 0.05$) and it explains that if per capita income was increases by 1 percent, the demand for milk will increase by 0.442 percent. As the income of the consumers is increasing, they would like to consume more milk. Instead of using dry milk they would prefer to buy fresh milk [14]. Similarly, the estimated coefficient of the household number was 0.847 which indicates that if household number is increased by 1 percent, the demand for milk will increase by 0.847 percent. In fact, the population of the country is increasing which in turn also increases demand for milk to meet the rising demand of milk for consumers and the supply of milk must be available [15].

4. CONCLUSION

It can be concluded that price of milk, number of milking animals, variable cost in supply function, price of milk, and per capita income in demand function significantly influenced cows' milk production in Jordan. Demand functions indicate that the elasticity of milk demand increased at retail level, due to growing proportion of consumers and increasing prevalence of substitutes the goods. The increase in the price elasticity for milk implies that consumption has become slightly more price responsive and that price may become a more important feature in the selling of milk.

Moreover, substitution and replacement of cows' milk contribute to increasing milk production. As a result of the high costs variable of feed, there must be a government support to cows' breeder in order to reduced costs of feed. Furthermore, future studies needed to enhance the potency of these preliminary findings, through more disaggregated analysis for the information to design appropriate policies for consumption and production of milk, and encouraging farmers to the establishment of dairy industry which will accommodate milk production, and promote milk products to be exported to other countries.

COMPETING INTERESTS

Author has declared that no competing interests exist.

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