CONSEQUENCES OF THE 2003 CAP REFORM ON A MEDITERRANEAN AGRICULTURAL SYSTEM OF PORTUGAL

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ABSTRACT

Agriculture in dry land Mediterranean areas faces considerable level of production risk as result of the unpredictable weather. Governmental income stabilisation instruments have had a major impact on Mediterranean farms in changing land allocation, and changing income levels and variability.

Using a mathematical programming model, the impact of the 2003 CAP reform on land allocation and on income variability is evaluated for a Portuguese Mediterranean farm. The results show an increase of extensification of production activities. They also show an increase in total farm income, a reduction in relative total income variability and an increase in relative production income variability.

Keywords: Agricultural policy modelling, decoupling, Mediterranean

JEL: Q18, C61

Introduction

The south of Portugal has a Mediterranean climate characterised by rainfall concentrated in Winter, and almost no rain and high temperatures during Summer. Moreover, rainfall distribution during and across years is very irregular. Agricultural activity is almost based on winter crops and some early Spring crops, although the yields are low and not stable as result of the rainfall year-to-year variation. During Summer and later Spring only irrigated crops are possible, wherever water is available, being a solution for a more stable farm income, and avoiding yield risk. Extensive or semi-extensive livestock production systems are based on seasonal pasture and forage productions, which are also subject to great variability of weather conditions. Seasonal production of pasture and forage associated with year-to-year yield variability leads to the need of adjustments in livestock feed-mix in certain periods of the year. Thus, farmers' decisions, such as on optimal herd, marketing strategies for selling meat and adjustments in animal feed-mix, are directly dependent on intermediate product availability. Consequently, the assumption of an average year is the major limitation of mathematical programming models used to study the impacts of agricultural policies on dry land agricultural systems. In these systems, agricultural production variability should be taken into account when studying policy impacts on farm income.

Rational farmer decisions on what, how and how much to produce, depend upon information on the availability of resources, costs, expected productivity, and product prices. These expectations, based on experience, affect his perspectives on possible gains or losses, taking into account the technology utilized. Income variability is the risk that a producer has to consider when taking production decisions. Thus, farmers usually prefer farm plans and production technologies that maintain their income stable, regardless of obtaining lower income levels.

When farmers are risk-neutral, the maximization of the expected profit might represent their decision-making process. Nevertheless, farmers have, usually, a risk averse behaviour (Binswanger, 1980), resulting in production decisions that conflict with those regarded as optimal from a social point of view. This fact has brought about agricultural economists to pay attention to the stabilization schemes of agricultural policies designed to reduce farming risk.

Consequently, governments have seen as very important issues, both risk sources and farmers' attitudes to risk. Farm income reduction to avoid risk has a negative multiplier effect on income and on employment in rural areas. Moreover, farmers' strategies to avoid risk tend to reduce efficiency of farm resource use, diminishing income and decreasing the supply of risky products. Governments have had public intervention in various vectors: investments on public goods, price stabilisation measures, compensatory payments, farm insurance and calamity assistance programs are some of the traditional measures implemented (European Commission, 2001). Direct governmental intervention,

particularly the semi-decoupled compensatory payments, has been very important to Mediterranean farmers in reducing their income variability.

Recently, the level of attention to the risk behaviour of Mediterranean farmers has increased due to the 2003 Common Agriculture Policy (CAP) reform implementation and the ever-increasing importance of environmental issues.

According to the 2003 CAP reform, a system of a progressive reduction of direct payment is introduced on a compulsory basis for the years 2005 to 2012. This means that farm subsidies are expected to be completely decoupled from production by 2013. This is expected to enhance the capability of the farming to remain in the sector in competitive conditions and to strengthen the sustainability of rural areas. Simultaneously, it is expected to benefit the environment, eliminating the factors, such as high prices and production-linked payments, which have been an incentive to production intensification with consequent harmful effects to the environment.

To avoid the abandonment of agricultural land and to ensure the maintenance of good agricultural and environmental conditions, each Member State establishes a set of standards. Hence, the single farm payment is conditional upon cross-compliance with environment, food safety, animal health and welfare as well as the maintenance of the farm in good agricultural and environmental conditions. The new reform of the CAP involves some discretion for member states regarding to how fully to decouple subsidy payments from production (EC Nº1782/2003). This change is expected to have a major impact on both farm income and income variability. This will be particularly evident in the dry land areas of the Mediterranean region in which cereals and extensive cattle are the principal activities. Likewise, the agri-environmental measures (Portaria nº1212/2003) have a major effect on farm income levels and on farm income stabilization in less favoured areas in the Mediterranean region. Agricultural policies have been concerned with both the negative impact of intensive agricultural practices on environment and the problem of land abandonment in areas in which agriculture is no longer competitive. The semi-decoupled income support and the accompanying measures of the 1992 Common Agricultural Policy reform (EC regulation 2078/92) were the first attempts to correct the negative aspects of the production-orientated policies. According to each country specificity, several agri-environmental schemes have been defined and applied. Under the Agenda 2000, similar emphasis was given to the sustainability of agriculture, as well as under the 2003 CAP reform.

Thus, the main objective of this paper is to study the impact of the new CAP reform on income variability of a Mediterranean farm located in the south of Portugal. The effect of the agri-environmental measures on production activities, and hence on income risk, is also investigated. The remainder of this paper is organised as follows. Section 2 is devoted to the analytical framework. The mathematical programming model used to analyse the impacts is described in this section, as well as the agricultural systems studied. Section 3 presents and discusses the results, which show the changes in land allocation, and the changes in income levels and income variability under the current and proposed agricultural policy scenarios. Finally, concluding remarks and policy implications are discussed in Section 4.

Analytical Framework

As referred in the previous section, farmers have, usually, a risk adverse behaviour. Hence, they prefer farm plans and production technologies that maintain their income stable, regardless of obtaining lower income levels. This problem has been addressed, for the Alentejo region, with models based on discrete stochastic programming (DSP) associated with a MOTAD (minimization of total absolute deviations) framework (Marques, 1988; Carvalho, 1994, Lucas, 1995, Carvalho *et al.*, 1997, Carvalho and Godinho, 2004). In order to achieve the objectives of this paper, the base model developed by Carvalho (1994, 2004) was modified, improved and applied to a typical farm in the Mediterrean region of Alentejo, located in Évora County.

According to Hazell and Norton (1986), if resources are freely tradable, any stochastic discrepancies between the resource requirements of a farm plan and the resource supplies can be captured in the objective function through buying and selling activities. Every risk in the constrained set can be transferred into the objective function of the model and a single risk decision rule can be applied. Hence, the model is based on discrete stochastic programming associated with MOTAD framework (Hazell, 1971; Hazell and Norton,1986). These techniques take in account the variation of

years, associated to a certain probability of occurrence. Hence, the model represents rainfall variability and its effects on yields, farmer's decision-making flexibility, and indirect farmer's aversion to risk. While the DSP framework allows for sequential decision making, which characterizes the flexibility of farmers in modifying strategic decisions as the growing season unfolds; the MOTAD framework captures the effects of income risk. This risk results from cash crop yield variability, intermediate products selling variability from adjustments in livestock feed-mix, and animal selling variability from adjustments in marketing strategies for selling meat.

The model assumes that farmer maximise expected returns to management and land, subject to a set of constraints related to farm's limited resources of land, machinery, and labour, livestock feeding requirements and risk, as well as to the no negativity conditions. A simplified formulation of the model is:

$$\text{Max } E(Z) = E(Z_n X_n) - W_g N_g + R_p P_i V_{pi} + W_r P_i N_{ri} \quad (1)$$

Subject to

$$A_{mn} X_n \leq T_m \quad (2)$$

$$Y_i + M_{si} X_s + M_{ir} - M_r + M_{pi} - M_p \geq 0 \quad (3)$$

$$P_i Y_i \leq \lambda \quad (4)$$

Equation (1) states that producer maximise the expected return to land, management, and other fixed factors. $E(Z_n X_n)$ stays for expected gross margin of X_n crop and livestock activities; N_g represents purchasing activities, and W_g their prices; V_{pi} represents the livestock selling activities for the different marketing strategies by state of nature, R_p their gross margin, and P_i the probability of occurrence of each state of nature; N_{ri} represents the selling activities of intermediate products, and W_r their prices.

Equations (2) stay for resources availability and livestock feed requirements in which A_{mn} represents a mxn matrix of technical coefficients for crop and livestock activities; T_m is the vector of the available resources.

Equation (3) computes the sum of absolute deviations from expected returns *per* state of nature. In this equation, Y_i stays for total negative deviation from expected income for each state of nature; M_{si} is the matrix of absolute deviations from expected income of crop activities (X_s); (M_{ir} -M_r) is the deviation from the mean of the intermediate products selling activities, and ($M_{pi} - M_p$) represents the deviation from the mean for marketing strategies of livestock activities.

Equation (4) sums weighted negative deviations across states of nature according to their probabilities of occurrence. Thus, λ is the sum of the expected total negative deviations and will be parameterised from 0 to λ max in order to analyse the trade-off between expected income and risk.

The model simulates the 2003 new CAP reform considering the decoupleage of all area and headage payments and their replacement by a single payment. This single payment is maintained constant over time and it does not depend on land allocation among the different crops. It also takes in account the modulation of single payments, meaning a progressive reduction in the amount paid to the farmer.

The model is applied using data available from a farm survey, for the years 2000, 2001 and 2002, which correspond to the “reference period”. This “reference period” is used to calculate the amount of the single payment subsidy under the CAP Reform. The farm data are referred to resources availabilities, technical coefficients and farmer objectives. Other data like product and factor prices, soils and alternative activities were available from official statistics and experts.

The agri-environmental measures are also incorporated in the model. Several schemes have only been offered within specific areas and differentiated premiums have been awarded according to eligible areas. This farm is considered eligible for the on-going agri-environmental schemes related to extensive forage production systems and for the dry land arable crop production systems. These schemes are included in Group I of the agri-environmental measures, which has the objective of reducing the negative environment externalities of agriculture.

Dry land crop activities of this farm, with 366 ha of total area, are based on cereals (wheat, durum wheat, and triticale), on forages (oats*vicia, oats*lupines, oats), and on pastures (fallow, subterranean

clover and fertilized fallow). The irrigated crop activities, followed in 65 ha, include corn for grain or for silage, wheat, sunflower, sorghum for hay or silage, tomato and sugar beet.

Livestock activities, which include cattle and sheep, are based on different production technologies, and distinguished by different breeding periods, and crossing strategies. The composition of livestock unit (the unit of account for livestock) is defined according to the male/female ratio and to the replacement rate of males and females, and includes breeding and replacement animals. The several marketing strategies for selling meat represent independent activities related to the respective production activity through the production rate. Livestock feed requirements are entirely fulfilled from feed supplied from crop activities. Fodder production variability determines the selection of livestock technology and marketing strategies.

The model is applied to two CAP political scenarios. In the first one, named old CAP, the CAP scenario refers to the 1992 CAP reform with the changes introduced by the Agenda 2000 measures (Council of the European Communities, 1999). Under this scenario, the main measures are concerned to arable crops, beef and sheep activities. The compensatory payments are awarded *per* arable hectare, according to the farm productivity class, and *per* livestock head. The producer also receives a monetary compensation due to the set-aside requirements. Related to bovine activities, CAP measures introduced in the model refer to sucker and heifer premiums, special male bovine premium and slaughter premium, and to the extensification payment. Regarding to sheep activities, the subsidies included are the ewe premium and the supplementary premium.

The old CAP scenario is evaluated with and without the agri-environmental schemes. Unlike the new CAP, these schemes are still coupled to production, in particular, the dry land arable crop production measure is coupled to the crop area, and the extensive forage production is linked to forage and pastures areas, and hence, indirectly, to livestock production. This might induce an increase of land allocation to no competitive (unprofitable) activities.

The second scenario, named new CAP, reflects the full implementation of the 2003 CAP reform in which the compensatory payments, related to the reference period and awarded under the old scenario are transformed in a single payment and totally decoupled from both crop and livestock production. The modulation of the single payment implies a reduction of 5% in the amount paid to the farmer. The total amount paid to farmer is also reduced by 1% for construction of the organic farming fund. Similarly, the new CAP scenario is evaluated with and without agri-environmental schemes.

Model Results

Table 1 shows the comparison between the two political scenarios with and without the agri-environmental measures for the extreme situation of income variability (λ equal to 100% of λ maximum). This λ is the total weighted sum of negative deviations and represents what, in average, the farmer can loose in income. It is related to dry land crop activities and to livestock activities.

In the dry land, a decrease in cereals and hay areas and an increase in pasture under both with and without agri-environmental measures are expected with the new CAP reform. This change is more accentuate without agri-environmental measures once, in this case, farm subsidies are totally decoupled from production under the new CAP reform.

Regarding to irrigated land, the major differences are observed in tomato and sugar beet activities. Sugar beet production, not produced under the old CAP scenario, replaces tomato under both with and without the agri-environmental measures. This can be the result of the strong effect of decoupleage of the tomato price subsidies and of the sugar beet compensatory payments under the new scenario. The costs used to estimate the gross margin of the activities might also explain the result since only the variable costs are taken in account and these costs are heavier for tomato than for sugar beet. If the total costs (including the fixed costs) were taken in account, this substitution could not occur, since sugar beet has higher fixed costs than tomato. The production of intermediate products for animal feeding in irrigated land decreases slightly. Even though the increase in dry land pasture areas, the decrease of fodder production in irrigated land leads to decline in livestock activities (bovines).

Table 1 - Impact of 2003 CAP Reform on Crops and Livestock Activities – Maximum Risk

λ/λ max = 100%	***With Agri***		***Without Agri***	
	New CAP	**Old CAP**	**New CAP**	**Old CAP**
Crops *(ha)*				
Dry land				
Cereals	41.9	44.6	17.6	39
Hay	65	80.5	74.4	86.7
Pasture	194.1	175.9	209	175.3
Irrigated land				
Sunflower	6.1	7.3	7.8	7.3
Cereals	18.3	21.9	23.4	21.9
Hay	6.1	7.3	7.8	7.3
Silage	12.2	14.6	15.6	14.6
Sugar beet	34.7	-	27.2	-
Tomato	3.1	32.5	3.1	32.5
Livestock*:*				
Bovines *(livestock unit)*	177	326	209	329
Stocking rate *(Standard Unit/ha)*	0.71	1.33	0.76	1.31

Source: Compiled from Model Solution

Table 2 shows the cropping areas and the livestock activities under the new and old CAP with and without the agri-environmental schemes under the assumption of minimum risk aversion (λ/λ max equal to 100%).

Table 2 - Impact of 2003 CAP Reform on Crops and Livestock Activities – Minimum Risk

λ/λ max = 0%	***With Agri***		***Without Agri***	
	New CAP	**Old CAP**	**New CAP**	**Old CAP**
Crops *(ha)*				
Dry land				
Cereals	-	33	-	39
Hay	65	83.3	65	86.7
Pasture	236	184.7	236	175.3
Irrigated land				
Sunflower	0.7	7.3	2.3	7.3
Cereals	2.2	21.9	6.8	21.9
Hay	0.7	7.3	2.3	7.3
Silage	1.5	14.6	4.6	14.6
Sugar beet	58.8	-	51.9	-
Tomato	3	32.5	3	32.5
Livestock*:*				
Bovines *(livestock unit)*	76	294	119	329
Stocking rate *(Standard Unit/ha)*	0.26	1.14	0.41	1.31

Source: Compiled from Model Solution

The impact of the new CAP reform with and without agri-environmental measures for the minimum level of risk (λ/λ max = 0%) is shown in Table 2. As one can notice, the impact of the reform on land allocation, for both dry and irrigated areas, is stronger when the farmer is risk averse. The level of extensification is much higher than in the previous case (maximum risk). Cereals, as very

risky activities, are no more produced in dry land under the new CAP with and without agri-environmental measures. This extensification is also very important for livestock activities and is more evident with the agri-environment measures. Since these measures lead to a larger gross margin of fodder activities (hay and pastures) in the dry land, this increase in the gross margin compensates for the stocking rate reduction, and hence the farmer does not need to produce so much foodstuffs as he used to produce in the irrigated land.

In summary, the implementation of the new CAP reform leads to an extensification of production activities. This is more evident for dry land areas in which pasture substitutes for cereals, and in livestock activities which stocking rates decrease to more than an half.

Table 3 – Impact of 2003 CAP Reform on Expected Income and Risk

	With Agri		**Without Agri**	
	New CAP	**Old CAP**	**New CAP**	**Old CAP**
Total Expected Farm Income *(€)*	296 786.4	240 670.3	290 731.6	235 294.1
Total Expected Farm Income w/o subsidies *(€)*	48 919.2	-16 786.6	57 734.5	-12 575.21
Production Expected Income *(€)*	64 878.7	240 670.3	57 734.5	235 294.1
Expected Subsidies *(€)*	247 867.3	257 456.9	232 997.1	247 869.3
Sum of negative deviations (λ)	6 802.4	10 570.8	6 730.6	10 602.5

Source: Compiled from Model Solution

The new CAP reform increases, in relation to the old CAP, the total income in about 23% under both with and without agri-environmental measures, as shown in Table 3. Likewise, the farm income without subsidies increases enormously. On the contrary, production expected income, that is, the value of the objective function of the model, and hence related to the level of production activities under the new CAP decreases about 75%. This occurs because, under the old CAP scenario, many activities have negative gross margins without subsidies, as the total expected farm income without subsidies shows. However, the farmer continues following those activities since they still have high subsidies coupled (livestock activities) and semi-decoupled to their production level, as it is the case of cereals. The agri-environmental measures increase slightly farm incomes and subsidies from 12% under the new CAP (production expected income) to 2% under the old CAP scenario but decreases the farm income without subsidies in about 30% under the old CAP and about 15% under the new CAP. This effect is due to the fact that the agri-environmental are still coupled with production even under the new CAP scenario.

Figures 1 and 2 show the trade-off between expected income and risk for the different levels of risk aversion under the old and the new CAP reform scenarios with and without agri-environmental schemes. In this analysis, the different levels of risk aversion, that is, the expected total sum of negative deviations (λ), was parameterised at the levels of 0%, 20%, 40%, 60%, 80%, and 100% of its maximum value. As expected, the 2003 CAP reform, introducing the single payment scheme, totally decoupled from production, reduces the relative income variability (λ divided by expected total income) (Figure 1). This reduction is more effective for higher levels of risk or income variability (100% of λ max). On the other hand, the agri-environmental schemes appear do not have much influence on relative total farm income variability because their amount is very small relatively to the total farm income level.

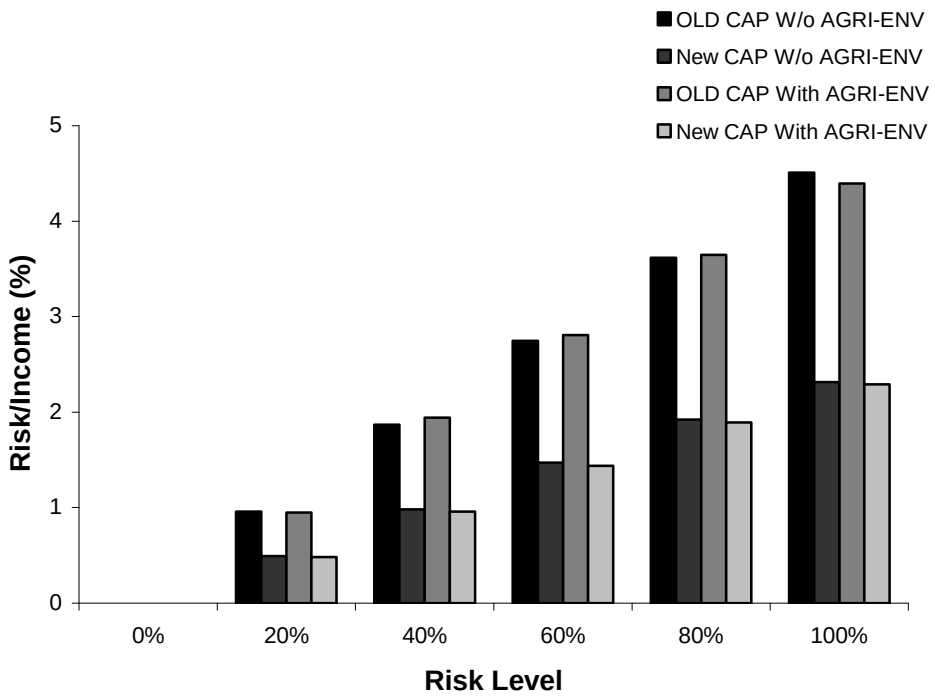

Figure 1 – Risk and Total Farm Income

Figure 2 shows that the new CAP reform increases the relative risk (in this case, λ is divided by expected production income) for all the levels of risk and under with and without agri-environmental scenarios. Thus, new CAP situation is more risky than the old one when only the expected production income is taken in account.

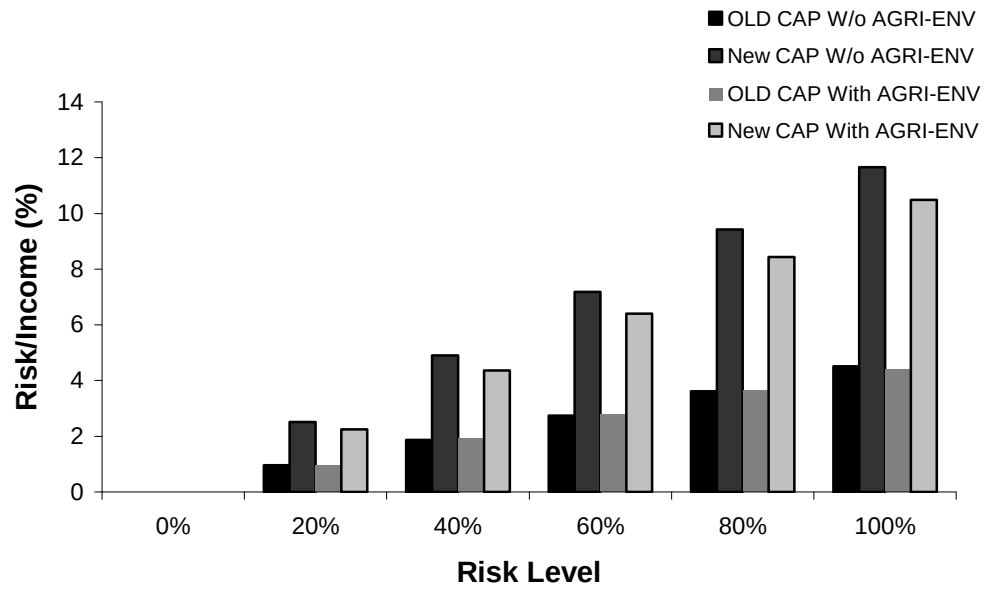

Figure 2 – Risk and Production Farm Income

As the new CAP measures are decoupled from production, farmers have no longer the stabilisation effect on production income variability from political intervention. Hence, farmers are expected to respond more to market signals. The agri-environmental measures do not alter the results under the old CAP scenario as in the previous analysis. However, as they are still linked to production they decrease slightly the level of risk under the new CAP.

In summary, the analysis of both figures allows one to conclude that, under the new CAP reform, the existence of the single payment decreases the variability of total farm income but relative risk increases when only the expected production income is taken in account. One can also conclude that the impact of the agri-enviromental measures on the level of risk is very small.

The previous figures are based on data contained in Table A1 of Appendix. In this table the expected total income and expected production income associated with the total weighted sum of negative deviations (λ) is presented for the four models.

Concluding Remarks

Agriculture in dry land Mediterranean areas faces a considerable level of production risk as result of the unpredictable weather. Governmental intervention, such as income stabilisation instruments, has had a major impact on Mediterranean farms in changing land allocation, reducing their income variability and changing income levels.

In terms of farming activities, the implementation of 2003 new CAP reform leads to an increase of extensification of production activities. This is more evident for dry land areas in which pasture substitutes for cereals, and in livestock activities in which stocking rates decrease to less than an half. For farms located in this region, the single payment scheme increases the total farm income but its variability decreases since cereals and fodder production are very dependent from climatic conditions, in special rainfall. According to results, under the agri-environmental scenarios, cereals continue being produced demonstrating that these measures have a major impact in avoiding the problem of land abandonment in less favoured areas of the Mediterranean region in which agriculture is no longer competitive. This is particularly evident in the dry land areas of the Mediterranean region in which cereals and extensive cattle are the principal activities.

This study also shows that the implementation of the 2003 CAP reform has a strong effect on farmers' income, measured in terms of total expected returns to land and management, and on farmers' production risk. The introduction of the single payment scheme, totally decoupled from production, increases the total farm income but reduces the relative total income variability. The reduction of income risk is more effective for higher levels of risk or income variability (100% of λ max). When only the expected production income is taken in account, meaning that the decoupled subsidies are not accounted for the farmers' income, the new CAP situation is more risky than the old one and the production income decreases. Hence, the relative risk increases when only the expected production income is taken in account.

As only a single farming system is analysed, further research should be conducted on other farming systems. In addition, possible changes in commodity prices, due to market liberalization, should be studied in future research.

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APPENDIX

Table A1 – Trade-off between expected income and risk

New CAP with Agri	**1**	**2**	**3**	**4**	**5**	**6**
λ/λ Max	0%	20%	40%	60%	80%	100%
Total Expected Farm Income*(€) (TI)*	273859.8	281944.9	283989.4	284124.9	287543.7	296786.4
Production Expected Income*(€) (PI)*	58145.9	60599.58	62407.26	63763.78	64509.48	64878.72
Total sum of negative deviations *(€) (*λ)	0	1360.488	2720.975	4081.463	5441.95	6802.438
λ/PI (%)	0	0.48	0.96	1.44	1.89	2.29
λ/TI (%)	0	2.24	4.36	6.40	8.44	10.48
New CAP without Agri	**1**	**2**	**3**	**4**	**5**	**6**
λ/λ Max	0%	20%	40%	60%	80%	100%
Total Expected Farm Income*(€) (TI)*	264741.2	274107.9	274492	274927.9	279936.5	290731.6
Production Expected Income*(€) (PI)*	51286.93	53594.05	54958.76	56204.71	57125.18	57734.47
Total sum of negative deviations *(€) (*λ)	0	1346.11	2692.23	4038.34	5384.45	6730.57
λ/PI (%)	0	0.49	0.98	1.47	1.92	2.32
λ/TI (%)	0	2.51	4.90	7.19	9.43	11.66
Old CAP with Agri	**1**	**2**	**3**	**4**	**5**	**6**
λ/λ Max	0%	20%	40%	60%	80%	100%
Total Expected Farm Income*(€) (TI)*	214467.6	222973.2	228507.3	233387.3	237287.1	240670.3
Production Expected Income*(€) (PI)*	214467.6	222973.2	228507.3	233387.3	237287.1	240670.3
Total sum of negative deviations *(€) (*λ)	0	2114.15	4435.97	6548.01	8654.19	10570.76
λ/PI (%)	0	0.95	1.94	2.81	3.65	4.39
λ/TI (%)	0	0.95	1.94	2.81	3.65	4.39
Old CAP without Agri	**1**	**2**	**3**	**4**	**5**	**6**
λ/λ Max	0%	20%	40%	60%	80%	100%
Total Expected Farm Income*(€) (TI)*	207804.2	221025.7	226823.1	231632.6	234452.48	235294.09
Production Expected Income*(€) (PI)*	207804.2	221025.7	226823.1	231632.6	234452.48	235294.09
Total sum of negative deviations *(€) (*λ)	0	2120.49	4240.98	6361.47	8481.96	10602.46
λ/PI (%)	0	0.96	1.87	2.75	3.62	4.51
λ/TI (%)	0	0.96	1.87	2.75	3.62	4.51