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Araştırma Makalesi

Analysis of the Relationship Lag Between Beef Production Amount and Average Meat Price in Turkey Using the Koyck Model

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ABSTRACT

In this research, we used the data was taken from Turkish Statistical Institute (TUIK) between 2001 and 2018. In the resulting tables, the meat production amount of slaughtered cattle represents the dependent variable, while the average meat price represents the independent variable. Analysis was carried out with the help of the Koyck model to determine the relationship lag between the dependent variable and the independent variable. As a result of the research, it was found that the average meat price affected the meat production amount of the past two years, and the time period for a change in beef production amount to have an impact on the price was 0.007 years. In addition, a 1 ton increase in beef production in year t increases its price by 0.994390, and it was determined by the analysis that this increase was 0.007731 in the t-1 period.

Keywords: Beef meat production, Koyck model, average meat prices.

Türkiye'de Sığır Et Üretim Miktarı ve Ortalama Et Fiyatı Arasında İlişki Gecikmesinin Koyck Modeli ile Analizi

ÖZ

Bu araştırma, Türkiye İstatistik Kurumu (TÜİK) tarafından yayınlamış olan 2001-2018 yılları arasında istatistiksel tablolardan elde edilmiştir. Elde edilen tablolarda kesilmiş büyükbaş hayvanların et üretim miktarı bağımlı değişkeni temsil ederken ortalama etinin fiyatı da bağımsız değişkeni temsil etmektedir. Bağımlı değişken ile bağımsız değişken arasındaki ilişki gecikmesinin belirlenebilmesi için de Koyck modeli yardımıyla analiz yapılmıştır. Araştırma sonucunda, ortalama etin fiyatı geçmiş iki yılın et üretim miktarını etkilediğini, sığır et üretim miktarında meydana gelen bir değişimin fiyat üzerinde etki yaratma süresi 0.007 yıl olduğu bulunmuştur. Ayrıca t yılında sığır et üretimindeki 1 tonluk bir artış fiyatını 0.994390 oranında arttırmakta olup, t-1 döneminde de bu artış 0.007731 oranında olduğu yapılan analiz ile belirlenmiştir.

Anahtar kelimeler: Sığır et üretimi, Koyck modeli, ortalama et fiyatları.

INTRODUCTION

The most important source of income and economic activity of humanity since the moment it came to earth has been animal husbandry. Livestock farming is an extremely important factor in terms of adequate, healthy and balanced nutrition of the population, which tends to constantly increase, and has an important place in terms of raw material supply in related industries. In addition, it is a sector that benefits the country's economy, creates the highest added value to unit investment and provides employment opportunities at the

lowest cost (Demir, 2012). It is divided into two groups as cattle and sheep farming. In addition to being the most obvious source of income for people living in rural areas, both sheep and cattle breeding is also known as the economic source of developing societies (Güven et al., 2017).

Turkey, a developing society, has a rich network of companies dealing with cattle breeding and slaughtering. However, the insufficient number of animals in the enterprises, the fact that they are scattered family enterprises, the plant production used in feed production is not at a sufficient level, the fluctuations in prices, etc. It has created uneasiness such as not being able to meet the target in production (Aydın et al., 2011). In addition, fluctuations in production and prices such as high meat prices, decrease in the number of animals, illegal animal entry, imbalance in input and product prices; Meat consumption varied in relation to the average income per capita (Şahin et al., 2013).

According to the literature review; Although there are many studies on the Koyck model, bovine meat production and price of meat (Özçelik and Özer, 2006; Dikmen, 2006; Erdal, 2006; Erdal and Erdal, 2008; Çetinkaya, 2012; Doğan et al., 2014; Çelik, 2015; Özsayın, 2017) is considered important in terms of repeating the studies regularly, observing the changes occurring in businesses and developing solutions to their problems.

In this research, it is aimed to determine the relationship lag between the meat production amount and the average meat price of cattle slaughtered in Turkey during the specified years.

MATERIAL and METHOD

The data set in this research was obtained from the meat production amount and average meat price of slaughtered cattle in the statistical tables between 2001 and 2018 published by the Turkish Statistical Institute (TUIK). In the research, the relationship between the meat production amount and the average meat price of cattle slaughtered in Turkey during the determined years was analyzed with the help of the distributed lag Koyck model.

Koyck model is a type of model used to determine the effect sizes of the lags when the independent variables follow each other. As the number of lags increases in the model, the lagged values of the independent variable gradually decrease. It is said that the delay in the independent variable also affects the dependent variable and the delay rate decreases geometrically.

Distributed delay models have a reliable side due to the ease they offer in explaining theories. These types of models include the lagged values of the explanatory variable among the independent variables. If such models are given a value that is not possible to explain, they are called infinite, otherwise they are called finite models. The model that is unlikely to be delayed (infinite) can be represented as follows;

$$Y_t = \alpha + X_t + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \beta_3 X_{t-3} + \cdots + u_t \quad (1)$$

If it is a model with (finite) n delays that are likely to be delayed;

$$Y_t = \alpha + X_t + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \beta_3 X_{t-3} + \cdots + \beta_n X_{n-3} + u_t \quad (2)$$

This model briefly:

$$Y = \alpha + \sum_{i=0}^{n} \beta X_{t-i} + u \quad (3)$$

This is the explanatory variable X's current value not only with (X_t), but also with the values it has taken in the past. ($Y_t \cdots Y_{t-n}$) depend veriable (Y_t) shows that it has an effect on In the elapsed time, Y reacts to X after a certain period of time, this time is called delay.

To obtain the Koyck model, in a model with an improbable (infinite) delay as mentioned above, Koyck states that the β coefficients of the lag values associated with all independent variables in the model have the same sign, and these values decrease geometrically. This assumption;

$$\beta_0 = \lambda^n \qquad n=0,1,2,\ldots \quad (4)$$

Here λ, ($0< \lambda < 1$) the rate at which the distributed delay decreases or decreases, $1-\lambda$ is the adaptation speed and β_n is the coefficient of delay. If the value of λ is close to zero The rate of decrease of β increases by that degree, and if it is close to one, it decreases by that degree. The weighted average of the delays gives the average number of delays and is as follows:

$$Average\ Latency = \frac{\lambda}{1-\lambda} \quad (5)$$

The average number of lags indicates the time period it takes for a one-unit change in the independent variable X to have an effect on the dependent variable Y.

According to the explanations made above, the (infinite) equation that is unlikely to be delayed is as follows:

$$Y_t = \alpha + \beta_0 X_t + X_t + \lambda\beta_0 X_{t-1} + \lambda^2\beta_0 X_{t-2} + \lambda^3\beta_0 X_{t-3} + \cdots + u_t \quad (6)$$

Since the model is a model with an unlikely (infinite) lag, it is not possible to apply the linear regression solution method, and since the λ coefficients are far from being linear, Koyck pulled the model back a period and obtained a model like this:

$$\lambda Y_{t-1} = \lambda\alpha + \lambda\beta_0 X_t + \lambda^2\beta_0 X_{t-1} + \lambda^3\beta_0 X_{t-2} + \lambda^4\beta_0 X_{t-3} \cdots + \lambda^k u_{t-1} \quad (7)$$

If necessary adjustments are made to this model:

$$Y_t = \alpha(1-\lambda) + \beta_0 X_t - \lambda Y_{t-1} + u_t \quad (8)$$

is in the form (Koyck, 1954).

DISCUSSION

This study was conducted considering the meat production amount and average meat sales prices of cattle slaughtered between 2001 and 2018. In the research, firstly, Schwartz lag length criterion was used to obtain the Koyck model. The results are given in Table 1.

Table 1. Schwartz lag length criterion result.

Lag	LogL	LR	FPE	AIC	SC	HQ
0	10.84531	NA	0.000969	-1.263616	-1.172322	-1.272067
1	44.67575	53.16211	1.38e-05	-5.525107	-5.251225	-5.550460
2	55.96251	14.51155*	5.15e-06*	-6.566073	-6.109603*	-6.608328
3	60.1806	4.217851	5.70e-06	-6.597194	-5.958137	-6.656351

* indicates lag order selected by the criterion, LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error, AIC: Akaike information criterion, SC: Schwarz information criterion, HQ: Hannan-Quinn information criterion

In Table 1, it has been determined that the number of delays will be taken as 2. That is, starting from the 2nd year, the effect of price on meat production is zero.

Later, the extended delay Koyck model was studied:

$$Y_t = a_0 + \beta_1 C_t + \beta_2 C_{t-1} + \cdots + \beta_n C_{t-k} + u_t \quad (9)$$

Y_t= Meat production amount (Ton)
C_t= Meat price (TL/ Kg)
was obtained and one lagged value of the meat price was taken as an independent variable in this model and the transformed Koyck Model estimate is given in Table 2.

Table 2. Transformational Koyck Model estimation result.

Variable	Coefficient	Std. Eror	t-Statistic	Probablity(p)
Still	-10.44266	1.489355	-7.011534	0.000
Y_t	0.994390	0.112670	8.825650	0.0000
C_{t-1}	0.007731	0.003703	2.088018	0.0543

R^2=0.87, F=53.14, p=0.000, DW=1.82

In Table 2 C_t= -10.44266+0.994360Yt+0.007731C_{t-1} (10)
The Koyck model was obtained in the form.

In this model; C_t= meat price in period t, Y_t= meat production amount in period t, C_{t-1}= meat price in the period before t. When statistical significance levels were examined, C_{t-1} coefficients, which are a lagged value of meat production and meat price, were found to be significant according to the t test ($p < 0.05$). Since the Durbin Watson statistic value was 1.82, no autocorrelation problem was observed.

According to the model prediction, a 1 ton increase in meat production increases the meat price by 0.994390 and by 0.007731 in the previous period. In this case, the average number of delays is

Average Latency $= \lambda(1-\lambda) = 0.007731/(1-0.007731) = 0.007$ (11)

It is in the form. According to this result, the time required for a change in meat production to significantly affect the price of meat is 0.007 years.

If the following model is written using the Koyck model;

$$C_t = a_0 + \beta_1 Y_t + \lambda C_{t-1} + u_t \quad (12)$$

and

$$\beta_k = \beta_0 \lambda^k \quad (13)$$

$0 < \lambda < 1$ since;
β_0 = 0.994390; $\lambda = 0.007$
$\beta_1 = \beta_0\ \lambda$ = (0.994390)(0.007)= 0.00696073,
$\beta_2 = \beta_0\lambda^2$= (0.994390)$(0.007)^2$= 0.0000487251

$a_0 = \alpha/(1 - \lambda)$= -10.44266/(1-0.007)= -10.516273

If the regression equation is rewritten with the help of the Koyck model obtained with these calculations;

$$Y_t = a_0 + \beta_1 C_t + \beta_2 C_{t-1} + u_t \quad (14)$$

$$Y_t = -10.516273 + 0.00696073 C_t + 0.0000487251 C_{t-1} \quad (15)$$

Since the λ coefficient in this model is 0< λ<1, the delayed meat production amount has a decreasing effect on meat production. In the model, a one-ton increase in meat production increases the price of meat by 0.994390, by 0.00696073 in the previous period and by 0.0000487251 in the two periods before, and this effect reduces to zero at the end of the 2nd year.

CONCLUSION

In this research, analysis was carried out with the help of the Koyck model due to the high correlation of 93.8% between the meat production amount of slaughtered cattle and the average meat price.

As a result of the analysis, the coefficient of determination of the meat production amount and the average meat price of slaughtered cattle was found to be 87%. In addition, as a result of the t test, the lagged value (C_{t-1}) of the meat production amount of slaughtered cattle was statistically significant ($p<0.05$), and the time required for a change in meat production to significantly affect its price was determined to be 0.007 years.

In addition, as a result of this research, it is thought that whether there is a statistically significant difference between the average meat price and meat production amount between the determined years, these values can guide the researcher in redetermining the values.

Conflicts of interest: The authors of the article declare that they do not have any conflict of interest

Author contribution: The authors declare that they have contributed equally to the article.

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