Investigation of the Lagged Effects of Livestock Supports on the Animal Production Value in Turkey

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Abstract

A significant part of the population in Turkey is under the malnutrition risk due to the food insecurity in terms of animal products. A number of policies have been implemented in order to increase animal production despite of unsatisfactory results. Thus, the main research question is whether livestock policies really affect animal production value, and if so, to what extent and how long its effect continues. In the study, it was used Koyck and Almon distributed lag models based on annual time-series data from 1986 to 2019. The results confirmed a significant and positive association between livestock supports and animal production value. Moreover, animal production value has increased steadily for six years due to supports. Further, necessary time to observe the effect of subsidies on animal production value for one-unit change was determined as 2.98 years by Koyk model. Therefore, long term and stable structural livestock policies should be implemented to increase the development and competitiveness of the sector.

Keywords: Distributed lag models, Koyck model, Almon model, agriculture.

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Abbreviations used: FAO (UN, Food and Agricultural Organization), OECD (Organization of Economic and Cultural Development), CAP (Common Agricultural Policiy), EU (European Union), IMF (International Monetary Fund), TL (Turkish Lira), USD (United State Dolar), Schwarz Information Criteria (SIC), OLS (Ordinary Least Square),

INTRODUCTION

Animal production has been significantly decreased in Turkey per capita, which was much faster especially in recent years. Per capita daily protein and energy production from animal origin can be considered as an important indicator to show relationship between animal production and nutrients. When this indicator is taken into consideration, it can be said that although energy and protein production level of foodstuff in Turkey is adequate, production of foods from animal origin is not at the sufficient level to ensure adequate nutrition. According to FAO data, per capita total energy supply in 2017 was 3720 kcal/day, while per capita energy supply from animal products was 567 kcal/day. Similarly, per capita total protein consumption quantity was 102.2 gr/day, while per capita animal protein supply was 35.6 gr/day. Experts suggest that the average protein requirement of the individuals for healthy and balanced nutrition should be average 1 gr for each kilogram of body weight per day, of which at least 42% (about 35-40 gr) should be provided from animal source foods (Saçlı, 2007). Compared to developed countries, a considerable part of the population in the country is under the malnutrition risk due to problems in terms of availability and accessibility of animal products. For example, daily per capita total protein supply and animal protein supply were 103.85 gr and 60.38 gr in EU, 109.6 gr and 69.78 gr in USA, respectively (FAO, 2020).

Livestock sector has faced many challenges in Turkey. Some of these challenges are small scale and dispersed enterprises, low productivity, insufficient livestock policies and the lack of sufficient support.

Livestock policy is one of the basic policies of every country regardless of development level. Although it is not sufficient, livestock sector has been supported by the different agriculture policy measures since the establishment of the republic in Turkey. The main purposes of the support policies are to provide sufficient nutrient for the society, to reach self-sufficiency in the animal production, to increase the productivity of holdings, to increase income of livestock farmers and to ensure rural development.

In Turkey, there has been a positive relationship between livestock supports and animal production value by the years. Increasing animal production supports increase animal production value. According to the Ministry of Agriculture and Forestry data, livestock support amount reached to 3 million TL in 2000s. Last ten years, livestock supports have increased more than 100% and the share of that in agricultural subsidies reached to 34.6% in 2019. The value of animal production was also reached to 259 billion TL by increasing 22 times in the same period (TurkStat, 2020).

In recent years, the number of studies about the effects of agricultural subsidies on various indicators such as production, farm income, and economic growth are increasing. In line with the diversity of agricultural policy programmes, empirical studies analysed different aspects of government subsidies in agriculture. Vozarova and Kotulic (2015), for instance, found that there was a strong correlation between amount of gross agricultural production and the volume of subsidies granted in Slovakia. Malan et al. (2016) found that price distortions had a strong, significant impact on cocoa and cotton yields in Africa. Skreli et al. (2015) found that government subsidy had a clear, positive impact on the area planted with olives and vineyards in Albania. Minviel and Latruffe (2014) found that targeted investment subsidies were positively associated with farm's technical efficiency, while Bojnec and Latruffe (2013) found that agricultural subsidies reduced the technical efficiency of Slovenian farms but improved their profitability. Brady et al. (2009) analysed the impact of decoupled direct payments on biodiversity and landscape and found that eliminating the link between support payments and production had only limited negative consequences for the landscape. Semerci and Çelik (2017) examined the utilisation level of subsidies in dairy cattle enterprises in Hatay province of Turkey and found that livestock subsidies were decreasing the production costs and increasing farmers' income significantly.

The various policy support mechanisms may affect production decisions in the agriculture sector. One of the critical issues in analysing the impact of subsidies in agriculture is to recognise the long lags involved. Especially, this situation is very crucial in livestock because the sector has the high investment cost. Supports on livestock sector today might result with investment of new enterprises and improvement of current enterprises in the sector in the future. Unlike crop production, one or more years is necessary to see the effect of supports on animal production sector. When taking into consideration the lag between the production of animal products and marketing, it would be seen that the length of lag of that is longer than that of crop production.

In order to determine the appropriate policy settings in the livestock, a necessary condition is to understand the relationship between livestock subsidies and the value of animal production. Therefore, the objective of this study was to investigate the role of subsidies in livestock production value. However, as well as the impacts of the subsidies are quite extensive, the study only focused on the reflection of subsidies on production value. In particular, the paper examines the short- and long-run pass-through of subsidies to animal production value in Turkey. Thus, the aim was not only to examine any relationship between subsidies payments and animal production value but also to investigate the scope and time span of this relationship. Investigating the time effect of livestock subsidies has substantial importance, as it offers us with the knowledge related whether subsidies payments cause future benefits and increase livestock value in the long run. There is no empirical evidence showing the association between livestock supports and animal production value from long lags perspective. In this context, this is the first study examining the long-term effect of subsidies on animal production value of livestock sector by using distributed lag models. Within this scope, analyses were conducted to see whether livestock policies really affect the production value of the sector and if so, to what extent and how long its effect continues.

MATERIAL and METHODS

Data

The data of the study were collected from records of Turkish Statistical Institute (TurkStat), Ministry of Agriculture and Forestry (MAF), and OECD (Producer Support Estimates database). The data related to the value of livestock production and livestock supports were put yearly from 1990 to 2019. Deflated values of animal production and supports according to producer price index were used in study. All series have been transformed in natural logarithms, because otherwise, with trending data, the relative error might decline over time and this is inappropriate (Tiffin and Dawson, 2000). In the models, total animal production value was represented as AV_t variable and total livestock supports amount was presented as Sub_t variable.

Figure 1 gives animal production value and livestock supports by the years in Turkey. Between 1990-2019 years, while total livestock supports with constant price has increased by 3.7 times, total animal production value with constant price has increased by 6.0 times.

Theoretical Framework

Distributed lag models have a specific place in literature of economics because it allows us to analyse the behaviour of economic units (consumer, producers, etc.) based on appropriate dynamic models.

Studied and used for the first time by Irving Fisher (Isyar, 1999), distributed lag models take into account not only the present year value but also the previous year values of defining variable (Erdal et al., 2009). If the length of lags for explanatory variable is not determined, this type of model is called an as “infinite lag model” and shown as follows:

$$Y_t = \alpha + \beta_0 X_t + \beta_1 X_{t-1} + \beta_2 X_{t-2} + ... + u_t \quad (1)$$

On the other hand, if length of lags for explanatory variable is defined as *k*, this type model is called “finite distributed lag model” and can be written as:

$$Y_t = \alpha + \beta_0 X_t + \beta_1 X_{t-1} + \beta_2 X_{t-2} + ... + \beta_k X_{t-k} + u_t \quad (2)$$

Mostly, dependent variable (Y) responds to the explanatory variable (X) after some time which is called as “lag period”. Unknown parameters (α, β_0, …, β_k) in these models can be estimated by the ordinary least square method (OLS). But this estimation has certain drawbacks about the lack of information on maximum length of lags and decline of degrees of freedom. Besides, the most important problem is about multicollinearity between explanatory variables (Gujarati, 2004) that leads to biased results. To overcome these challenges in distributed lag models, Koyck (1954) has developed one of the distributed lag models. Koyck’s method assumes that effects of lags of explanatory variable on dependent variable decrease geometrically:

$$\beta_k = \beta_0 \lambda^k \qquad k=0,1,... \quad (3)$$

Where λ ($0<\lambda<1$) is known as the rate of decline of the distributed lag. Besides, $1-\lambda$ is defined as the speed of adjustment. In other words, each estimated β coefficient is less than the previous β coefficient. The value of lag coefficient, β_k, depends on the value of λ. The closer the value of λ to one, the slower the rate of decline in β_k is. Whereas, the closer the value of λ to zero, the quicker the decline in βk is. Mean lag is the weighted average of all lags involved and can be formulated as (Gujarati, 2004):

$$\text{Mean lag} = \lambda / (1-\lambda) \quad (4)$$

Mean lag provides the summary information of the speed with which the dependent variable (Y) responds to the explanatory variable (X). For instance, assume that it is used annual data, and mean lag is found as “6,” this means that it takes “6” years’ for the effects of changes in explanatory variable (X) to be perceived on dependent variable (Y). The features of Koyck scheme assumes nonnegative values for λ and $\lambda<1$ and finite of the sum of β’s (Gujarati, 2004). As a result, Koyck method on the infinite model can be formed as:

$$Y_t = \alpha + \beta_0 X_t + \beta_0 \lambda X_{t-1} + \beta_0 \lambda^2 X_{t-2} + ... + u_t \quad (5)$$

In this form, linear regression method cannot be applied to this form of model (Equation 5), since there are large number of parameters to be estimated and λ coefficients are highly nonlinear form. As a solution, Koyck suggests to take lag by one period back to obtain following form:

$$Y_{t-1} = \alpha + \beta_0 X_{t-1} + \beta_0 \lambda X_{t-2} + \beta_0 \lambda^2 X_{t-3} + ... + u_{t-1} \quad (6)$$

Thereafter, the equation (7) is obtained as a result of equation (6) multiplied by λ.

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

The equation (8) is got by subtracting equation (7) from equation (5):

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

Afterwards, the model can be rearranged as:

$$Y_t = \alpha (1-\lambda) + \beta_0 X_t + \lambda Y_{t-1} + v_t \quad (9)$$

where v_t in Equation (9) is equal to $u_t - \lambda u_{t-1}$ and the moving average of u_t, u_{t-1}. This procedure just described is known as Koyck transformation and Equation (9) is also called as Koyck model. In Koyck model, lag values of explanatory variable (X) are not defined to solve multicollineratiy problem. Therefore, Koyck model needs to estimate α, β and λ only to solve the distributed lag model (Gujarati, 2004).

Another model of distributed lag models is the Almon model. Since the β parameters of the Koyck model are continuously decreasing, many other situations that may be different can be ignored. For these reasons, in the case of the Almon model, β 's may increase first, then decrease, or decrease first and then increase.

Shirley Almon (1965) follows the "Weierstrass Theorem" in Mathematics and assumes that βi can be approximated by a suitable-degree polynomial in i, the length of the lag. There are two basic equations that generates the cruxes of Almon model (Gujarati, 2004);

$$Y_t = \alpha + \beta_0 X_t + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \ldots + \beta_k X_{t-k} + u_t \quad (10)$$

$$\beta_i = a_0 + a_1 i + a_2 i^2 + \ldots + a_n i^n \quad (11)$$

βi is an *n*th-degree polynominal in *i* . It is assumed that *n* (the degree of the polynomial) is less than *k* (the maximum length of the lag).

In the stage of modeling, firstly suitable time lag is acquired by using Schawarz Information Criteria (SIC) or Akaike Information Criteria (AIC).

In the model, the lag that makes AIC and SIC value the minimum value is considered to be the suitable time lag (Kutlar, 2000). The notations related to AIC and SIC values are defined in Equation 12 and Equation 13;

$$AIC = T \ln + 2n \quad (12)$$

$$SIC = T \ln\sigma^2 + n \ln(T) \quad (13)$$

T = Number of usable observations, n = Number of parameters estimated, σ^2 = KKT /Tn =the highest probability estimation or error variance related to the model and KKT = Residual sum of squares (RSS).

After the determination of the suitable time lag, the polynomial degree needs to be determined. Polynomial degree is at least one more than the number of each flection (maximum or minimum points). The determination of the polynomial degree is mostly subjective. Thus, to determine these criteria is up to the researcher's forecasting (Akın, 2002). In this study, based on SIC the most suitable time lag has been determined as "X-6" season and polynomial degree has been determined as second-degree polynomial by forecasting. After the determination of the polynomial degree, the suitable "Z" values are acquired. In the acquisition of "Z" values, The Equations 14, 15 and 16 can be used;

$$Z_{0t} = \sum_{i=0}^{k} X_{t-i} \quad (14)$$

$$Z_{1t} = \sum_{i=0}^{k} i X_{t-i} \quad (15)$$

$$Z_{2t} = \sum_{i=0}^{k} i^2 X_{t-i} \quad (16)$$

In the Almon scheme, Y is regressed according to "Z" variables that have been generated, not according to "X". The equation (17) can be estimated by usual OLS method. So, the forecast of α and a_i (a_0, a_1 and a_2) would provide all the statistical conditions required, on condition that possibility disturbance term fulfils the forecast of classical linear regression Model (Gujarati, 2004).

$$Y_t = \alpha + \alpha_0 Z_{0t} + \alpha_1 Z_{1t} + \alpha_2 Z_{2t} + u_t \quad (17)$$

Moreover, when the "a" coefficients are obtained from equation (17), the original βi's are estimated from equation (11) as follows in the Equations 18, 19, 20 and 21.

$\beta_0 = a_0$ (18)
$\beta_1 = a_0 + a_1 + a_2$ (19)
$\beta_2 = a_0 + 2a_1 + 4a_2$ (20)
$\beta_3 = a_0 + 3a_1 + 9a_2$ (21)
……………………..
$\beta k = a_0 + ka_1 + k^2a_2$

Thus, the distributed lag model can be interpreted in according to equation (10) by putting into their places of the obtained βi values.

Although there are studies using Distributed Lag Models in agriculture sector, none of these studies is from subsidies perspective. For instance, several authors studied the relationship between production and price in buffalo milk (Çelik, 2015a), in sheep milk (Çelik, 2015b) and cow milk (Özsayın, 2017). Within this context, this study has the potential to add benefit to agricultural policy aspect of the sector by using this methodology.

RESULTS and DISCUSSION

An Overview of the Livestock Sector in Turkey

Livestock sector has a significant potential in Turkey. The sector's contribution to farm income is substantial, and livestock production and marketing activities are important for the economic development of rural areas in Turkey (Yurdakul et al., 1999). Animal production including meat, milk, eggs, honey, wool, and hides constituted approximately 32.2% of total agricultural production value in 2019 (TurkStat, 2020). However, this value is comparatively fairly low than that in developed countries, which is about 60-70%. In recent years, Turkey's livestock sector has displayed an increasing trend in terms of productivity but a decreasing trend for per capita consumption of animal products (Akbay and Boz, 2005).

Historically, according to livestock inventory data, the number of bovine and small ruminant animals were increasing until the early 1980s but it has decreased after this date. Between 1980-2009 years, the number of bovine animals decreased by 36.1% (about 6 million heads) and the number of small ruminants decreased by 60.3% (about 41 million head). As from 2009, it has been observed an increase in the number of livestock due to the increasing supports. Thus, the number of cattle and buffaloes in Turkey reached to 17.9 million heads with an increase of 65.3% in 2017 compared to 2009. The number of sheep and goat in Turkey reached to 48.5 million heads with an increase of 80.4% in 2019 compared to 2009 (TurkStat, 2020).

In contrast to the red meat sector, the numbers of poultry and beehives have steadily increased during the same period. Poultry products are gaining importance and account for a major share of animal products in human diets in Turkey as in many other countries (Akbay and Boz, 2005). By 2019, Turkey had 348.8 million head of poultry and 8.1 million beehives, almost 6 times higher for poultry and 3.7 times higher for beehives than those numbers in 1980.

Considering the animal number and production, the level of yields per animal in Turkey are considerable low in comparison with the developed countries. Despite the significant growth in carcass and milk yields, the productivity increases have not been sufficient to prevent reduction in output potential caused by declining animal inventories, particularly in the sheep sector (Koc et al., 2001).

For the past 100 years, Turkish government has implemented a number of policies aimed to improve production of animal production but the outcomes have been dissatisfactory. The supports for plant production was substantial within the agricultural policies in Turkey, while supports for animal production had been remained at a more limited level. As a result of this, important problems had begun to be experienced in livestock sector.

Implemented policies in this period had adversely affected both the quality and quantity of animal production. This situation had also caused the ambivalent in product prices and producers' incomes. In consequence of these adverse developments, in 1987, the government introduced "Agricultural Packet" measures, which particularly concerned livestock sector. As a part of this measure, subsidy payments for import of breeding animal, mixed feed sales and incentive premium payment for milk were initiated. Incentive premium payments for red and poultry meat were implemented periodically, but these subsidies were terminated in 1995. In addition, incentive premium was paid to private sector in order to support artificial insemination. Medicines used for animal health had been reimbursed at a rate of 20% over the drug price. However, these measures had not been sufficient, and as a result livestock had declined and Turkey's food imports have gradually increased after the 1980s (Aral and Cevger, 2000; Sayın, 2001).

In consequence of internal dynamics and external factors, the comprehensive agricultural reform had been added to agenda since 2000. One of the main reasons of agricultural policy reforms was the reducing the burden of agriculture on the economy especially after the economic crises in these years. Besides this internally factor, internationally binding and non-binding pressures played an important role in the reform initiatives. These were the Uruguay Round agreement on agricultural trade, the accession negotiations with the EU which put 'adjusting to the CAP' on political agenda, the 1999 agreement with the IMF reforming agricultural policy, and the agreement with the World Bank as an important financial supporter for the Agricultural Reform Implementation Project (ARIP) (Köse, 2012).

Therefore, after 2000, the aims of agricultural policies within the context of the agriculture reform had been changed considerably. The direct income support based on land (decoupled from type or quantity of production) had put into force as the main policy instrument instead of almost all input and output price subsidies and grants in various forms. In 2000, Decree of Supporting Livestock numbered as 2000/467 under "The Project of Supporting and Improving Livestock" was initiated for following five-year period in order to develop livestock and increase animal production. Along with this decree, incentives were brought for artificial insemination, calves born by artificial insemination, equipment to use for artificial insemination, animals with breeding certificate, and keeping the stud book records in order to bring the genetic breeding more efficient and common. Furthermore, supports such as breeding heifer support, beekeeping and honey support, support of incentive pay for meat and milk, forage crops support, and fisheries were implemented (Anonymous, 2000; Ertürk et al., 2015). In 2005, new decree numbered as 2005/8053 had been entered into force but it was withdrawn after one year. In the scope of this new decree, the supports of "payment per animal" were implemented as livestock policy instruments and artificial insemination supports were terminated (Saçlı, 2012).

In 2006, a legal framework was formed for supports via The Law of Agriculture entered into force (Ertürk et.al., 2015). The purpose of this law was to determine necessary policies and make regulations in order to be developed and supported of agriculture sector and rural area in line with development plans and strategies. Within this scope, main objectives of the support instruments for livestock were to increasing of coarse fodder production and animal breeding, increasing productivity, specialisation of animal enterprises, providing of animal health and welfare, ensuring the hygiene conditions in the enterprises, incentive of animal identification system, processing and marketing of animal products and their control, monitoring and improvement of standards, supporting of aquaculture (Anonymous, 2006).

Since 2017, Turkey has been initiated to implement a new subsidy program, which is called as "National Agriculture Project". This project covers a new subsidy allocation system for agricultural products.

The project was built on 941 agricultural basins based on climate and soil to subsidize specific crops for each zone. One of the important components of the project is "Domestic Production Support Model in Livestock". The main objective of this component is to eliminate import-based husbandry and to increase the livestock inventory in Turkey. The sub-components of the livestock subsidies are the establishing areas for grazing animals, the establishing breeding pregnant heifers' production centers, the establishing breeding ram and male goat production centers in order to produce high quality male stock for the other herds, the establishing buffalo production centers, the establishing resting and control/inspection stations in order to reduce the number of animal deaths and diseases from rough transport conditions (MAF, 2020).

In sum, especially from 2000s, Turkey has made enormous strides in terms of livestock policies. In this period, both the amount of new regulations in livestock supports and the share of livestock subsidies in total agricultural supports increased. As in recent years, many of the subsidies were given to livestock. While the share of livestock subsidies in total support was 0.02% in 1990, it reached 0.5% in 2000, 9.6% in 2005, 20.3% in 2010 and 34.6% in 2019 (MAF, 2020). Roughly 4.2 billion TL (0.5 billion USD) support was provided for the livestock sector in 2019, with 12 percent increase compared to the previous year.

The Results of Almon and Koyck Models

Almon and Koyck models, which are distributed lag models, were used to investigate the association between livestock support payments and animal production value in this study. In order to determine whether or not it was appropriate to distributed lag models of the relationship between these two variables at the studied period, a correlation analysis was performed. A correlation coefficient of 0.97 was found, indicating a strong relationship between the two variables. This result indicated that animal production value and livestock subsidies relationship could be studied using distributed lag models.

In order to form Koyck and Almon model, it was necessary to determine lag length of livestock subsidies series. For this purpose, it was used Schwarz Information Criteria (SIC). The lag length is found by determining value making the smallest to Schwarz value (Acquah 2010). At this stage, it was started with a very great k value (lag length) without making any restriction for the form of distributed lag (Özsayın, 2017). There is no general rule for determining the maximum lag length, so researchers usually determine this length by themselves subjectively. In the literature, the maximum lag length for monthly series is determined as 12 or 24, while this number can be set as 4, 8 or 12 for seasonal series (Kadılar 2000). In this study, maximum lag length was taken as "8" since dataset was yearly. In accordance with schwarz criterion value, which was determined for different lag lengths in Table 1, the smallest value of SIC was obtained as "6".

As it is seen in Table 1, the effect of livestock subsidies on animal production value would disappear after six years. After determining the lag length, the Koyck model was estimated to deal with multicollineratiy problems. The Koyck model estimation result was reported in Table 2. According to the results, livestock subsidies (Sub) had positive significant effect on animal production value (AV) with adjusted R^2 of 0.83 in value.

To investigate necessary time period for one-unit change in subsidies to have a perceptible effect on animal production value, it was calculated mean lags using Koyck model. According to the results, it took 2.98 years for subsidies to be felt on production value for livestock sector. (Table 2).

Considering that $\beta k = \beta_0 \lambda^k$, it can be reached regression equation (22) by using β_0 and λ derived from Koyck model.

$$Yt = \alpha + \beta_0 X_t + \beta_1 X_{t-1} + \beta_2 X_{t-2} + \ldots + \upsilon_t \text{ and } \beta k = \beta_0 \lambda^k \; k = 0,1,\ldots \quad (22)$$

$$AV = 1.630 + 0.054Sub_t + 0.040Sub_{t-1} + 0.030Sub_{t-2} + 0.023Sub_{t-3} + 0.017Sub_{t-4} + 0.013Sub_{t-5} + 0.010Sub_{t-6} \quad (23)$$

Calculation of the coefficients reported in equation (23) are as follows:

$\beta_0 = (\lambda^0\ \beta_0) = 0.054$; $\beta_1 = (\lambda^1\ \beta_0) = 0.040$; $\beta_2 = (\lambda^2\ \beta_0) = 0.030$; $\beta_3 = (\lambda^3\ \beta_0) = 0.023$; $\beta_4 = (\lambda^4\beta_0) = 0.017$; $\beta_5 = (\lambda^5\ \beta_0) = 0.013$; $\beta_6 = (\lambda^6\ \beta_0) = 0.010$

The effect of subsidy expenses on production value are geometrically declining as seen in equation (23), since λ is between 0 and 1.

However, while Koyck model suggests that lag coefficients undergo geometric decay, that is, the values of the lag coefficients decline in the pattern of a geometric progression, Almon model assumes that a polynomial of a fairly low degree can represent the lag coefficients (Watson & Teelucksingh 2002). For this reason, The Almon model is more flexible than the Koyck model in that it allows the effect of X on Y to change over time.

In the Almon model, "$\beta_k = \alpha_0 + k\alpha_1 + k^2\ \alpha_2$ "assumption is used instead of $\beta k = \beta_0\lambda^k$ assumption. It must be calculated α_0, α_1, α_2 values in order to be able to apply this assumption. In the Almon sequence that is created, the regression of dependent variable is acquired according to "Z" variables that have been generated, not according to "explanatory variable". Since polynomial model degree was determined as second, the empirical equation considering Z values can be written as follows (equation 24) according to results of the model in Table 3.

$$Y_t = \alpha + \alpha_0 Z_{0t} + \alpha_1 Z_{1t} + \alpha_2 Z_{2t} + u_t$$

$$Y_t = 6.425 + 0.087Z_{0t} + 0.012Z_{1t} - 0.013Z_{2t} + u_t \quad (24)$$

The result in Table 3 showed that the overall model was statistically significant with having relatively high the adjusted R-squared value (87%).

$$Y_t = \alpha + \beta_0\,Sub_t + \beta_1\,Sub_{t-1} + \beta_2\,Sub_{t-2} + \beta_3\,Sub_{t-3} + \beta_4\,Sub_{t-4} + \beta_5\,Sub_{t-5} + \beta_6\,Sub_{t-6} + \beta_7\,Sub_{t-7}$$

$$Y_t = 6.425 - 0.062\,Sub_t + 0.013Sub_{t-1} + 0.063Sub_{t-2} + 0.087Sub_{t-3} + 0.086Sub_{t-4} + 0.060Sub_{t-5} + 0.008Sub_{t-6}$$

According to Almon model results in Table 4, livestock support payments seemed to have a negative effect on animal production value in the current year, but after one year, this affect changed the sign and became positive. However, the parameters of supports "t-0" and from "t-2" to"t-5" found statistically significant. One unit increase for previous year in the livestock subsidies caused an increasing on current animal production value by 0.013 unit, this value fallowed an increase of animal production value for "t-2" period by 0.063, for "t-3" period by 0.087 and for "t-4" period by 0.086. After 5 years, the subsidies effect on production value decreased but impact was the positive.

CONCLUSION

Since the beginning of 2000s, agricultural policies related to livestock have changed rapidly and continuously. Besides, the share of that in total agricultural supports has also increased. Therefore, it has been necessary to carry out a study on determination of the effect of these changing supports on the value of animal production considering the lagged values. For this purpose, this study investigated that the existence and the effect of long-term relationship between animal production and subsidies in Turkey which has the problem of inadequate animal food production for many years. According to results, support payments for animal production came out as an important factor that would affect the farmer's production process. The results confirmed the expectations that subsidy payments could increase the attractiveness of livestock investments and accordingly, increase producer supply for the animal production. Besides, relatively high the adjusted R-squared value from Almon model indicated that 87% of the changes in animal production value could be explained by the support payments and lagged values of that.

Moreover, there was an increase in the value of animal production in the following years by means of the supports provided to livestock. According to the results provided by Almon model, the effect of this increase continued until the fourth year. After fourth year, this effect went on increase decreasingly. The Koyck model result showed that a 10% increase in subsidies would lead to an increase in animal production of 0.54% in current year, 0.40% in the following year, 0.30% in three years and 0.23% in the fourth year. This effect remained decreasingly until sixth year. According to Koyck model results, necessary time period for being felt on animal production value of one-unit change in subsidies took 2.98 years. As it could be seen in this study, livestock support payments could not only increase the value of animal production for current year, but also could increase the production value of the following years. In sum, animal production value was sensitive to the livestock subsidies of past periods. Supports had effect positively on farmers' decision and this effect remained 6 years.

In the last 100 years, the supports for plant production were substantial within the agricultural policies in Turkey, while supports for animal production has been remained at a more limited level. As a result of this, important problems have begun to be experienced in livestock sector. Implemented policies in this period have adversely affected both the quality and quantity of animal production. This situation had also caused the ambivalent in product prices and producers' incomes. The major problems of animal production in Turkey are low productivity and high production costs. This is closely related to the race characteristics of existing animals as well as animal husbandry and feeding. Besides that, some factors such as the high cost of animal feed, which is the important cost factor in animal breeding, small-scale production, unorganized and inadequacy of marketing infrastructures affects adversely the competitiveness of the sector. According to these results, animal production problem in Turkey should be solved by long term and stable structural livestock policies to be provided for livestock and the sector's competitiveness can be increased.

The study only aimed to focus on the investigation of the link between livestock subsides and livestock production value. However, further research is needed to the investigation of the effects of these subsidies from the various aspects such as socio-economic and productivity on the sector by based on comprehensive survey data.

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Tables and Figures

Table 1. Lag length values (Schwarz criterion)

Lag length	k=0	k=1	k=2	k=3	k=4	k=5	k=6	k=7	k=8
Schwarz criterion	3.01	0.02	-0.83	-0.56	-0.93	-0.62	-0.96*	-0.58	-0.77

Table 2. The results of Koyck model

$$AVt = 1.630 + 0.054Sub_t + 0.749\ AV_{t-1}$$

	Parametres	Coefficient	Std. Error	t-Statistic	Prob.
Constant	α	1.630	0.398	3.365	0.001**
Ln(Sub)	β	0.054	0.027	1.769	0.088*
Ln(AV (-1))	λ	0.749	0.071	10.622	0.000**
Adjusted R^2=0.829 F=71.217 p=0.000 DW=1.95					
Mean lag value	=λ/(1−λ)	2.98			

*** and * indicate p-values significant at 1% and 10% levels respectively.*

Table 3. The results of Almon model

Parametres	Coefficient	Std. Error	t-Statistic	Prob.
Constant	6.425	0.050	128.365	0.000**
Z_0	0.087	0.021	4.201	0.000**
Z_1	0.012	0.005	2.420	0.025*
Z_2	-0.013	0.005	-2.359	0.029*

Adjusted R^2=0.874 F=53.983 p=0.000

*** and * indicate p-values significant at 1% and 5% levels respectively.*

Table 4. Lag effects of livestock subsidies on animal production value in Turkey in Almon model (m=2;p=6)

Lag Distribution of Variables	i	Coefficient	Std. Error	t-Statistic
* . |	β_0	-0.062	0.030	-2.030*
.* |	β_1	0.013	0.010	1.380
. * |	β_2	0.063	0.016	3.847*
. *|	β_3	0.087	0.021	4.201*
. *|	β_4	0.086	0.016	5.375*
. * |	β_5	0.060	0.011	5.624*
.* |	β_6	0.008	0.033	0.243
	Sum of Lags	0.256	0.023	11.205

*p<0.01

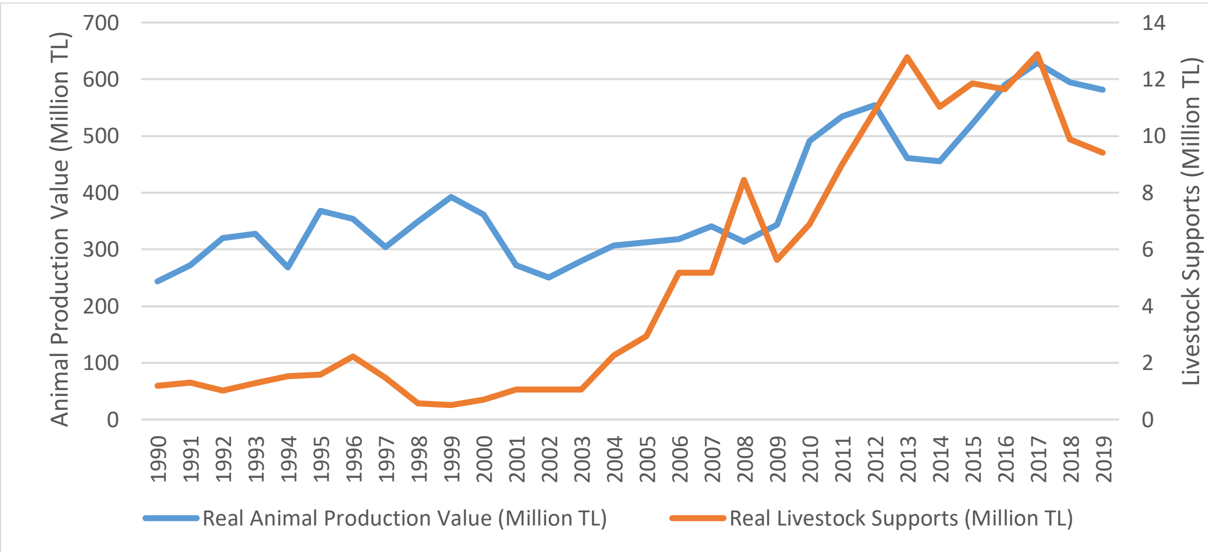

Figure 1. Animal production value and livestock supports by the years in Turkey (2003=100) (TURKSTAT, 2020; MAF, 2020; OECD, 2020).