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AN ENTERPRISE LEVEL ANALYSIS OF THE FACTORS AFFECTING BEEF PRODUCTION

N. Ertek[1] and A. Keskin[1]

[1]Department of Agricultural Economics, College of Agriculture, Ataturk University, Erzurum, Turkey
Corresponding Author's E-mail: akeskin.25@gmail.com

ABSTRACT

The purpose of this study was to perform an enterprise level analysis of the factors influencing production of beef. This analysis is based on a structural equation model projected by taking the social, technical and economic production aspects into account in unison. In the model, the cross-sectional data obtained from the surveys conducted with 256 farmers in the TRA region in 2015, was used. The results of the study indicated that the most crucial animal production infrastructure that has an impact on bovine meat production at enterprise level was the technical aspect. Within the scope of the animal production infrastructure, the type of barn, the ratio of the culture / mixed species within the entire feeder cattle population and the amount of the daily-consumed concentrate feed, were determined as the most important variables respectively. The structural equation model, when taken into account in a general manner, shows that the policy makers within the scope of the TRA region should prioritize structural policies aimed at improving and developing the technical structure of bovine meat production and should shift their support to this area.

Keywords: economic structure, animal production, TRA Region, Structural Equation Model, Turkey.

INTRODUCTION

The fluctuations in the price of milk (Figure 1) and the inputs especially the price of feed (Figure 2) throughout recent years has led to the slaughter of a sizeable amount of livestock and a considerable decline in the bovine population in addition to meat production (Figure 3). The graphs below present figures for Turkey in general in addition to the region-specific figures for the TRA region (Erzurum, Erzincan, Bayburt, Kars, Ağrı, Iğdır, Ardahan) to highlight the area of the study (Anonymous, 2016b).

While the price of the milk peaked between 2004 and 2006; it began decreasing thereafter with the exception of the year 2010. In the TRA Region, where stockbreeding is vitally important, the aforementioned fluctuations were experienced more severely. In the same manner, price fluctuations experience in the feed, which happens to be the most important input for the stockbreeding sub sector, led to the slaughter of breeding animals for dairy farming which constitute a source for stockbreeding (Ünlüsoy *et al.* 2010).

Decline in bovine meat production by year (as indicated in Figure 4) is alarming for the sector when considering the low productivity levels. In addition, the rise in income per capita experienced in recent years (Figure 5) also led to an increase in red meat consumption. As a result, due to the failure to meet increasing demand, meat prices had risen (Figure 6) (Anonymous, 2017).

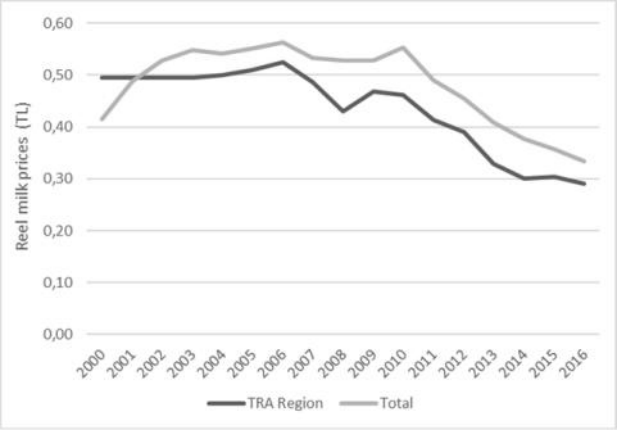


Figure 1. Reel milk prices by year (2003=100)

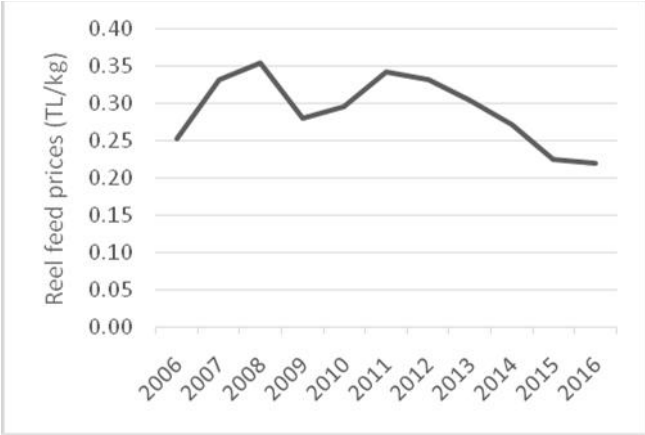


Figure 2. Reel feed prices by year (2003=100)

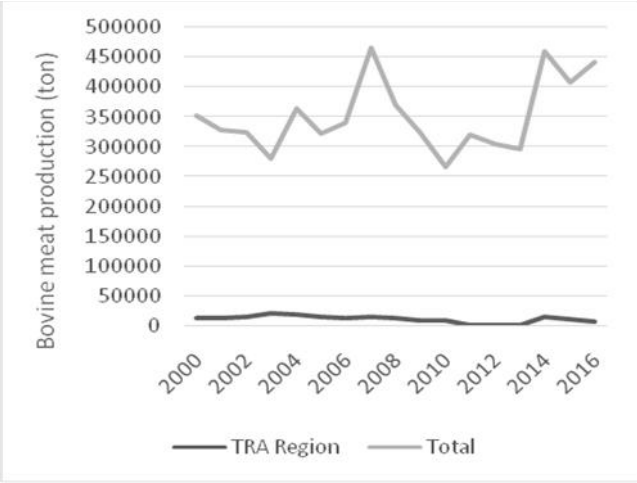


Figure 3. Bovine meat production by year

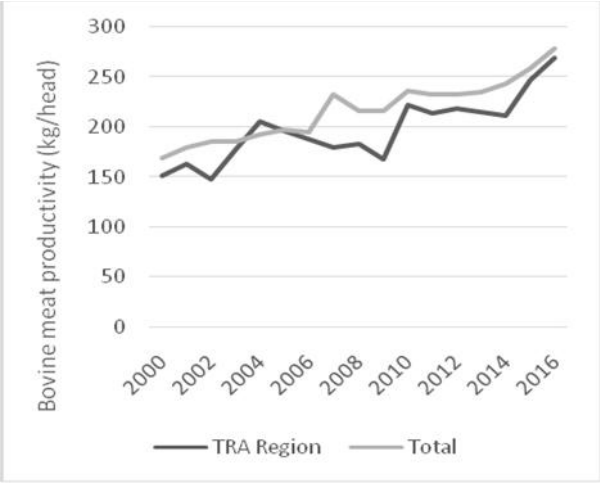


Figure 4. Bovine meat productivity by year

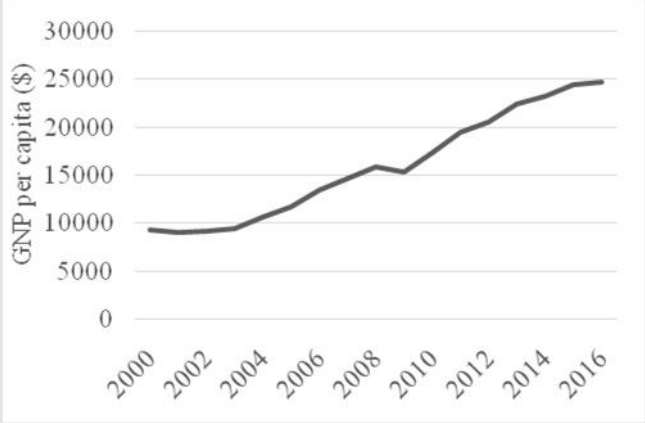


Figure 5. GNP per capita by year

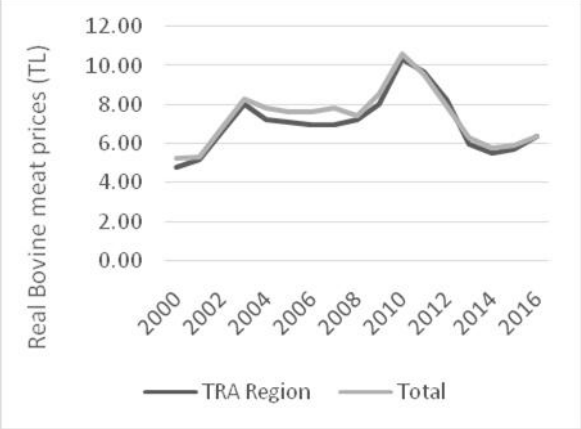


Figure 6. Real Bovine meat prices by year (2003=100)

The increase in prices prepared the environment for the deregulation of the import of live bovine and bovine meat in 2016 (Aydın *et al.* 2010). When this structure is taken into account with a holistic approach, it can clearly be seen that there are some very serious problems in bovine meat production. The efforts made towards the solution of the structural problems focused on which one of the structural problem should be given priority in terms of the social, technical and economic aspects of animal production. In addition, the study is important in terms of providing sufficient and balanced nutrition and preventing foreign source dependency. As of 2016, meat consumption per capita is 25.00 kg in USA, 11.00 kg in Russia and 10.90 kg in the EU area, while the amount is 8.40 kg in Turkey (Anonymous, 2016a). It is clear that Turkey is way behind the developed countries in terms of sufficient and balanced nutrition. The fact that bovine meat consumption in Turkey has not yet reached desired levels makes the studies conducted for the purpose of increasing bovine meat production even more important.

The purpose of this study is to analyze the factors that affect bovine meat production at the enterprise level. This analysis is based on a structural equation model that was estimated by factoring in the social, technical and economic animal production structure taking them into account altogether. Within this scope, an attempt to determine which factors should be prioritized in the policies was exercised in order to increase bovine meat production.

There are several studies and works that analyze animal production in terms of social, technical and economic aspects respectively (Ball and Chanbers, 1982; Yavuz, 1994; Yavuz, 1999; Keskin *et al.* 2000; Yavuz *et al.* 2003; Yavuz *et al.* 2006; Turhan *et al.* 2010; Keskin *et al.* 2010). However, there is no study in the literature which analyzes the social, technical and economic factors altogether by considering their impact on each other. Hence, this study fills an important gap. In addition, the

study clarifies the question of "Which of the social, technical and economic structures within animal production structure should be given priority over the rest when formulating policies?"

MATERIALS AND METHODS

The data used in the study is obtained from surveys conducted on 256 farmers from the TRA Region (Erzurum, Erzincan, Bayburt, Kars, Ağrı, Iğdır, Ardahan) defined as one of the Level 1 regions in Turkey. LISREL 9.1 software was used for the analysis of the model. Concerning the topic, enterprises that were only related to livestock breeding were included in the sample size of the study. The number of enterprises which the surveys would be applied to was determined by the Stratified Sampling Method by considering the number of animals (according to the General Agricultural Census) that the enterprises have. The strata were divided as the enterprises having 0-4, 5-9, 10-19, 20-49 and 50+ animals. Since the enterprises that have 0-4, 5-9 and 100+ animals were deemed as extreme values, they were not included in the sampling. It was projected that a part of the survey would not reflect the facts and would not represent the population, the number of surveys was increased by 10%. For the determination of the number of enterprises which the surveys would be applied, work was accomplished within a confidence level of 95% with a margin of error by 5% (Çiçek and Erkan, 1996). As a result, the number of surveys to be conducted was determined with the formula below:

$$n = \frac{Nz^2\sigma^2}{d^2(N-1)+z^2\sigma^2}$$

In the formula;

n = sample size,

N = the total number of units belonging to the sampling frame.

σ^2 = population variance

d =acceptable error ($\bar{x}$ .0.05)

z= *z* value in the standard normal distribution table based on the rate of the acceptable error.

The analysis of the factors that influence bovine meat production at the enterprise level were conducted with the assistance of the structural equation model formulated by taking the social, technical and economic aspects of the animal production into account altogether. While the data was being analyzed, a path analysis was conducted with the observed variables. Then a measurement model that indicated how latent variables or the hypothetical structures are defined by observed variables and how that indicates the measurement characteristics of the observed variables (reliability and validity) was defined (Jöreskog and Sörbom, 1996). This model is the cluster of the connections between the observed and the latent variables.

After defining the measurement model, a structural model was shaped and the conformability criterion was calculated. Finally, the estimation of the model was performed and it was interpreted in line of the results.

THEORETICAL FRAMEWORK

Structural Equation Model: The Structural Equation Modeling clearly takes measurement errors into account when statistically analyzing the data. In addition to the fact that the model can handle measurement errors, the structural equation model enables researchers to develop, estimate and test complex models with multiple variables, as they are also capable of considering the direct and indirect effects of variables in any given model. In essence, the purpose of the Structural Equation Analysis is to reveal whether pre-determined patterns of connections are verified by the data or not (Bayram, 2010).

***The Mathematical Formation of the Structural Equation Model*:** The linear equations, formed for the observed variables of the independent latent variable are presented below:

$$\boldsymbol{x = \Lambda^x.\xi + \sigma}$$

X: The matrix of the observable variables,

Λ^x: The factor index of the measured independent variables, which are affected by the independent latent variables.

ξ: Independent latent variable,

σ: Error Vector for the observed variables of the independent latent variables.

The linear equations, formed for the observed variables of the dependent latent variables are as follows:

$$y = \Lambda^y.\eta + \varepsilon$$

y: The observed vector of the observed variables of the dependent latent variables.

Λ^y: The factor matrix of the observed variables, belonging to the dependent latent variables,

η : Dependent latent variable.

E: The Error vector for the observed variables, belonging to dependent latent variables.

The linear equations, formed for the structural model are presented below:

$$\eta = \Gamma.\xi + B.\eta + \zeta$$

Γ: Regression factor matrix of the dependent latent variables which are influenced by the independent latent variables,

B: Regression factor matrix between the dependent latent variables, influenced by the independent latent variables,

ζ: Regression factor matrix of the dependent latent variables which are not influenced by the independent latent variables.

Assumptions of the Model:

1. The observed variables have a normal distribution with multiple variables,
2. The latent variables have a normal distribution with multiple variables,
3. There are linear relations between the latent variables,
4. There are linear relations between the observed and the latent variables,
5. There are outliers present.
6. The error terms have no correlation,
7. There are no multi-collinearity problems,
8. The sufficient sample size was obtained.

In the model utilized for the study (Figure 7), the latent variable is the bovine meat production at enterprise level (BMP). The observed variables are as follows:

- ***The Social Structure (SS) related-observed variables aimed at livestock breeding:***

➢ EST : Education status.
➢ ASS : The availability of a social security.
➢ PE : Professional experience.
➢ DLE : The distance of the land to the enterprise.

- ***The Technical Structure (TS) related observed variables aimed at the livestock breeding:***

➢ BS : The structure of the barn (Traditional or modern).
➢ CCR : The ratio of the cultivated or crossbreed species within the total Number of animals,
➢ RC : The daily consumed amount of roughage
➢ CF : The daily consumed amount of concentrate feed.

- ***The Economical Structure (ES) related observed variables aimed at livestock breeding:***

➢ NBC : Number of beef cattle
➢ MA : Membership of any association,
➢ LS : Whether any livestock subsidies are benefited or not.
➢ PLC : The price of live cattle
➢ GM : Gross margin,
➢ IPM : Incentive payments for meat.

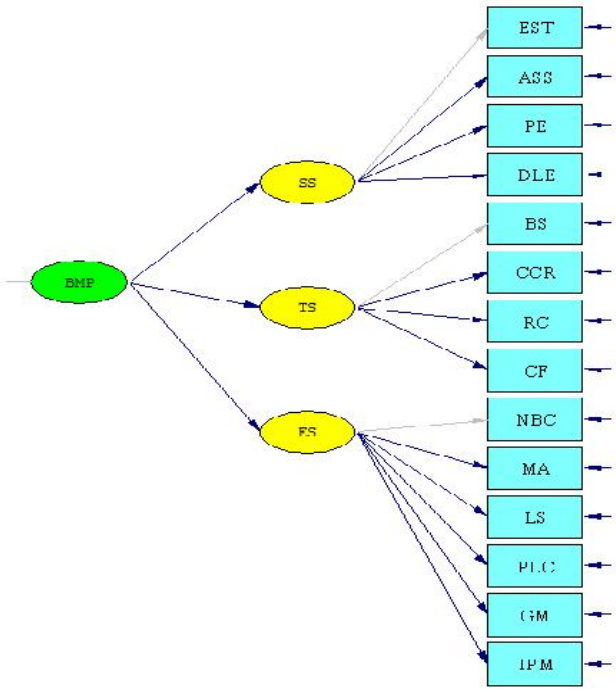


Figure 7. The figure based representation of the structural equation model

STUDY FINDINGS AND DISCUSSION

Measurement Model: The measurement model is a confirmatory factor analysis process where the latent variables are considered general factors. Jöreskog and Sörböm (1996) reported that the main purpose in a measurement model is indicating how sufficient as measurement tools the indicators are, for measuring latent variables (Sümer and Bek, 2012).

The social, technical and economic structures that influence bovine meat production were analyzed via SPSS Statistics Software Suit by taking a total of 14 variables into account. The acceptability of the data was tested by the Kaiser-Meğer-Olkin (KMO) quotient and Bartlett Sphericity Tests. The KMO quotient requires a figure above 0.60 for factorability of the data matrix for its acceptability. The Bartlett test analyzes whether there is a relation between the variables on a partial correlations base (Büyüköztürk, 2009). As a result of the factor analysis, the KMO quotient was revealed to be 0.688 and it was determined that the data is acceptable for factor analysis.

For the measurement criterion, used for analyzing the harmony between the model and the data, the X square/degree of freedom (X^2/DF), p value and RMSEA Root - mean-square error approximation) value were examined. The X square / degree of freedom harmony index should be close to zero or should get a value below 5 (Schumacher and Lomax, 2004). The X Square / freedom (X^2/DF) ratio for the study model was calculated to be 4.43. Therefore, the value is considered

to be within the acceptable range. The RMSEA value was found to be 0.10 in the model. Since this model falls within the range of 0.08 – 0.10, it is acceptable, albeit not being in good harmony. The study model is statistically significant at 5% significance level due to the fact that it was calculated to be p<0.0000. The indicated values show that the results of the model are at an acceptable level based on the model accordance criterion and the standard value.

The *t* values of the variables, observed in Table 1,and all the observed independent variables were considered statistically significant at 5% significance level with the exceptions of the following variables: whether social security is available or not (Social factors); whether there is membership of any association or not; and whether any livestock subsidies are benefitted or not (economic factors).

While professional experience (PE) was found to be the most important factor in the social structure, it was followed by educational status (EST). The most important factors in Technical structure were the structure of the barn (BS) and the ratio of cultivated or crossbreed species within the total number of animals (CCR) respectively. The most important factors in economic structure were revealed to be the gross margin (GM) and incentive payments for the meat (IPM) respectively.

In addition, the relationship between technical infrastructure and economic structure as well as social structure was found to be statistically significant at 5% significance level while the relationship between social structure and economic structure was revealed to be insignificant.

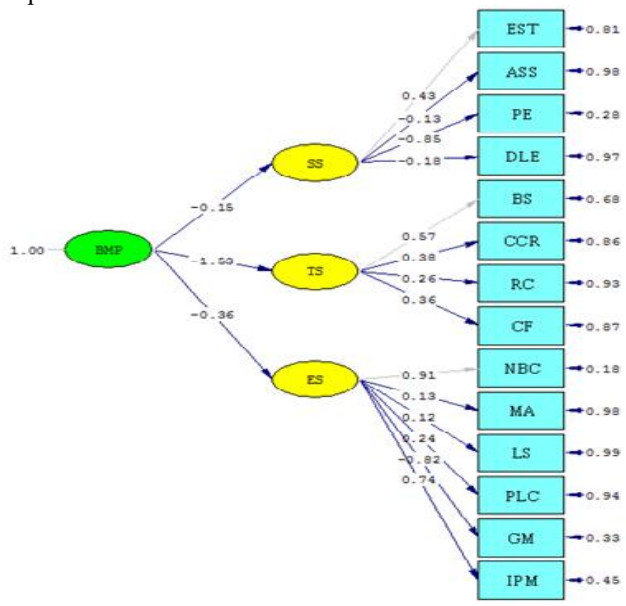
Table 1. The Parameters of the Observed Variables

Latent Variables	*Observed Variables*	*t value*	*Standard Error*	R^2
Social Structure(SS)	EST	3.39	0.106	0.190
	ASS	-1.75	0.091	0.017
	PE	-4,06	0.030	0.720
	DLE	-2.33	0.280	0.032
Technical Structure (TS)	BS	6.82	0.054	0.320
	CCR	3.61	0.023	0.140
	RC	2.76	0.086	0.067
	CF	3.50	0.046	0.130
Economic Structure (ES)	NBC	4.33	0.076	0.820
	MA	1.93	0.022	0.016
	LS	1.80	0.033	0.014
	PLC	3.76	0.026	0.060
	GM	-14.75	0.058	0.670
	IPM	13.19	0.087	0.550

Source: Original calculations.

Structural Model: The main purpose of the structural model is to define the relationship between the latent variables and to test the proposed cycle (Kline, 2005). The conformity stats of the structural model defined by the measurement model, are the same as the measurement model. In contrast to the measurement model, the structural coefficients between the latent variables were analyzed (Bagozzi and Yi, 1988; Sümer and Bek, 2012). Figure 8 provides the structural model and the standard values. According to this, the current social, economic and technical structure adversely affect bovine meat production within the region in question. When the production of bovine meat at the enterprise level is analyzed as a whole, in terms of its social, technical and economic aspects, it was determined that the technical structure in bovine meat production was more significant (-1.53).

There is a negative relationship between bovine meat production at the enterprise level and professional experience and gross margin while the said relationship is positive for all other observable variables. When professional experience is associated with age, the traditional attitudes of the older population against innovation, as well as their expectations for the future has negative impact on bovine meat production. In addition, with the exception of two enterprises, all the enterprises within the scope of the study obtained negative values for the gross margin. Therefore, the negative relationship between the gross margin, which is included in the economic factors, and bovine meat production, can be explained in this context.



Chi-Square = 327.67 df= 74 P-value= 0.0000 RMSEA= 0.10

Figure 8. Structural model and its standard values

In the structural equation model, how well a pre-determined model, (a theory) explains the obtained data is determined by the 'Goodness of Fit' Index. The

Goodness of Fit Index is the stage where the model is accepted or rejected. While there are various Goodness of Fit Indexes, in application only 4 - 5 of them are in widespread use (Cengiz and Kırkbir, 2007). In this study, the most commonly preferred Goodness of Fit Indexes were utilized.

For this study, the X^2/DF was calculated as 4.43 for the structural model. Therefore, the study is within the acceptable range. RMSEA and *p* values are used for the evaluation of conformity. While the p value for the Study Model is within the acceptable range (p: 0.0000), the RMSEA value was revealed to be at the maximum limit (0.10).

Another criterion used to evaluate how well the model fits into the data set is the Goodness-of-Fit Index (GFI). This index should get a value between 0 and 1. The following criterion should also get a value between zero and one: Adjusted Goodness-of-Fit Index (AGFI), Normed Fit Index (NFI), Relative Fit Index (RFI) Incremental Fit Index (IFI), Tucker-Lewis index (TLI), Non-Normed Fit Index (NNFI), and Comparative Fit Index (CFI). In this study, the values regarding the indicated criterion were close to 1. The aforementioned values, being close to 1, indicate that the conformity between the model and the data is perfect while 0 represents a non-conformity (Külter, 2010).

Table 2. The Conformity indexes of the structural equation model.

Conformity indexes	Conformity Symbols	Model Value
X^2 / Degree of Freedom	X^2/df	4.43
p value	P	0.00
Goodness-of-Fit Index	GFI	0.85
Adjusted Goodness-of-Fit Index	AGFI	0.78
Normed Fit Index	NFI	0,69
Tucker-Lewis index	NNFI	0.69
Relative Fit Index	RFI	0.62
Comparative Fit Index	CFI	0.75
Incremental Fit Index	IFI	0.75
Root mean square error of approximation	RMSEA	0.10

Source: Original calculations.

The Goodness-Of-Fit Indexes were found to be around 0-1, which falls within an acceptable range. Therefore, it is safe to say that, the study model developed/based on the theory, is in conformity with the data set (Table 2).

RESULTS

The fluctuations in milk prices experienced in recent years, as well as the increase in the price of the inputs (especially the feed), has led to the slaughter of countless dairy livestock and subsequently, a steep decline was experienced in the bovine population and thus in bovine meat production. Decline in bovine meat production by years, when taking low productivity levels into account, signals a troubling bottleneck situation for the sector.

According to the results of the study, the current social, technical and economical animal production structures, adversely affect bovine meat production in the TRA Region. When the production of bovine meat, at the enterprise level, is analyzed as a whole in terms of its social, technical and economic aspects, it is safe to say that the technical structure in bovine meat production was most important. Significant factors that influence bovine meat production, in order of importance, are: professional experience and educational status (in social structure), the structure of the barn, the ratio of cultivated or crossbreed species within the total number of animals, as well as the daily-consumption of concentrate feed (in technical structure) and finally the number of animals, gross margin, incentive payments and the price of live cattle (in economic aspect).

Regarding livestock breeding, support for the technical aspect of bovine meat production in the TRA Region should be provided in the form of regional level re-planning and regulations that take animal health and wellbeing into account in order to enable the transition to modern barns and to increase the ratio of cultivated or crossbreed species within the total number of animals. Within this context, more effective utilization of the IPARD Program should be realized. In addition, artificial insemination programs and projects that will be developed in this regard, should be prioritized in order to increase the ratio of the cultivated or crossbreed species. The amount of daily-consumed concentrate feed seems to be an important factor for the producers. Therefore, subsidies towards the consumption of concentrate feed to improve the technical structure are viewed as a convenient tool of policy making.

The results of the studies demonstrate that the support for livestock breeding is not effective at the bovine meat production level. In addition, the level of the utilization of the support with regard to explaining the economic agricultural structure was found to be low (0.12). The livestock breeding activity, due to the importance and the unique characteristics of agriculture, should be supported as it has been supported in all other countries. However, such a support should be formulated in a constant manner, and in a way that would increase the competitiveness of the enterprises. On the other hand, it is clear that the incentive payments for meat are important political tools. When the results of the study are reviewed as a whole, it is seen that the most important factors that influence cattle feed at enterprise level, in

order of importance, are: technical, economic and social factors. This order is crucial in terms of political priorities and the efficient use of resources. However, the results, given here should be evaluated and interpreted within the scope and context of the TRA Region because, it is known that the Level 1 regions differ from other regions in many aspects. Further studies are needed to reach to conclusions applicable for other TRA regions in the Country.

In light of all the analyses presented here, it is safe to say that the most basic factor that influences bovine meat production in the TRA region, is profitability. The results of the study demonstrate that agricultural policies which may be implemented towards the improvement of the Technical Structure, which is an important instrument in terms of providing a profitable and sustainable income in animal production, will result in the improvement of the economic structure and subsequently the social structure in an automatic manner. Hence policies towards the establishment of optimum enterprise size, in terms of livestock, should be accelerated.

REFERENCES

Anonymous. (2016a). World Agriculture Outlook, http://www.globalagriculture.org/, (10.02.2016).

Anonymous. (2016b). Turkish Statistics Institution, www.tuik.gov.tr/, (05.05.2017).

Anonymous. (2017). Organization for Economic Co-operation and Development, https:// data.oecd.org/, (20.05.2017).

Aydın, E., M. F. Can, Y. Aral, Y. Cevger and E. Sakarya (2010). The impact of the decisions on the import of the livestock and red meat in Turkey on the bovine stockbreeders, J. Veterinarians. 82(2): 51-57.

Bagozzi, P. R. and Y. Yi, (1988). On the Evaluation of Structural Equation Models, J. the Academy of Marketing Science.16(1): 74-79.

Ball, V.E. and G.R. Chambers (1982). An Economic Analysis of Technology in The Meat Products Industry, American J. Agricultural Economics. 64(4): 699-709.

Bayram, N. (2010). Introduction to Structural Equation Model and Amos Applications, Ezgi Printhouse, Bursa.

Büyüköztürk, Ş. (2009). Data Analysis Handbook for Social Sciences, Pegem Academy, Ankara.

Cengiz, E. and F. Kırkbir (2007). A suggestion for a structural model aimed at the relationship between the total tourism effect, perceived by the local population and the Tourism subsidies. J. Social Sciences. 07(7): 19-37.

Çiçek, A. and O. Erkan (1996). Research and Sampling Methods in Agricultural Economy Gaziosmanpaşa University Faculty of Agriculture Print house, No: 12, Lecture Note Series No: 6, Tokat.

Jöreskog, K. G. and D. Sörbom (1996). LISREL 8: Users Reference Guide, SSI International.

Keskin, A., A. Aksoy and F. Yavuz (2000). Ana Analysis on the Structural Changes Between the Regions in Red Meat Production in Turkey 4. Congress of Agricultural Economics, Tekirdağ.

Keskin, A., V. Dağdemir and N. Demir (2010). Economic Analysis of Sheep Breeding According to The NUTS Level 1 Region in Turkey, Scientific Research and Essays. 5(7), 641-645.

Kline, B. R. (2005). Principles and Practice of Structural Equation Modeling, the Guilford Press, 2nd ed., New York.

Külter, B. (2010). The effect of the store characteristics on the brand choices of the retailers, J. Social Sciences. 7(14): 163-182.

Schumacher, R.E. and G.L. Richard (2004). A Beginner's Guide to Structural Equation Modeling, 2nd Edition, Lawrence Erlbaum Associates Publishers, London.

Sümer, N. and Y. Bek (2012). Structural Equation Models and LISREL Applications, Ondokuz Mayıs University Faculty of Agriculture, Faculty of Sciences and Literature, Samsun.

Turhan, Ş., B. Erdal and B. Çetin (2010). Price Formation in Red Meat in Turkey and the Influencing Factors, IX. Agriculture Congress, Şanlıurfa.

Ünlüsoy, K., E. İnce, and F. Güler (2010). Red Meat Industry and the Competition Policy in Turkey Competition Authority III. Department, Ankara.

Yavuz, F. (1999). The Analysis of the Livestock and Dairy Stock Breeding Policies in Turkey, Declarations of the I.st livestock and dairy stock breeding Symposium in Turkey (December 2-3), İzmir.

Yavuz, F., Ö. Akbulut and A. Keskin (2003). A Study on the Efficiency of the Reform and Support Policies in Turkish Bovine Industry Turkish J. Veterinary and Animal Sciences, 27, Ankara.

Yavuz, F., A. Keskin and H.B. Işık (2006). The Comparative Analysis of the Changes in Meat Prices in Turkey, with EU. VII. Congress of Agricultural, Antalya.

Yavuz, O. (1994). The Structural Issues of the Eastern Anatolian Agriculture and Suggestions for Solutions I. Congress for Agricultural Economics, İzmir.