Productive cost analysis and evaluation of cost-return models of pig farms in Greece

STAMATIS AGGELOPOULOS*

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Abstract

Pig farming is one of the most important sectors of animal production in Greece. One of the main problems that pig farming is faced with in Greece, in relation to the other countries of Europe, is the high cost of production, which affects the competitiveness of the sector both in the international and domestic market.
From an analysis of the cost data, it is found that labour expenses decrease as the size of the farm increases, while the annual livestock, veterinary care and other expenses increase along with the size of the farms. The feeding expenses seem to be higher in medium-capacity farms, and lower in low-capacity farms. Furthermore, the analysis shows that the greatest effect and significance in the determination of the total cost is attributed to the cereal grain (raw feed material), that constitutes a basic part of the supplied livestock feed.
This analysis serves to prove that there is a need for financing new building installations and for the purchase of modern mechanological equipment, since such a step will lead to increased productivity, lower the production cost and improve the working conditions for all those employed in this sector.

Key-words: pig farming, production cost, performance, principal components analysis, financing

Résumé

L'élevage de porcins est l'un des secteurs les plus importants de production animale en Grèce. Par rapport aux autres pays européens, la Grèce se trouve face à des coûts de production élevés qui se répercutent sur la compétitivité de cet élevage sur le marché national et international.
L'analyse des données économiques montre que les coûts du travail se réduisent au fur et à mesure que les dimensions de l'exploitation augmentent alors que les frais pour les animaux, pour les soins vétérinaires augmentent avec les dimensions de l'exploitation. Les dépenses alimentaires sont plus importantes dans les exploitations moyennes et plus faibles dans les petites exploitations. De plus, l'analyse montre que l'effet le plus significatif dans la détermination du coût total est lié aux aliments céréaliers qui sont à la base de l'alimentation animale.
Cette analyse met en lumière la nécessité de financer de nouvelles installations et d'acheter des équipements mécaniques modernes afin d'augmenter la productivité, de réduire les coûts de production et d'améliorer les conditions de travail de tous ceux qui sont employés dans ce secteur.

Mots clé: *élevage de porcins, coûts de production, performance, analyse des composantes, financement*

1. Introduction

Pig farming is a particularly important activity of the EU agricultural sector, since it corresponds to 11% of the agricultural production of Europe. The EU of 25 member-states includes 2,165,000 breeders, while the total number of animals is equal to 151,867,000 pigs (European Commission, 2003).

In Greece, pig farming is considered one of the most dynamic sectors of the rural economy, since it contributes to the overall production of meat by 30% and covers approximately 60% of the annual demand for pork (Ministry of Agriculture, 2003). Greek pig farming represents 1.66% of the total number of breeders and 0.65% of the total number of pigs in the EU (European Commission, 2003). Since the 1960s and the implementation of funding programmes and financial subsidies, pig farming in Greece has begun to evolve from a family business into an entrepreneurial activity. From 1995 onwards, the sector seems to have acquired a clear entrepreneurial orientation and is characterized by intense livestock concentration (Batzios, 2001). Nevertheless, despite the improvements made in recent years, there are still weaknesses observed in relation to most pig farming enterprises, which can definitely be attributed to the slow pace of business development within the sector. As a result, Greek pork is in a less competitive position than European pork. The competitive profile of Greek pig farming can improve either through an increase in production or by reducing the overall production cost (Vlachos, 2003).

The breeding expenses for pigs are a correlation of the total production of pork per sow (performance), the average number of sows used for breeding, the mean daily weight gain of the fattening pigs, and the "convertibility" of the feed (Kitsopanidis, 1999).

The aim of this paper is to study the formulation of the production cost in Greek pig farming enterprises, and the correlation and progress of the overall production cost and the total annual production of pork, in relation to the size of the farms. In addition, the paper will explore the "internal consistency" of the factors that comprise the overall production cost and their role in its formulation.

2. Materials and Methods

The research was carried out in the geographical regions of Attica-Viotia-Evia, Thessaly, Central Macedonia and Western Greece, which are considered important pig farming centres in Greece. The variety of breeding conditions in these regions can allow us to make a generalization of the study results for the whole country, without any major deviation from the real picture (Galanopoulos, 1998). The

* Department of Farm Management, Alexander Technological Educational Institute of Thessaloniki, Greece

technical-financial data in the study refer to the period 2000-2001 and were collected through specially prepared questionnaires.
The sampling method used for the determination of the sample was the analogical stratified sampling (Farmakis, 1994; Apostolopoulos, *et al.*, 2001). Thus, the sample was proportionately collected from 12 strata (4 study areas and 3 size groups for the pig farming enterprises). The sample size was set at 80 pig farming enterprises, a number that corresponds to 22.4% of the total number of pig farms in the selected regions and 9% of the total number of pig farms in the country (Table 1). It includes 43 businesses from Thessaly, 5 from Macedonia, 18 from Attica-Viotia-Evia, and 14 businesses from Etoloakarnania.

Table 1: *Ranking of pig farming enterprises according to size*

Prefectures	Size classification of the enterprises					
	20-199 sows		200-399 sows		≥400 sows	
	Total number of farms	No of farms in the sample	Total number of farms	No of farms in the sample	Total number of farms	No of farms in the sample
Evia	12	2	10	3	36	2
Trikala	78	14	8	3	24	3
Etoloakarnania	13	4	8	7	20	3
Larisa	22	9	11	5	17	2
Karditsa	10	4	5	1	7	2
Drama-Xanthi	12	3	5	1	6	1
Attica-Viotia	24	4	18	3	12	4
Total	171	40	65	23	122	17

SOURCE: Research data

In order to study and compare their production expenses, the pig farming enterprises were divided into three categories, depending on the size of their breeding activities (M) (Whittemore, 1993; Dotas, 1995):
-M_1: This includes low-capacity farms with 20 to 199 sows. They are family-type units that only use basic operating equipment.
-M_2: This includes medium-capacity farms with 200 to 399 sows. They are units that possess integrated feed mix production systems with different levels of automation. They present a high rate of modernization and follow the latest developments in pig farming.
-M_3: This includes high-capacity farms with 400 or more sows. They are industrial-type units, with an important rate of verticalization.
According to the relevant literature, the basic factors which formulate the overall production cost in a pig farming enterprise are labour, feeding, annual livestock expenses, annual expenses for fixed assets (buildings and equipment) and expenses for drugs-vaccinations (Kitsopanidis, 1999; Lansink and Reinhard 2004). The level of the overall production cost is particularly important, since it is linked to the profit gained by the pig farming enterprises and their degree of competitiveness (Kitsopanidis, 1999).
The basic production expenses were determined using the technical-financial data from the farms in the sample as a basis, and were then classified according to their size. The classification was carried out using the non-parametric Kruskal-Wallis test, which corresponds to the non-parametric analysis of variance test (Anova-analysis) with one factor (independent variable) (Agresti and Agresti, 1979; Hinkle *et al.*, 1988; Tsantas *et al.*, 1999). The size of the enterprise was taken as the independent variable, with three levels M_1, M_2, M_3, and the production cost data were the dependent variables. In case of statistical significance in the Kruskal-Wallis test, the paired comparisons of the levels of the independent variable were performed using the Mann-Whitney statistical test, which corresponds with the non-parametric t-test for independent samples (Hinkle *et al.*, 1988; Tsantas *et al.*, 1999). It is worth noting that the non-parametric tests were chosen because it was considered that the assumptions of normality or homogeneous variance were not valid.
Through the application of Principal Components Analysis, we studied the consistency of the variables that comprise the overall production cost, and their significance in its final formulation (Nieuwoudt, 1972; Cattell, 1978; Dunteman, 1989; Tabakis, 2001; Quetier *et al.,* 2005).
The production cost for pigs is a correlation of the overall production of pork per sow (performance), the average number of sows in production (size of farm), the average daily weight gain of the fattening pigs, and the "convertibility" of the feed (Vaessen and Backus, 1997; Kitsopanidis, 1999). Therefore, based on the above, the correlation was examined between the total annual production of meat and the overall cost of production, in relation to the size of the farms. In order to select the function model that best explains the relation between the above-mentioned variables, we checked the observed level of significance p, the corrected determination coefficient R^2_{adj} and the standard deviation error of the relevant models. For models where $p \leq 0.5$, the selection of the best model was based on the highest R^2_{adj} and the lowest standard error (Hinkle *et al.*, 1988; Hair *et al.*, 1995; Bora-Senta and Moysiadis, 2000).

3. Results

Table 2: *Comparison of production expenses per sow in relation to the level of breeding activities*

Production expenses (euros/sow)	M_1:20-199 sows N:40 farms	M_2:200-199 sows N:23 farms	M_3:≥400 sows N:17 farms
	Mean±Std. Deviation	Mean±Std. Deviation	Mean±Std. Deviation
Wages	$158.38^a \pm 91.7$	$131.43^a \pm 73.5$	$76,80^b \pm 14.6$
Feeding	$1090.13^a \pm 282$	$1189.58^a \pm 117.3$	$1123.42^a \pm 128.8$
Annual livestock expenses	$62.09^a \pm 33.7$	$107.64^b \pm 27$	$127.48^b \pm 21.4$
Annual expenses for fixed assets	$349.23^a \pm 87.6$	$338.94^a \pm 102.4$	$328.18^a \pm 51$
Veterinary care, other expenses etc.	$139.96^a \pm 63.3$	$194.18^b \pm 52$	$193.26^b \pm 49.4$
Total	$1799^a \pm 83.9$	$1961^b \pm 98.05$	$1849.14^b \pm 91.4$

Table 2 shows the ranking of the production expenses per sow in relation to the level of breeding activities on the pig farms. Means in table 2 which are characterized by the same letter on the same line do not differ statistically significantly, at a significance level ?=0.05, according to the performed Mann-Whitney test (Hinkle *et al.*, 1988; Toothaker, 1993; Tsantas *et al.*, 1999). The Kruskal-Wallis test showed that there is a statistically significant difference between the three size groups of farms, which concerns wages (x^2=28.260, d.f.=2, p=0), annual livestock expenses (x^2=39.741, d.f.=2, p=0), the cost of veterinary care and other expenses (x^2=13.621, d.f.=2, p=0.001), and the production expenses as a whole (x^2=28.653, d.f.=2, p=0).

As we can observe in this table, the cost of labour is higher in low-capacity farms (M_1), and lower in high-capacity farms (M_3). In the latter, there is a higher degree of efficiency from the work done by the workforce. The specialization and distribution of labour that can be implemented in a relatively large farm of this kind increase the productivity of the workforce, since employees can become highly-skilled in certain tasks and are subsequently more productive (Batzios, 2001).

The annual livestock expenses are higher in the high-capacity farms (M_3) and lower in the low-capacity farms (M_1). High-capacity farms place greater emphasis on upgrading their genetic material, which leads them to additional annual livestock expenses.

The expenses for veterinary care and other costs (for transport, freight, electricity, telephone, fuel, lubricants etc) are higher in the medium-capacity (M_2) and high-capacity farms (M_3) and lower in the low-capacity farms (M_1). Low-capacity pig farming enterprises are characterized by less intensive breeding conditions and make a more efficient utilization of their workforce, which means that the conditions pertaining to the animals' management are more favourable, they require fewer veterinary drugs etc.

Feeding expenses seem to be higher for medium-capacity farms (M_2), and lower for low-capacity (M_1) and high-capacity farms (M_3). It is a fact that large pig farming enterprises focus more on the feeding parameter, since they possess integrated systems for the preparation of feed mixes, using different levels of automation. It is worth noting that the exploitation of this parameter is directly linked to an increase in breeding productivity (Dotas, 1995). Small pig farming enterprises tend to use ready-made feed-forage, since they do not own the necessary equipment to produce their own animal feed.

The annual fixed capital expenses seem to be higher for low-capacity farms (M_1) and lower for medium-capacity (M_2) and high-capacity farms (M_3).

As regards the overall production cost, the medium-capacity pig farming enterprises present the highest value. It is a fact that these farms display a high level of modernization and therefore require a large amount of capital for their restructuring (Aggelopoulos, 2004).

As a next step, we analyze the production cost for pork and the elements it is based on. The cost of production is analyzed into the following parameters (Kitsopanidis, 1999): cereal grain (raw feed material), annual livestock expenses, annual fixed capital expenses (buildings and mechanological equipment), veterinary drugs, feed pre-mixes (vitamins-trace-elements), land, foreign and family labour.

Through the application of Principal Components Analysis, we examine the number of factors that can be used to interpret the overall production cost. The analysis has highlighted a factor that constitutes a linear combination of all the cost elements. The eight individual expenses that comprise

Table 3: *Loadings of the production cost data*

Cost data	Factorial loadings
X_1 materials	0.974
X_2 annual livestock expenses	0.965
X_3 annual fixed capital expenses	0.957
X_4 medication	0.871
X_5 pre-mixes	0.833
X_6 soil	0.740
X_7 third-party labour	0.641
X_8 family labour	0.586

Table 4. *Comparison of three models: linear, quadratic and logarithmic for all farms in the sample*

Comparison of three models: linear, quadratic and logarithmic for all farms in the sample			
Models	Std. Error	R^2_{adj}	p
1. Linear	0.298	0.740	0.000
2. Quadratic	0.200	0.880	0.000
3. Logarithmic	0.158	0.668	0.000
Proposed Model: 2	$Y=b_0+b_1X+b_2X^2$		
Coefficients	Std. Error	T	p
b_0= 5.642	0.1900	29.68	0.000 S*
b_1= -0.005	0.0003	-15.08	0.000 S*
b_2= 1.428	1.4640	9.75	0.000 S*
Comparison of three models: linear, quadratic, logarithmic for size M_1			
Models	Std. Error	R^2_{adj}	p
1. Linear	0.359	0.810	0.000
2. Quadratic	0.248	0.910	0.000
3. Logarithmic	0.198	0.717	0.000
Proposed Model: 2	$Y=b_0+b_1X+b_2X^2$		
Coefficients	Std. Error	T	p
b_0= 5.840	0.2510	23.27	0.000 S*
b_1= -0.006	0.0006	-9.92	0.000 S*
b_2= 1.950	2.9900	6.53	0.000 S*
b_2= 1.950	2.9900	6.53	0.000 S*
Comparison of three models: linear, quadratic, logarithmic for size M_2			
Models	Std. Error	R^2_{adj}	p
1. Linear	0.103	0.250	0.008
2. Quadratic	0.099	0.307	0.009
3. Logarithmic	0.095	0.262	0.007
Proposed Model: 2	$Y=b_0+b_1X+b_2X^2$		
Coefficients	Std. Error	T	p
b_0= -17.01	11.690	-1.455	0.160 NS*
b_1= 0.02	0.012	1.602	0.120 NS*
b_2= -5.71	3.450	-1.656	0.110 NS*
Comparison of three models: linear, quadratic, logarithmic for size M_3			
Models	Std. Error	R^2_{adj}	p
1. Linear	0.101	0.043	0.207
2. Quadratic	0.104	-0.017	0.442
3. Logarithmic	0.104	0.041	0.212

S* statistically significant at a significance level α=0.05

NS* statistically non-significant at α=0.05

the production cost create a uni-dimensional factor, which accounts for 69.37% of the total variance, with a high internal consistency (Cronbach's a=0.868). This factor could be characterized as a composite production cost. The relevant importance of the individual expenses as expressed through the factorial loadings is provided in Table 3.

From Table 3, we observe that the greatest effect on the determination of the composite cost is linked to the cereal grain (X_1), (raw feed material), while labour (X_8) has the least effect. Thus, a limitation or reduction of the expenses for cereal grain, shown to be the most influential parameter for the formulation of the production cost, will correspondingly lead to its reduction. The development of the pig farming sector is linked to the effort to reduce the use of cereal grain. Any strategic effort to reduce the production cost in pig farming, must have as its starting point the possibility of financing the cereal grain market, and should examine the use of raw feed material that is more economic or shows an improved performance. In addition, the financing of investments related to the operation of integrated animal feed production systems, which aim to reduce the cost of feeding, is also connected to a more efficient use of the feeding coefficient.

A study was subsequently made into the correlation between the annual total production of pork and the overall production cost, both for the sample as a whole, and for the size categories of the farms.

a). For all farms in the sample

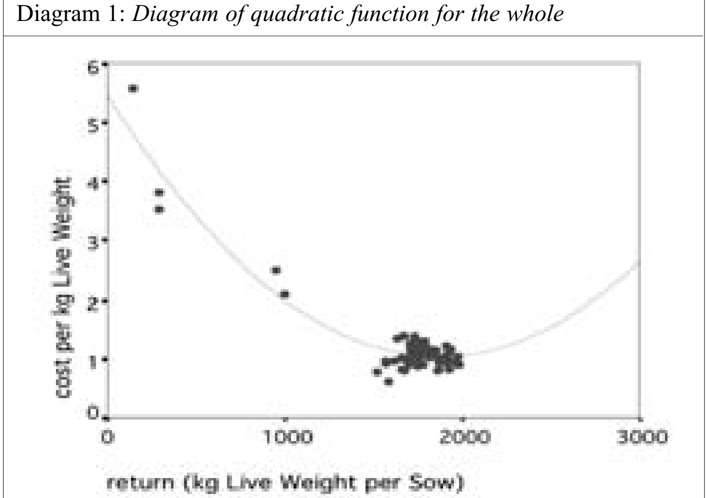
Based on the data in Table 4, the quadratic function is the one that best describes the relation between the two parameters.

The resulting equation is as follows:

$$Y=5.642-0.005X+1.428X^2$$
$$(0.190) \quad (0.0003) \quad (1.464)$$

The relation between the sow's performance and the total breeding cost shows that 88% of the variability of the breeding cost is explained by the performance of the sow (R^2=0.88).

Diagram 1: *Diagram of quadratic function for the whole*



After studying Diagram 1, we find that the production cost per Kg live weight decreases as the performance increases. This is due to the distribution of the fixed cost between an increasing number of product units, and also to the increasing efficiency of the elements comprising the variable cost (e.g. animal feed, medication and other).

b). Based on the size of the farms

b_1). Farms with 20-199 sows (M_1)

According to Table 4 for the size M_1, we can see that the quadratic function best depicts the relation between the two parameters. This relation between the sow's performance and the total breeding cost indicates that the level of the latter depends by 91% (R^2=0.91) on the performance of the sow.

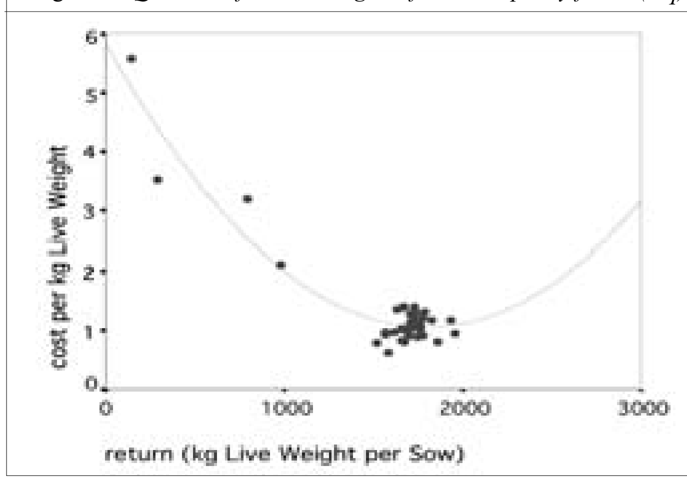
The resulting regression equation is as follows:

$$Y=5.84-0.006X+1.95X^2$$
$$(0.251) \quad (0.0006) \quad (2.99)$$

This equation shows there is a tendency for the breeding cost to develop in correlation with the performance of the sow.

A closer study of Diagram 2 indicates that the production cost per Kg live weight decreases as the performance increases. Therefore, in this case also, the more rapid increase in performance in relation with the increase to the variable cost is what causes the production cost to drop when the sow's performance improves. The maximum cost-performance value is 5.57 euros for 144.15 kgs live weight. The low performance values in some farms of this size are related to the fact that the farms in question focus more on the sale of piglets or there is a lack of facilities for development-fattening. The lowest cost-performance value is 0.62 euros for 1583.33 kgs live weight per sow.

Diagram 2: *Quadratic function diagram for low-capacity farms (M_1)*

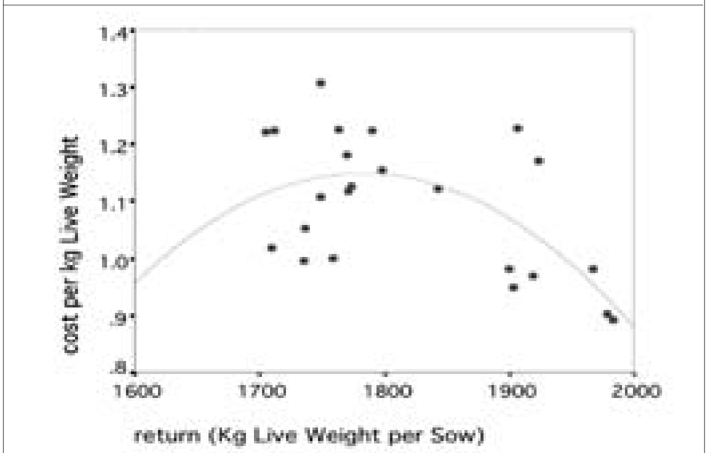


b_2). Farms with 200-399 sows (M_2)

Based on Table 4 (for the size M_2), it appears that the quadratic function best reflects the relation between the two parameters. The relation between the sow's performance and the breeding cost was found to be strong and proves that the level of the breeding cost depends by 37% (R^2=0.370) on the performance of the sow. The equation below shows how the breeding cost develops based on the sow's performance.

The maximum cost-performance value is 1.31 euros for 1749.33 kgs live weight, while the lowest value is 0.89 euros for 1983.33 kgs live weight per sow.

Diagram 3: *Quadratic function diagram for medium-capacity farms (M_2)*



The resulting regression equation is as follows:

$$Y=-17.01+0.02X-5.71X^2$$

(11.69) (0.012) (3.45)

This function shows that the production cost increases for a short period, reaches a peak value and then decreases. This can be explained by the fact that the pig farming enterprises of $?_2$ size often present a high rate of modernization and therefore need a large amount of capital for this purpose and in order to acquire new equipment and infrastructure. However, in due course, as the performance increases at a more rapid pace, so the production cost decreases.

b_3). Farms with 400 or more sows (M_3)

Table 4 shows that none of the three functions is statistically significant at a significance level of 5%, and therefore cannot effectively express the relation between performance and production cost. The linear function could probably best depict the relation between the two parameters, but with a certain reservation, since the data does not satisfactorily adapt to any model. The linear function shows that the production cost decreases as the performance of the sow increases.

4. Conclusions-Proposals

Pig farming medium-capacity farms present the highest production cost which can be explained by their high rate of modernization and the large amounts of capital required for their operation.

More specifically, according to the course followed by the cost of the production coefficient, we see that:

-The cost of labour decreases when the number of sows and therefore the size of the farms increase.

-The annual livestock expenses increase when the size of the farms increases, since high-capacity farms maintain a livestock with a high genetic value.

-Expenses for veterinary drugs increase in conjunction with the size of the farms. Low-capacity pig farms require a limited use of veterinary drugs, due to the favourable conditions they offer for the animals' management.

-Feeding expenses seem to be higher in medium-capacity farms, and lower in low-capacity farms. High-capacity farms increase their feeding expenses in line with their effort to increase productivity.

From a study of the cost using Principal Components Analysis, we observe that the greatest effect on cost determination is linked to cereal grain (raw feed material), which is the basic expense for animal feed. Any strategic effort to reduce the cost of production in pig farming must begin from the use of cereal grain and examine the alternative use of more economic and effective raw material for feed preparation. Choosing the most appropriate, efficient way of preparing the livestock feed, planning a well-balanced and economic diet knowledge of the nutritional content of animal feed, the suitability of the facilities used for mixing, feeding and storage, and subsidies for the animal feed market, will all lead to a decrease of this expense and subsequently of the production cost as a whole.

If we examine the relation between the production cost and performance for all the farms in the sample, and for low- and high-capacity farms, we observe that the production cost decreases as the performance increases. In such farms, the variable expenses and the fixed expenses distributed into more product units contribute to a reduction of the production cost. For medium-capacity farms, the production cost increases, reaches a peak value and then decreases. This is related to the high rate of modernization and the large amounts of capital required for the modernization of their fixed capital. This analysis serves to prove that there is a need for financing new building installations and for the purchase of modern mechanological equipment, since such a step will lead to increased productivity, lower the production cost and improve the working conditions for all those employed in this sector.

References

Aggelopoulos S., 2004. "*Breeding and Production Systems in Greek Pig farming and their relation to the economicity, competitiveness and sustainability of the sector*", PhD thesis, Aristotle University of Thessaloniki, Faculty of Geotechnical Sciences, School of Agriculture, (in Greek).

Apostolopoulos C., Theodoropoulou H., Petrakos G., Theodoropoulos G., 2001. *"Factors Affecting the Regional Pig Meat Productivity of Commercial Pig Units in Greece"*. *Agricultural Economics Review*, (2)1, 39-46.

Agresti A. and Agresti B., 1979. *Statistical Methods for the Social Sciences*, San Francisco, Dellen Publishing Company, U.S.A., 112 pagg.

Batzios Ch., 2001. "*Animal Production Economy*", Sychroni Pedia publications, Thessaloniki, (in Greek).

Bora-Senta E. and Moysiadis Ch., 2000. "*Applied statistics-MultipleRegressions*", Thessaloniki, Ziti publications, (in Greek).

Cattell R.B., 1978. *"Factor Analysis: An Introduction and*

Manual for the Psychologist and Social Scientist", Westrop, Connecticut: Green-Wood Press, 152 pagg.
Dotas D., 1995. "*Pig farming",* Aristotle University of Thessaloniki, Publications Service of University, Thessaloniki, (in Greek).
Dunteman G.H., 1989.*"Principal Components Analysis", in Quantitative Applications in the Social Sciences",* Sage University Papers, London.
European Commission 2003. *"The Common Agricultural Policy"*, 2003 Review.
Farmakis, N. (1994), "*Introduction to sampling"*, Nea Pedia, Athens, (in Greek).
Galanopoulos K., 1998. *"Financial Study of Pork Production: Long-term balance of production and trade in Greece"*, Journal of Zootechnical Science, (25), 19-28, (in Greek).
Hair J., Anderson R., Tatham R. and Black W., 1995). "*Multivariate Data Analysis with Readings",* 4th Edition, Prentice-Hall International, INC., USA., 221 pagg.
Hinkle D., Wiersma W., and Jurs S., 1988. "*Applied Statistics for the Behavioral Sciences*", 2nd Edition, Boston: Houghton Mifflin Company, 62-75.
Ministry of Agriculture 2003. "*Existing status of pig farming units in Greece 2001-2003",* Department of Animal Production Data, ?thens, (in Greek).
Kitsopanidis G., 1999. *"Sustainability and competitiveness in the modern pig-farming enterprise"*, Journal of Zootechnical Science, (2), 33-51, (in Greek).
Lansink A.O. and Reinhard S., (2004). "Investigating technical efficiency and potential technological change in Dutch pig farming", Agricultural Systems, (79)3, 353-367.
Nieuwoudt L., 1972. "Principle Component Analysis of Input: A Production Function, Journal of Agricultural Economics, 33: 277-283.
Quetier F., Marty P., Lepart J., 2005. *"Farmers' management strategies and land use in an Agropastoral landscape"*, Agricultural Systems, 84(2), 171-193.
Tabakis N., 2001. *"Investigating the Occupational Adjustment Determinants: A Factor Analysis Approach"*, Scientific Yearbook of Applied Research, (4)1, 139-152.
Toothaker L., 1993. "*Multiple Comparisons Procedures, in Quantitative Applications in the Social Sciences",* Newbury Park, Sage University*,* U.K.,07-89.
Tsantas N., Moysiadis Ch., Bagiatis N., and Chatzipantelis Th., 1999. *"Data Analysis with the help of Statistical Packages",* Ziti publications, Thessaloniki, (in Greek).
Vaessen M. and Backus G., 1997. *"Comparison of the cost Price of pork in some selected E.U. membership countries"*, Research Institute for Pig Husbandry, Netherlands.
Vlachos I., 2003. *"Trade, Distribution Networks and Competitiveness of Greek Pork"*, in P. Zoiopoulos (ed.) Modern Trends in Pig farming, Agrinio, University of Ioannina, 135-161, (in Greek).
Whittemore C., 1993. "*The science and practice of pig production"*, Longman Group, U.K., 167 pagg.