MODELLING ECONOMIC ALTERNATIVES FOR TOBACCO PRODUCERS: THE CASE OF SHEEP FARMING

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Abstract

After the introduction of the new tobacco regime, many regions in Greece, formerly specialized in tobacco cultivation, are now facing serious threats of economic and social decline. Sheep farming is considered by many analysts as a viable alternative to tobacco. This study analyses the financial performance of sheep production and the risk that producers are taking. Through a stochastic efficiency analysis with respect to a function we explore the economic viability of conventional and organic sheep farming; key factors determining the economic outcome of these activities are also investigated. Both organic and conventional sheep farming appear as viable alternatives. The viability of organic farming lies, mainly, in organic payments. Conventional farming generates a slightly lower but less uncertain net return.

Keywords: organic farming, dairy sheep, risk analysis, SERF, agricultural policy

1. Introduction

In April 2004, the E.U Council of Agricultural Ministers agreed a widely ranging reform of the Mediterranean products' policy regimes (Council of the European Union, 2004). The main element of this agreement was the shift from the production-linked payments to the decoupled single farm payment, which was the cornerstone of the June 2003 main CAP reform. Greece decided to opt for full decoupling of the premiums on a historical basis and put into effect the new policy regime in 2006.

Among the Mediterranean products, tobacco has traditionally a very important role in the Greek economy. The great significance of tobacco arises from the fact that it requires less fertile soil and offers high income and employment opportunities to thousands of rural families (Mattas et al., 1998). In 2003, tobacco production holds a 4.45% of the gross agricultural production and a 5.96% of the gross crop production (H.M.R.D.F[1], 2007). It is also worth noting that, according to the N.S.S.G.[2], almost 44% of the total area of tobacco cultivation is located in the region of Macedonia.

Today, only two years after the introduction of the new tobacco regime, the first consequences are already clear. The less competitive tobacco varieties, i.e. *Virginia*, have been almost abandoned while other varieties, i.e. *Basmas*, have been significantly reduced. In this dynamic environment, the need of restructuring the agricultural sector has been recognized by both policymakers and agriculturalists. Tobacco producers seek for alternative activities, which can successfully replace tobacco. There are several suggested alternative crops, such as fodder crops, permanent crops and vegetables (International Tobacco Growers' Association, 1993; Gale, 1999; Reaves, 1999; Rhea et al., 2001; Mattas et al., 2005; Vargas and Campos, 2005). In Greece, many analysts see in livestock farming and especially in sheep farming a viable alternative (Tzouramani and Sintori, 2005; Sintori et al., 2006; Tsiboukas, 2006).

Sheep farming production share of the animal gross production and of the gross agricultural production of Greece is 45% and 15% respectively. As in the case of tobacco, it provides income to thousands of families and it contributes highly to regional development especially in isolated and less favoured areas. Under the CAP reform in 2003, the single payment system has, also, replaced previous CAP payments (H.M.R.D.F., 2007).

Greece is one of the major producers of sheep milk and sheep meat in E.U (9 millions sheep population). The majority of sheep farms are small, not-intensive, family farms, with a high degree of diversification in terms of herb size, capital, productivity etc. This system refers to the 85% of the sheep population. Nevertheless, in the last few years, there is a trend of establishing new, modern and intensive sheep farms in lowland areas, which produce forage and grains to cover whole or part of the animal needs and have greater amount of invested capital (H.M.R.D.F, 2007).

[1] Hellenic Ministry of Rural Development and Food
[2] National Statistical Service of Greece

It is worth mentioning that the productive system of sheep farming in the mountainous areas of Greece is very close to that of organic sheep farming. This fact, gives a competitive advantage to the Greek sheep farmers against their European rivals. Indeed, there is a considerable rise of organic sheep farming in Greece. During the 2002-2006 period, the number of organically bred sheep experienced a rise of about 260%, representing the 2.9% of the total sheep population in Greece and the 9% of the organic sheep population in E.U. (Abando and Rohnerthielen, 2007). As a consequence, the organic fodder crop cultivations (e.g. medic) have also risen.

The first organic sheep products appeared in Greece at the end of 2000 (F.I.N.G[3]., 2003). The most important distribution channels for organic products are the specialized organic market stores, the open market, the delicatessen stores and the delicatessen departments of super-markets (I.C.A.P., 2004). In spite of the continuously increasing market demand for organic dairy products in Greece, there are several difficulties, as the organic dairy products market is not yet well developed. There are few certified slaughterhouses, while the organic sheep milk price premium is very small. In many cases farmers sell their organic sheep milk and meat as conventional, receiving no premium at all. Hence, they only benefit from the E.U. subsidy which is about 35€/head.

The main purpose of this paper is the analysis of the financial performance of sheep production and the risk that producers are taking. Through a Monte Carlo stochastic simulation model and a stochastic efficiency analysis with respect to a function (SERF) we explore the economic viability of conventional and organic sheep farming. Key factors that determine the economic outcome of the above activities are also investigated. The analysis focuses on the region of Macedonia, because of the region's high dependency on tobacco.

2. Methodology

Organic agriculture is considered to be a risky alternative. Analysing organic farmers' decision making implies understanding how they rank potential activities with uncertain outcomes. There are several economic methods that one may use to compare alternative production systems such as enterprise budgets, whole-farm budgeting, mathematical programming, simulation, dominance, etc. Most of these methods refer to the average net farm income, which is an insufficient criterion as it ignores possible differences in the riskiness of net income between cropping systems (Lien et al., 2006). Risk programming and stochastic simulation are two alternative methods that incorporate risk (Hardaker et al., 2004a). The stochastic dominance analysis is widely used in agricultural economics in income risk differences between crop systems analysis (Mahoney et al. 2004; Ribera et al. 2004; Smith et al. 2004). This method is based on the theory of expected utility and involves a pair-wise comparison of expected utilities derived by decision makers from a set of risky net revenues. The major advantage of the stochastic dominance criterion is that it reduces the set of all possible risky choices to a smaller group of alternatives (Moss, 2001).

In this work we apply the Stochastic Dominance Analysis to compare the distributions of net returns between conventional and organic sheep farming systems in the region of Macedonia in North Greece. Assume that a farmer must decide whether to invest in an organic f_o, or in a conventional g_c production system with cumulative distribution functions of their net revenues given by $F_o(x)$ and $G_c(x)$ respectively. Organic dominates the conventional productions system in the sense of the first order stochastic dominance (FSD) if

$$G_c(x) - F_o(x) \geq 0 \quad \forall\, x \in \Re \text{, with strict inequality for some } x \in \Re$$

[3] Federation of Industries of Northern Greece

The first rule assumes that farm operators prefer more of an outcome to less and that the utility of income is defined by a monotonically increasing function. In practice, return distributions of two investment alternatives often intersect, in which case FSD cannot discriminate between the two alternatives.

If we consider investors to be risk averse (the decision maker's utility function is unknown, monotonically increasing and strictly concave) a choice between distributions could be made using the second order stochastic dominance (SSD) criterion. Formally, the organic dominates the conventional crop in the SSD sense if

$$\int_{-\infty}^{x} G_c(x) - F_o(x) \ dx \geq 0 \ \ \forall \ \ x \in \Re \text{, with strict inequality for some } x \in \Re$$

In other words, SSD requires that the area under the cumulative density function for organic is always smaller than the area under the cumulative density function for the conventional crop. Thus, SSD assumes that the decision maker prefers more income to less and is not risk preferring (i.e. the risk aversion bounds are $0 \leq r \ \pi \ +\infty$).

In empirical work it is often found that the SSD is not discriminating enough to yield useful results (Hardaker et al., 2004b). The most general form of stochastic dominance, the stochastic dominance with respect to a function (SDRF) overcomes this weakness (Meyer, 1977). SDRF classifies decision makers by the characteristics of their Arrow-Pratt risk aversion coefficient $r(x)$ instead of their utility functions. The use of $r(x)$ instead of utility allows more accurate definition of the groups and has increased discriminatory power. In SDRF risk aversion bounds are reduced to $r_L \leq r \leq r_U$, and ranking of risky scenarios is defined for all decision makers whose risk aversion coefficients lie anywhere between the lower and upper bounds, r_L and r_U , respectively.

A more transparent and potentially more discriminant SDRF method which is called stochastic efficiency with respect to a function (SERF) identifies utility efficient alternatives for ranges of risk attitudes (Hardaker et al., 2004b; Richardson et al. 2005). SERF orders alternatives in terms of certainty equivalents (CE) as a selected measure of risk aversion is varied over a defined range. SERF can be applied for any utility function for which the inverse function can be computed based on ranges in the absolute, relative, or partial risk coefficient. SERF evaluates CEs for risk aversion coefficients (RACs) between the lower RAC (LRAC) and the upper RAC (URAC). Two scenarios, in our case organic F and conventional G cropping system, can be compared and ranked at each RACi

$F_o(x)$ Preferred to $G_c(x)$ at RAC_i if $CE_{F_{oi}} \ \phi \ CE_{G_{ci}}$
$F_o(x)$ Indifferent to $G_c(x)$ at RAC_i if $CE_{F_{oi}} = CE_{G_{ci}}$
$G_c(x)$ Preferred to $F_o(x)$ at RAC_i if $CE_{F_{oi}} \ \pi \ CE_{G_{ci}}$

SERF extends the lower and upper RAC case to a large number of RAC's uniformly distributed between two extreme RACs. The lower and the upper RAC are first defined and then the range of the RAC's is divided into 25 equal intervals and the CE's for all risky alternatives at each interval are evaluated. If a CE line in the SERF chart remains positive then rational decision makers will prefer the risky scenario to a risk free alternative. If the CE line goes beneath the x-axis, the decision makers with RACs greater than the RAC where CE equals to zero would prefer a risk free alternative.

Partial ordering of alternatives by utility values is the same as partial ordering them by certainty equivalents. For a risk-averse decision maker, the estimated CE is typically less than the expected money value. The difference between the expected money value and the CE is the risk premium (Hardaker et al., 2004b; Richardson et al. 2005). The risk premium reflects the minimum amount that would have to be paid to a decision maker to justify a switch from conventional to organic farming.

3. Model specification

A stochastic simulation model was build to estimate the net return of conventional and organic sheep farming. The stochastic model was based on deterministic enterprise budgets per ewe for each activity. The stochastic variables were then introduced to the model. Net returns were calculated by subtracting total costs from the total returns including subsidies for organic farming. The simulation model is presented below:

$$N\widetilde{R} = \widetilde{Y}_m * \widetilde{P}_m + Y_{ml} * \widetilde{P}_{ml} + Y_e * P_e + S - FC - V\widetilde{C}$$

where

$N\widetilde{R}$: Probability distribution for net return

$\widetilde{Y}_m$: Stochastic yield for organic or conventional milk

$\widetilde{P}_m$: Stochastic Price for organic or conventional milk

Y_{ml} : Yield for organic or conventional lamb meat

$\widetilde{P}_{ml}$: Stochastic price for organic or conventional lamb meat

Y_e : Yield for organic or conventional ewe meat

P_e : Price for organic or conventional ewe meat

S : Subsidies for organic sheep farming

FC : Fixed cost for organic or conventional sheep farming

$V\widetilde{C}$: Stochastic variable cost for organic or conventional sheep farming

According to Kitsopanides (2006), the gross revenue in Greek sheep farming consists mainly of the gross production value of milk and lamb meat. In dairy sheep farming, the gross production value of milk is greater than that of lamb meat. Approximately, 56.8% of the gross revenue comes from milk production and 34.2% from lamb meat (Zioganas, 2001), while the value of by-products (e.g. wool) is almost zero. Stochastic variables represent the uncertainty of milk price and yield. In the case of the gross production value of meat, the uncertainty arises mainly from the fluctuation of price, which is incorporated through the use of a stochastic price variable. The gross production value from ewe meat (non-productive ewes) contributes less to the total gross production value of the farm. Moreover, the replacement rate of ewes is common between farms while the market price of ewe meat is almost stable. Therefore, the uncertainty that comes from the fluctuation of yield and price of ewe meat is not considered in this study.

The single farm payment and the compensation payment for mountainous and less favored areas have not been taken into account, as these subsidies are not linked to a certain production activity. On the other hand, the subsidies for organic sheep farming are incorporated in the model, as the level of payment per ewe can be estimated.

Variable cost consists mainly of labour and feed cost. As the feed cost depends partly on milk yield, the model recalculates feed requirements as the milk yield is simulated (Asheim et al. 2005). Therefore, the stochastic part of the variable cost is the feeding cost for milk production.

4. Data description

The data used to build the deterministic enterprise budgets in this study was taken from face-to-face interviews with selected sheep farmers. Following Ribera et al. (2004), Kerselaers et al. (2007) and Lien et al. (2007), the data was supplemented with information from the literature and expert knowledge (Ministry of Agriculture, 1981; Zervas et al., 2000; Zioganas et al., 2001; Tzouramani and Sintori, 2005; Kitsopanides, 2006). The data gathered from the 24 selected farms (8 conventional and 16 organic) is part of a broader data collection survey on organic and conventional sheep farming in

North Greece, which is still in progress (AGEPRI, 2006). All conventional farms have similar characteristics and are close to the typical sheep farm production system in the region under study. This is also the case for the organic farms in the sample. Usually, organic farming is located in semi-mountainous and mountainous areas as their pastureland's requirement is greater. Moreover, the animal capital is lower, because the flock consists of less productive native races, adaptive to their environment and resistant to certain diseases.

To obtain a better yield and price distribution for conventional milk, we used historical data for yield and price, from the Greek FADN. We selected from the FADN sample all sheep farms located in the region of Macedonia, which had available data on milk price and yield for 5 years (1999-2003).

4.1. Cost of production

The costs of production were built from the data of the selected 24 farms of the AGEPRI survey. Specifications on labor, fixed and feed costs were also made according to the literature and the advice of experts in the field. The annual cost of flock per ewe for conventional and organic sheep farming is presented in Table 1. The feed cost is the main element of total cost in both organic and conventional sheep farming (34.78% and 50.57% respectively). It should be noted that conventional farms are more intensive and therefore have a 43.3% larger feed cost than organic farms. On the other hand, organic farms use larger meadow and pastureland than conventional farms, because organic sheep farming has to be land-related according to (EC) 1804/1999 Regulation. Therefore, total land rent is 69.1% greater in organic farming. The cost of feed concentrates (mainly grains and milk replacers) is bigger in conventional farming because the ration consists mainly of corn and other crops. The labor costs for organic farms appear to be 32.2% greater, because of the labor required for grazing the flock. Fixed cost is equal between the two activities, as far as buildings and equipment are concerned, because we have discovered few differences between conventional and organic farms. The difference between organic and conventional sheep farming fixed cost lies only in the value of animal capital.

Table 1. Annual Cost of Flock per Ewe for Conventional and Organic Sheep Farming

	Conventional		**Organic**	
	€/ewe	**% Total Cost**	**€/ewe**	**% of Total Cost**
Land	3.20	*1.83*	5.41	*3.76*
Labor	30.12	*17.23*	39.81	*27.64*
Variable Cost	99.73	*57.06*	58.74	*40.78*
Feed Cost	88.38	*50.57*	50.09	*34.78*
Purchased Hay	15.65	*8.96*	17.53	*12.17*
Purchased Corn	18.99	*10.86*	9.30	*6.46*
Other Purchased Concentrates (Grains and Milk Replacers)	22.25	*12.73*	2.27	*1.58*
Produced Grains	6.76	*3.87*	7.89	*5.48*
Produced Hay	23.10	*13.22*	12.66	*8.79*
Salt, Mineral etc.	1.63	*0.93*	0.44	*0.31*
Other*	11.35	*6.49*	11.39	*7.91*
Fixed Cost	39.61	*22.67*	36.02	*25.01*
Equipment and Buildings**	27.44	*15.70*	27.44	*19.05*
Animal Capital***	12.17	*6.96*	8.58	*5.96*
Variable Capital Interest	2.11	*1.20*	1.32	*0.91*
TOTAL PRODUCTION COST	174.76	*100.00*	144.03	*100.00*

* Veterinary and medicines, Fuels, Lubricants, Water, Electricity, Variable capital interest, Certification cost etc.
** Annual cost for fixed capital: Interests, Depreciation and Repairs
*** No depreciation cost is included. We consider depreciation cost equal to the necessary labour and feed cost for replacement ewes and rams.

4.2. Yield data

As mentioned above, we used historical data from the Greek FADN in order to build the distribution for conventional milk yield. Time and farm specific effects were removed from the panel data using the two way fixed effect model (Lien, 2001; Flatten and Lien, 2005).

The residuals of the OLS were found to be normally distributed[4]. Therefore, the milk yield distribution is considered to be normal. The deterministic component of the milk yield is the expected value of milk yield, while the stochastic component is the standard deviation of the residuals. The stochastic milk yield variable was simulated by 1000 Monte Carlo iterations. A statistical summary of the simulated and detrended historical yield data is presented in Table 2. Hypothesis tests were performed to determine whether the simulated stochastic variable reproduced the detrended historical data. The performed tests failed to reject the null hypothesis that the simulated means and variances are statistically equal to the detrended historical data at a 95% confidence level (Table 2).

Milk yield for organic farming was represented by a Triangle distribution, due to lack of historical data. Experts were asked to determine the maximum, minimum and mode milk yield of organic sheep farming in the region of Macedonia (135kg, 50kg and 84.4kg respectively). An alternative to triangle distribution is the GRK distribution, which simulated values less than the minimum and greater than the maximum at about 4% of the times. The Triangle distribution does not allow the stochastic variable to take values smaller than the minimum and bigger than the maximum. Both of the above distributions are used when the actual distribution cannot be determined (Simetar, 2006). A statistical summary of the simulated data (1000 iterations) for organic milk yield is presented in Table 2.

Table 2. Statistics for Simulated and Detrended Historical Data

Conventional Farming					
	Milk Yield		**Milk Price**		**Meat Price**
	Simulated	**Detrended Historical**	**Simulated**	**Detrended Historical**	**Simulated**
Mean	121.50	121.54	0.86	0.86	4.03
StDev	12.38	11.46	0.02	0.02	0.41
CV	10.19	9.43	2.56	2.57	10.14
Min	77.87	93.19	0.78	0.79	3.02
Max	160.70	158.24	0.93	0.91	4.98
Tests of simulated means vs observed means*					
	Test Value	**Critical Value**	**Test Value**	**Critical Value**	
2 Sample t Test**	-0.04	2.27**	0.01	2.27**	
F Test***	1.17	1.28***	1.01	1.25***	
Organic Farming					
Mean	89.81		0.92		4.50
StDev	17.46		0.07		0.41
CV	19.44		7.78		9.07
Min	50.71		0.75		3.50
Max	134.22		1.10		5.49

* 95% Convidence Level
** Fail to Reject the Ho that the Means are Equal
*** Fail to Reject the Ho that the Variances are Equal

4.3. Price data

The data used to build the price distribution came from the Greek FADN. All the observed prices were deflated using the adequate price indices (National Statistical Service of Greece; base year: 2006). The

[4] Shapiro-Wilks, Kolmongornov-Smirnoff, Anderson-Darling, Cramer-von Mises and Chi-Squared tests, failed to reject the Ho that the distribution is normal at a 95% Confidence level

two way fixed effect model was also used to correct the conventional milk price panel data. The residuals of the regression model were found to be normally distributed; therefore the price distribution for conventional milk is, also, normal[5]. The stochastic price distribution was simulated by 1000 Monte Carlo iterations. A statistical summary of the simulated price data is shown in Table 2. The same Hypothesis tests, as in the case of milk yield were performed, which failed to reject the null hypothesis that the simulated mean and variance are equal to the detrended historical data at the 95% confidence level. In addition, milk yield and price data were tested (using Simetar correlation matrix), and no correlation between them appeared.

Milk and lamb meat prices for organic farming, as well as lamb meat price for conventional farming were represented using the Triangle Distribution, for the same reasons mentioned in the previous section. The minimum, maximum and mode used for organic milk price were 0.75€, 1.1€ and 0.91€ respectively, for organic lamb meat price 3.5€, 5.5€ and 4.5€ respectively and for conventional meat price 3€, 5€ and 4.1€ respectively. The above stochastic variables were simulated by 1000 Monte Carlo iterations (Table 2).

5. Analysis and Results

The stochastic model estimates the probability of each net return outcome to occur providing the farmer with a net return range, minimum and maximum and the mean net return. Simulated distributions of expected net returns were developed in Simetar[6] environment (Simetar, 2006). Simetar develops a probability distribution of net return based on the distributions of yield and price. Monte Carlo simulation was used to determine the mean and variance of net return for conventional and organic sheep farming. The net return of each activity was determined by 5000 Monte Carlo iterations. The cumulative distribution functions (CDFs) were constructed to demonstrate the probability (on the Y-axis) of net return for each activity to be less than a particular level (on the X-axis). Although, CDFs provide useful information on the profitability of the compared activities, the preferred activity for a certain decision maker also depends on his risk aversion. To determine the preferred alternative SDRF and SERF analysis were applied.

The relative risk aversion with respect to wealth $r_r(W)$, lies between 0.5 (hardly risk averse at all) to about 4 (very risk averse). The coefficient of absolute risk aversion with respect to wealth $r_a(W)$, is computed as (Flaten and Lien, 2005): $r_a(W)=r_r(W)/W$. In this paper, we do not consider utility and risk aversion in terms of wealth but in terms of income, z. As Hardaker (2004a) showed, $r_a(z)= r_r(W)/W$. The typical level of farmers' wealth was assumed to be 14,912€. Therefore:

$$0.5/14{,}912 \leq r_a(z) \leq 4/14{,}912 \text{ or}$$
$$0.00003353 \leq r_a(z) \leq 0.000268$$

It should also be noted that we use the negative exponential utility function, because we assume that farmers are risk averse, so we need a utility function with a concave form (Flaten and Lien, 2005). Therefore, the utility function is:

$$U=1-\exp(-r \times z),$$

where r, is the coefficient of absolute risk aversion and $U'(z)>0$ and $U''(z)<0$.

We investigated two different scenarios. In the first, we compare the two activities (organic and conventional sheep farming), under the existing price and payment scheme. Farmers, however, considered the subsidies for organic farming as risky and they fear that this payment will soon be reduced or removed. Thus, following the work of Lien et al. (2006; 2007), a second scenario was analyzed, in which the subsidies for organic sheep farming were removed.

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[5] Shapiro-Wilks, Kolmongornov-Smirnoff, Anderson-Darling, Cramer-von Mises and Chi-Squared tests, failed to reject the Ho that the distribution is normal at a 95% confidence level

[6] Simetar ©, is an add-in program that functions within Microsoft Excel ©.

5.1. Existing price and payment scheme for organic farming

The results of the simulation of the net return for conventional sheep farming shows a less than 0.5% probability for a negative net return (Table 3). The mean is 31.35€, while the minimum net return is –14.76€ and the maximum net return is 74.45€. The minimum, maximum and mean net return for organic farming are greater (-6.08€, 97.84€, 36.35€ respectively), while the probability of negative net return is also low (0.35%). Organic farming shows a higher expected net return by 15.9% and has higher minimum and higher maximum values. It should also be noted that the CDF graph (Figure 1) for organic farming is less steep than the one for conventional, while the CV and the range of economic results are greater. Thus, the variation of the net return is greater in organic sheep farming.

Table 3. Statistics of the Net Returns (€) for Conventional and Organic (with and without subsidies) Sheep Farming

	Probability of Negative NR	Min. NR	Max NR	Mean NR	Standard Deviation	Range
Conventional	0.45%	-14.76	74.45	31.35	11.87	89.21
Organic with Subsidies	0.35%	-6.08	97.84	36.35	16.77	103.92
Organic without Subsidies	57.30%	-44.36	59.56	-1.93	16.77	103.92

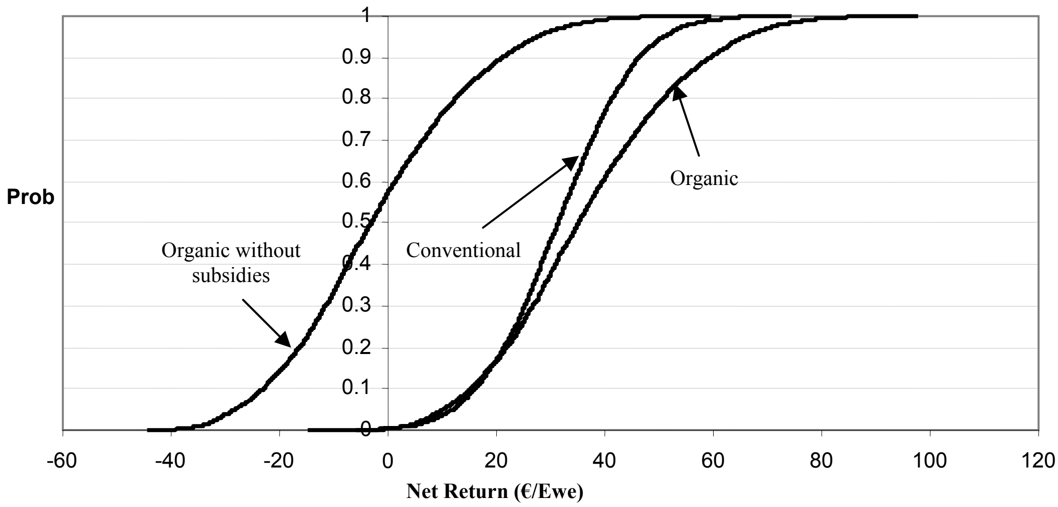

Figure 1. CDF Graphs of the Net Return for Conventional and Organic (with and without subsidies) Sheep Farming

Although, under the existing payment scheme in organic farming, none of the two activities show any significant probability of a negative net return, the preferred activity for a certain decision maker depends on his/her risk aversion. To determine the preferred alternative, a stochastic dominance analysis was applied. The FSD allows for no conclusive results as the CDFs cross (Figure 1). The SSD shows that organic dominates conventional sheep farming since the area under the CDF is smaller. Stochastic dominance provides answers for the lower and upper RAC. To determine the preferred activity for all levels of risk aversion a SERF analysis was applied. SERF analysis reveals that all classes of farmers regardless of their risk aversion prefer organic farming since the CEs are higher (Figure 2).

As mentioned above feed costs and especially grain costs are the most important elements of production cost. Moreover, recently a significant increase of grain prices, and especially the corn price, has occurred. In some areas of Greece the increase of conventional corn price has reached 60%. To account for this level of corn price increase, a sensitivity analysis was conducted (Kopke et al., 2007). The results indicate a 36% decrease of the net return for conventional sheep farming under the hypothesis of corn price increase of 60% (Figure 3). Sensitivity analysis was not performed for other grain prices, as corn is the most important element of the ration and other grains like barley and wheat are usually produced in the farm.

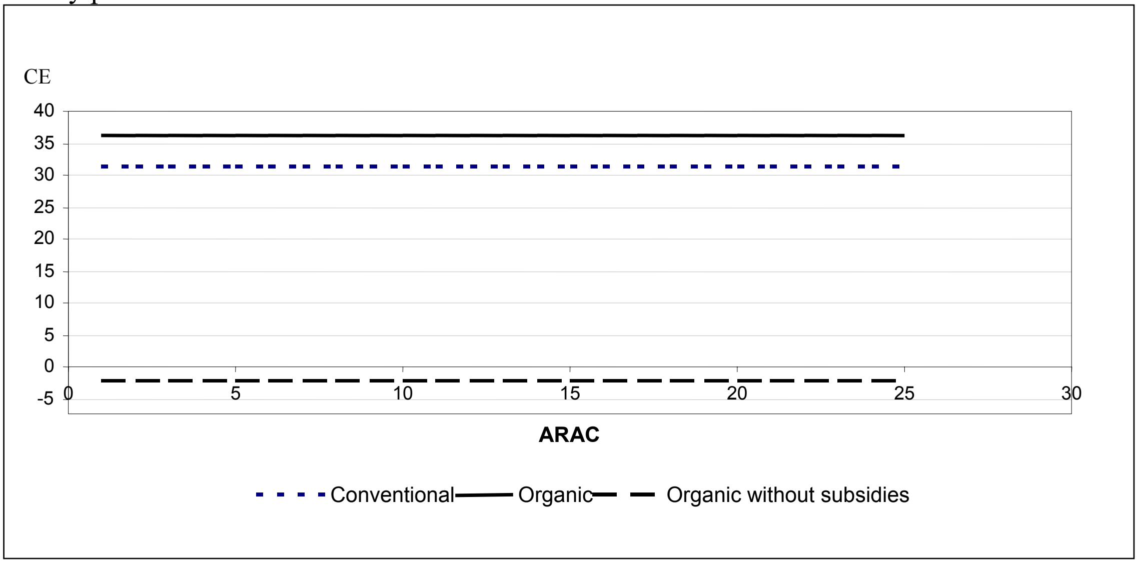

Figure 2. Stochastic Efficiency with Respect to a Function (SERF) Under a Neg. Exponential Utility Function for Conventional and Organic (with and without subsidies) Sheep Farming Net Return

Organic corn price experienced also an increase that reached a maximum of about 40%. In that case the net return is also reduced by 10.4%. To compare the elasticity of organic and conventional net return, a sensitivity analyses with a ±20% change of organic and conventional corn price was conducted. The results revealed a high dependency of net return on corn price, especially in the intensive conventional sheep farming. While organic farms experienced a ±5.2% change in net return, the conventional farms experienced a change in net return that reached ±12%. This result appears due to the fact that organic farming is less intensive, the feed requirements are mainly covered by pastureland and fodder and, thus, the amount of purchased grains is smaller.

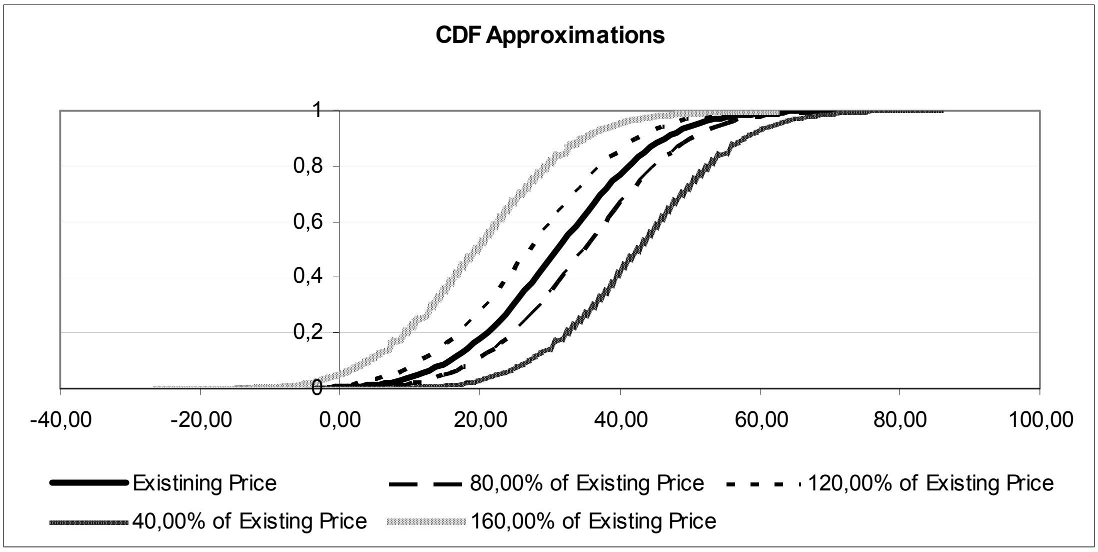

Figure 3. Sensitivity Analysis of Conventional Sheep Farming Net Returns for a ±20% and a ±60% Change of Purchased Corn Price

5.2. Organic farming without the existing payment scheme

If organic sheep farming subsidies are removed from the model, then the CDF for organic farming shifts to the left revealing a 57.3% probability for a negative net return (Figure 1). The minimum, maximum and mean net return under the hypothesis of no subsidies for organic farming are –44.36€, 59.56€ and –1.93€ respectively (Table 3). This result indicates that, since milk yield in organic farming and organic price premiums are low, the viability of the activity lies in organic subsidies. Therefore, under the existing situation, the only incentive to switch to organic sheep farming is the payment scheme.

The common fear of farmers that the subsidies will be reduced or removed, forces us to explore other possible strategies for the viability of organic sheep farming. Since production cost of organic sheep farming is already lower than that of conventional sheep farming, one might focus on the increase of gross revenue. This could be achieved by increasing either milk yield or/and price premiums for milk and meat. The former is an endogenous factor and can be accomplished by e.g. improvement of the animal capital, while the latter is an exogenous factor and implies a well-developed organic market. Gradual increases of the price premiums in our analysis indicate that if market prices for both organic milk and meat increase by a 26.7% (compared to the current organic prices), then organic farming can provide comparable net return to conventional farming even without subsidies (Figure 4, Organic A sheep farming). Since this increase in prices is rather unrealistic, another alternative was investigated. Given that a realistic milk and meat organic price premium in EU is about 20% above conventional price, we estimated that the milk yield increase necessary for organic sheep farming net return to compete conventional farming is 23% (Figure 4, Organic B sheep farming). This is a more realistic approach as it can be partly achieved by crossbreeding with more productive native sheep races, such as Serraika.

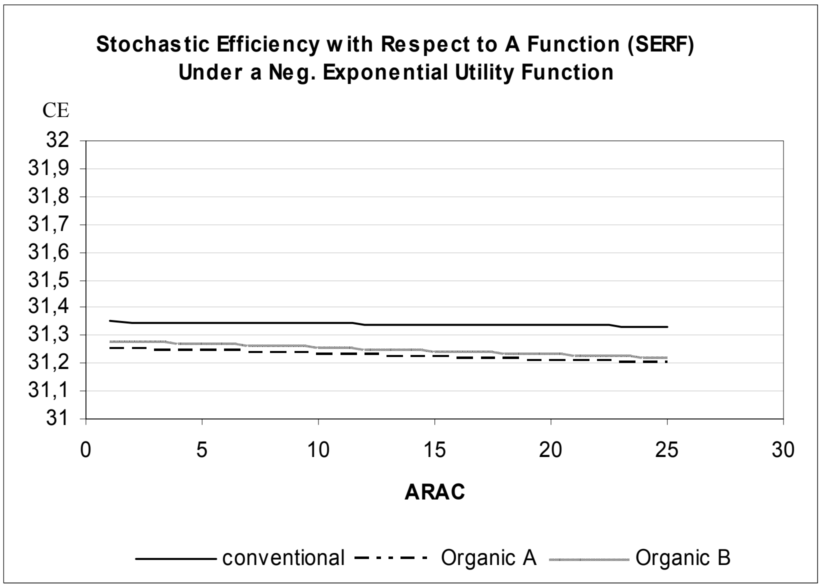

Figure 4. Stochastic Efficiency with Respect to a Function (SERF) Under a Neg. Exponential Utility Function for Conventional and Organic A and Organic B Sheep Farming

6. Concluding remarks

The gradual abandonment of the tobacco cultivation in large areas of Greece, due to the latest CAP reform has driven agriculturalists and policy makers to explore viable alternatives in areas such as the region of Macedonia. In this paper, we have explored as a possible alternative the case of organic and conventional sheep farming using SERF analysis.

The results show that both organic and conventional sheep farming yield high net returns with almost zero probability of a negative outcome. The expected net return of organic farming is 15.9% higher than conventional farming. Our analysis indicates that this is mainly the result of organic subsidies, in the absence of which the activity is unlikely to be viable. This is partly because the organic price premium for milk and meat is very small. Another reason is the relatively low milk yield of organic farming. The net return of sheep farming has a high dependency on grain prices and especially corn price. Sensitivity analysis reveals that the influence of corn price to the net return of conventional farming is twice as big as to the net return of organic farming.

Taking into account that organic farming is a land related activity with low production cost; the farmers' strategy should focus on the increase of milk yield through the improvement of animal capital. Yet, this is an insufficient condition. The market of organic milk and meat is still not well developed in Greece, and therefore most organic producers are forced to sell their products as conventional. On the other hand, conventional farmers should focus on lowering the feed cost via producing larger quantities of concentrates to minimize the risk that the fluctuations of grain prices cause.

Organic farming appears to be a promising alternative, especially in mountainous and semi-mountainous areas where pastureland is available and more intensive systems are less likely to appear. In the present circumstances, the organic payment scheme is a necessary motive for farmers to switch to organic sheep farming. The preceded analysis could be extended to investigate alternative farming systems for both organic and conventional sheep farming. An analysis of conventional extensive and intensive production systems could be added while different feed strategies could be also explored.

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