Revenue insurance as an income stabilisation policy: An application to the Spanish olive oil sector

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Abstract

Various forms of revenue insurance have been applied in Canada and in the US with relative success. In this paper different combinations of traditional agricultural policies and revenue and yield insurance are analysed for the Spanish olive oil sector. Taking a database containing about half million Spanish olive growers during 8 campaigns, five possible policies are studied and the results are examined according to different criteria including average revenue and its variability, growers utility gains, taxpayers cost and the transfer efficiency of support. The policies analysed are: (1) non-intervention; (2) the policy currently in force in Spain that combines a production aid with a yield insurance; (3) a revenue insurance, only; (4) revenue insurance combined with a production aid; and (5) an aid per tree in combination with revenue insurance. The methodology is based on Monte-Carlo simulations performed on about 100 groups of growers that have been grouped according to their expected yields and variability. Assuming and estimating olive oil price and yields correlations for each group of growers, the analysis allows for consistent policy comparisons at a very disaggregate level. Using the results for all analysed groups, policies are ranked based on the above criteria at the provincial and national levels. Results show that the current regime of EU production aids of olive oil eliminates the advantage of extending the current yield insurance to a revenue insurance. It is also shown that the level of support delivered by production aids cannot be reached with revenue insurance even with completely subsidised premiums. Finally, it is shown that the policy that combines tree aids with revenue insurance exhibits good results for all examining criteria.

Keywords: Agricultural policy, revenue insurance, olive oil sector

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Introduction

The denomination 'revenue insurance' comprises a variety of mechanisms for stabilising the revenue of farmers based on the theory of agricultural insurance. All these mechanisms have the common objective to reduce farmers' revenue variability. As they are based on the joint treatment of climate risks and market risks, they permit insuring farmers against decrease in revenue caused by a drop in prices, lower levels of yield or a combination of both causes.

The idea of insuring farmers' revenue by extending the traditional methods of price stabilisation or yield insurance, which were used separately until very recently, stems from various factors. On the one hand, the liberalisation of the agricultural markets could be associated to greater price instability (Meuwissen et al., 1999); on the other, the greater degree of market competition could lead farmers to look for economic efficiency based on production specialisation, thus making their economic results more sensitive to the variability in yield and to the prices of a reduced number of products. The fact that, in agreement with the World Trade Organisation (WTO), public subsidies in the field of agricultural insurance policies would be qualified under certain conditions as 'green box' (European Commission, 2001) has had considerable importance. Lastly and, perhaps the main reason, is the idea that revenue insurance policy may be a more efficient alternative to the traditional policies of revenue stabilisation, shifting the taxpayers burden from the latter to subsidise farmers' insurance premiums.

At the beginning of the 90's, the US and Canada began to develop different mechanisms of revenue insurance policies, by applying formulas based on the stabilisation of the revenue of a single product, of the whole farm revenues or by developing mechanisms more along the lines of mutual societies (Goodwin and Ker, 1998 b; Skees, 2000). Nowadays, 31.7% of the insured acreage in the USA is covered by some form of revenue insurance (RMA, 2001). The European Commission has commissioned several studies focusing on the broader topic of agricultural risks, among which revenue insurance policies have received special attention, and has motivated empirical work to examine various formulas of revenue insurance (Meuwissen et al., 1999). In Alava (Spain) the Potato Compensation Fund was initiated in 1997 under the form of individual accounts. Although it has not received much attention, perhaps due to the fact that only 150 growers are members (year 2001), it is worth analysing in detail since it is applied to a sector without a Common Market Organisation (CMO) and that takes in clearly differentiated productions depending on the crop varieties and collection dates (Sumpsi et al., 2001). This experience follows a formula similar to the Canadian NISA (Net Income Stabilisation Accounts), but in the case of Alava the state contribution to each member's account is based on the surface planted each year and not on the farmer's sales.

The overall results of the international experiences show that revenue insurance policies are difficult to design and administer (Meuwissen et al., 2000). On top of the traditional problems of crop insurance, such as moral hazard and adverse selection, there is the difficulty of carrying out a statistical analysis of the prices (Goodwin et al., 2000) and evaluating the correlation between prices and farmers' yields, or at least area average yields (Turvey and Amanor-Boadu, 1989; Skees, 2000). From an actuarial point of view, sound revenue insurance premiums are clearly dependent on the reliability with which the correlation between prices and yields can be estimated.

Further difficulties are encountered when trying to analyse the pros and cons of revenue insurance that totally or partially replaces a traditional instrument to stabilise or support farmers' revenue. While in general insurance policies should be used only for stabilisation purposes, loss ratios in the neighbourhood of 1.5 (as in the US) are an indication that premiums are consistently lower than the paid indemnities, and that insurance delivers also revenue support in addition to

revenue stabilisation. In their analysis of the Common Agricultural Policy (CAP) and possible ways for reform, Buckwell et al., 1997 sustain that, although a clear distinction should be made between policies for sustaining farmers' revenues and policies for revenue stabilisation, the dividing line is not always that clear. This debate of both a conceptual and empirical nature, is present in the relevant literature, perhaps due to the strong implications for future negotiations on agricultural trade in the World Trade Organisation (see Wu and Adams, 2001 and Young et al., 2001).

Several authors have comparisons of different revenue stabilisation policies using a variety of formulas of revenue insurance. Calkins et al., (1997) show that revenue insurance allows the agricultural farmers of Quebec to obtain greater expected income than a price insurance added to a yield insurance or than a system of individual savings accounts that receive state contributions. Their results also show that revenue insurance ensures greater efficiency of public expenditure, measured in terms of increase in gross margin per dollar of taxpayers contribution. Coble et al., (2000) show that revenue insurance policies are potential substitutes for other risk reduction strategies, such as hedging in futures and options. This indicates that revenue insurance has some properties that can be assimilated to the use of derivative markets, although it could constitute a more efficient tool for risk reduction by also protecting against drops in yields. Miller et al. (2000) find no clear advantages of revenue insurance over yield insurance in the case of peach growers because of the low correlation between yields and prices. Stokes et al. (1997) show that insuring for the whole farm's revenues is more efficient than insuring each crop by a different revenue insurance policy.

In spite of the increasing interest from both the methodological and analytical viewpoint ignited by the advent of revenue insurance policies, few works have tackled the alternative of replacing or complementing traditional tools of income support for farmers with revenue insurance policies. Hennessy et al., (1997), in a study that is considered a key antecedent of this current work, show that revenue insurance would guarantee producers 75% of their expected revenue by way of deficiency payments offered to maize and soya producers in the USA, at a fifth of the taxpayers cost. Such a degree of superiority of revenue insurance over the programme of deficiency payments gives rise to many methodological and empirical queries concerning the possible generalisation of this result to other sectors or circumstances. For example, the fact that all the Monte-Carlo simulations are carried out on the same representative farm or that the target price for the deficiency payments is considered fixed and not variable with the simulated production, could be assumptions that may be too restrictive for other contexts.

Objectives

The objective of this work is precisely to carry out a comparative analysis of a series of tools for stabilising olive oil growers revenues based on revenue insurance products, with other classical tools for sustaining and stabilising revenues. The policies analysed are: (1) non-intervention; (2) the policy currently in force in Spain that combines a production aid with a yield insurance; (3) a revenue insurance, only; (4) revenue insurance combined with a production aid; and (5) an aid per tree in combination with revenue insurance. The comparison will be carried out for the Spanish olive oil sector, although the conclusions derived from the analysis might be generalised to the other two European Union (EU) main producers, Italy and Greece, given that the same support policy is applied to the olive oil sector in the EU.

The olive oil sector is of special interest due to its economic and territorial importance and to the intense level of support granted by the EU Olive oil Common Market Organisation. From a methodological point of view, this work is a contribution to the literature on the subject since it

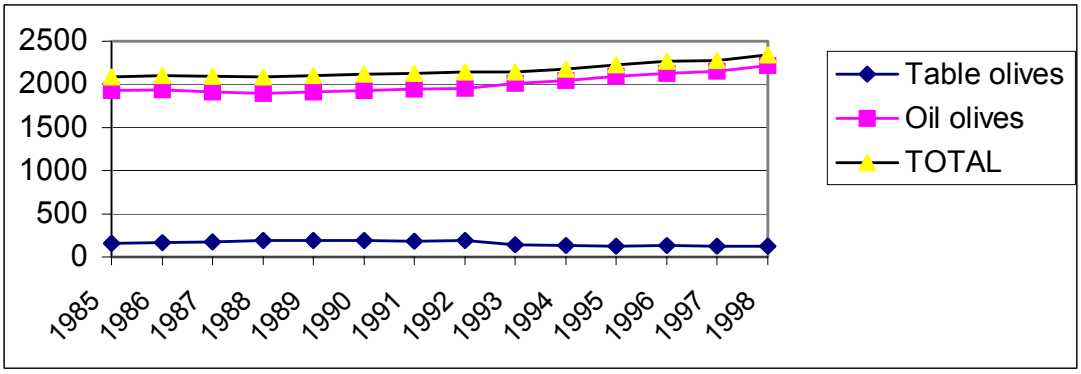
goes into a detailed analysis of the correlation between prices and yields, estimated for groups of homogeneous growers. It also incorporates the correlation of production aid, whose magnitude varies with each EU member state total production, and farmers' yields. This allows for detailed policy comparisons at a very disaggregate level, and it also relaxes restrictive assumptions commonly found in the literature, that could affect the reliability of the premiums calculated on the basis of such suppositions (Hennessy et al., 1997; Meuwissen, 2000; Calkins et al., 1997; Miller et al., 2000).

This study is motivated by the interest of ENESA (Spanish National Agency of Agricultural Insurance), the public body that implements the agricultural insurance policies in Spain, to study the possibility of converting some of its lines of yield insurance into revenue insurance. The database available for the study, which ENESA administers and updates systematically, containing in the case of the olive oil sector more than 500,000 growers with individual yields for 8 campaigns, provides a context setting very unusual for similar kinds of policy analysis.

The Spanish olive oil sector

Olive groves in Spain cover an area of more than 2.3 million hectares, of which only 5.3% is dedicated to the growing of table olives. Figure 1 shows that olive growing has experienced a slight upward trend in the last fifteen years. This study is going to concentrate on seven Spanish provinces (Jaén, Córdoba, Málaga, Badajoz, Toledo, Lérida and Tarragona), which together represent 62% of the surface and 73.7% of the total production. Figure 2 shows the evolution of olive production in Spain between 1980 and 2000.

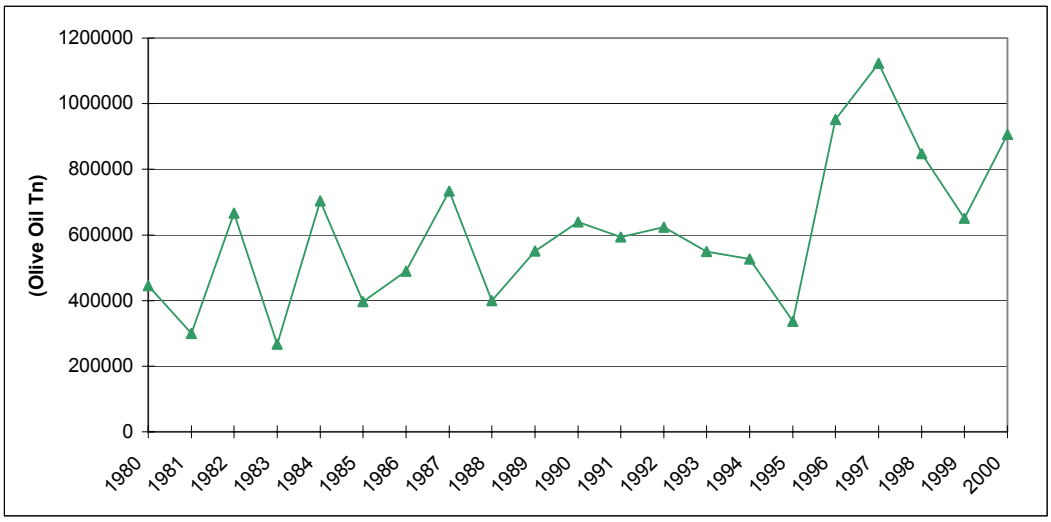
Figure 1. Evolution of the surface dedicated to olive-growing in Spain (1000 hectares)



Source: Data from MAPA[2] Yearbooks

[2] MAPA: Ministerio de Agricultura, Pesca y Alimentación (Ministry of Agriculture, Fisheries and Food)

Figure 2. Spanish Oil Production



Source: Data from MAPA Yearbooks

Yields are very sensitive to climatic conditions, specially to meteorological droughts. This is one of the reasons why, since the 2000-2001 crop year, there now exists in Spain a yield insurance that guarantees overall production in the face of any adverse climatic conditions.

The EU is the world leader in the production of olive oil and in foreign trade, contributing 70% of the world figures in both fields. The remaining 30% of the production is divided between Tunisia, Morocco and Turkey. The largest importers are the USA (46% of world imports) and the EU (44%), followed by Japan, Brazil, Australia and Canada who are also importers but of much less importance.

During the course of a marketing campaign the variability of prices is small due to the fact that the stock that links one campaign to the next attenuates in part the variations in production. Yet there is evidence that the level of the connecting stock between one campaign and the next is insufficient to absorb the impact caused in the market by important rises and falls in harvest levels. Figure 3 shows the sequence of weekly prices, referring to the index prices collected by the Spanish Ministry of Agriculture, from the first week of calendar year 1989 to the last week of 1999. The continuity between campaigns can be clearly appreciated, although the abrupt rise at the beginning of 1996 (week 361) and 1998 (week 522) is worth pointing out.

Table 4 provides results for two measures of efficiency transfer of support:

- The increase of certainty equivalent over public expenditure ΔCE/PE, referred to policy 1 (non intervention) as the reference point, gives an indication of efficiency transfer of support based on the utility gains per € of taxpayers cost.
- The increase of expected revenue over public expenditure ΔE(R)/PE**,** also referred to policy 1, provides indication of the efficiency transfer of support based on the increase of expected revenue per € of taxpayers cost.

On examining the results of Table 4 the following conclusions can be extracted:

Expected revenue: The policies with production aids (policies 2, 4 and 5), ensure a much greater level of revenue than policy 3 (revenue insurance, only). Even subsidising 100% of the premiums of revenue insurance would not be enough to reach revenue levels similar to the current ones, and similar to the ones obtained in all policies that include the production aid currently granted by the EU to olive oil growers. This implies that revenue insurance is insufficient to deliver an equivalent level of support delivered by the production aid. Policy 5, based on tree aids and revenue insurance, provides slightly lower expected revenue.

Distributional effects: The policy that makes the most equal distribution of expenditure, in terms of €/tree, is policy 5. In this case, the average public expenditure per tree fluctuates between 4.25 for Badajoz and 5.86 €/tree for Málaga. The one which makes the least equal distribution of expenditure is policy 2, reaching 13.23 for Málaga and 3.98 €/tree for Badajoz. This shows that the substitution of all or part of the production aid with insurance subsidies has redistribution effects. Channelling taxpayers' cost from production aid to subsidies to insurance premiums tend to reduce the level of support to farms with a greater average yield, specially farms in irrigated areas in which the variation in yields is significantly lower. This leads to a smaller dispersion of subsidies and levels of revenue between the different provinces.

Taxpayers' cost: The most costly policy in terms of €/tree is policy 2, reaching an average of 8.92 €/tree. We estimate that the total cost for Spain would reach 1,233.46 million € per year with 50% of olive trees covered by insurance policies (Table 5). The next policy in terms of cost would be scenario 4, with an average cost of 8.76 €/kg, whose total cost has been estimated at 1,221.91 million €s/year. The least costly policy, with the exception of policy 1 that does not incur in public expenditure, is number 3 (revenue insurance with a 100% subsidy), with an average of only 1.69 €/tree. However, it has to be taken into account that the final expected revenue is much lower than the current revenue (Policy 2).

Table 5. Estimated taxpayers cost for the work sample (100 groups) and for Spain

Policy	Cost of premium subsidies €/olive tree	Cost of production aids or tree aids €/olive tree	Total average cost* €/olive tree	Total cost in Spain* (million €/year) (146,553,195 olive trees)
Policy 2	1	7.92	8.42	1233.46
Policy 3	1.69	0	0.84	123.10
Policy 4	0.77	7.92	8.31	1217.86
Policy 5	1	4.25	4.75	696.13

*Supposing that 50% of the olive trees are covered by the different insurance policies.

In order to compare the results of each policy, three rankings have been carried out. The indicators used in each ranking are: 1) the minimum coefficient of variation, 2) the maximum ΔE(R)/PE, and 3) the maximum ΔCE/PE. The following scoring criteria has been used: (1) The

results of each policy in each groups are compared; (2) we give a score of 1 to the policy that wins in each group and 0 to all the rest; (3) the weighted average score for each policy is calculated, with the number of olive trees that represents each group in each province as a weighting criteria. Table 6 shows the results of the ranking according to the three criteria.

Table 6: Ranking of policies according to three criteria

	Minimum of CV		ΔE(R)/PE		ΔCE/PE	
Geographical Area	Best policy	Second Best	Best policy	Second Best	Best policy	Second Best
All 7 provinces	5	3	4	5	5	4
Badajoz	5	3	5	4	5	3
Córdoba	5	3	4	5	5	4
Jaén	5	2	4	5	5	4
Lérida +Tarragona	5	3	5	4	5	3
Málaga	5	3	4	5	5	4
Toledo	5	3	4	5	5	3

The policies are: (1) No intervention; (2) Yield insurance+production aids; (3) Only revenue insurance; (4) Revenue insurance+production aids; (5) Revenue insurance+tree aids.

Policy rankings shown on Table 6 are now discussed. First, Policy 5 ensures the lowest variability of revenues followed by policy 3. According to the first criteria of efficiency of public expenditure ΔE(R)/PE, the first place is occupied by both policy 4 (current aids and revenue insurance with a 50% subsidy) and policy 5 (aids per tree with revenue insurance with a 50% subsidy). It can be seen that in the provinces with lower expected yields, Badajoz, Lérida+Tarragona and Toledo, policy 5 is the preferred one. Whereas in Málaga, Jaén and Córdoba, with an expected yield of twice the size of the previous provinces, policy 4 is preferred.

According to the second proposed criteria for efficiency transfer of support, ΔCE/PE, policy 5 comes in first, both for all the 7 provinces together and for each province on its own. This denotes that in combination with the revenues insurance, the tree aid reduces risk more effectively than the production aid.

Given that the total taxpayers cost of policy 5 is lower than for policies 3 and 4, it may seem likely that if it were increased, the efficiency of expenditure would be reduced due to the concavity of the utility function, and thus we would end up with similar results to the ones in the previous point, with policies 4 and 5 nearing second place. But as we saw above, policy 5 provides the minimum CV, and would thus turn out to be superior to Scenario 4. We can see in Table 4, that in spite of the fact that policy 4 surpasses policy 2 in all rankings, the degree of efficiency of both policies is very similar. Thus we deduce that the greater degree of efficiency of revenue insurance is partially offset by the fact that production aid drops when yields grow, imperfectly reproducing the foundations of any revenue insurance, when price and yields are negatively correlated.

Having observed that the results of policies 2 and 4 do not differ very much, it is interesting to make a comparison of revenue insurance and yield insurance in an isolated way. To do this the indemnities payments that would have been made in the 1991-1998 campaigns if both insurance policies had existed have been simulated. From the results obtained, which are summarised in Table 7, we deduce that the yield insurance's impact is much stronger than revenue insurance's for two reasons. One, because average indemnities payments is almost three times higher for yield insurance than for revenue insurance. This confirms that vis-à-vis revenue insurance is much

cheaper than yield insurance. Secondly, because revenue insurance is also more balanced, as its simulated maximum indemnity is much lower, and the minimum is higher, than yield insurance's. This suggests that the cost of reinsurance of revenue insurance is, in relative terms, much lower than the cost of reinsurance of yield insurance.

Table 7: Comparison of the indemnity payments for yield insurance and revenue insurance: (Indemnities evaluated in millions of €s for the national total assuming that 50% of the olive trees in Spain are covered by the different insurance policies.)

Years 1991-1998	Yield insurance (Policy 2)	Revenue insurance (Policies 4 &5)
Average indemnities	20.8	7.1
Maximum annual indemnities	151.5	46.1
Minimum annual indemnities	0.01	0.13

Conclusions

Five different policies that support or stabilise olive oil producers revenues have been analysed: (1) No intervention (provides the comparison reference); (2) current EU production aid and yield insurance; (3) revenue insurance; (4) revenue insurance and EU current production aid; (5) revenue insurance and tree-based aid. Results show that Policy 5 has shown the best properties: (1) It places most of the budgetary cost in the tree aid, which is thought to provide a quasi-decoupled form of revenue support (on average, 81% of the cost would be assigned to tree aid, and 19% to subsidise revenue insurance premiums); (2) it reduces variability of revenue to a minimum; (3) it is the most equitable in terms of total expenditure per olive tree; and (4) it has the most efficient transfer of support from taxpayers to producers. The main disadvantage of scenario 5 is that the national average revenue would diminish in about 3 €/tree with regard to scenarios 2 and 4. This differences are sharply marked looking at expected revenue losses in the provinces with the highest yields, like Málaga which would lose around 7 €/tree and Jaén with a loss of 4 €/tree.

We leave for future research going further into the study of a policy of aids per tree or perhaps per hectare, to which a revenue insurance could be added. Special care would have to be taken with this modality of aid, so that although it may vary with the provincial or county average yields, it would need to preserve the characteristic of an aid partially decoupled from production.

As far as revenue insurance is concerned we have noticed that the current policy that combines a production aid with yield insurance gives results that are very similar to the ones that would be obtained by maintaining the current production aid and substituting the yield insurance for a revenue insurance. The theoretical superiority in efficiency of revenue insurance is offset by the way production aid is calculated for each year and EU member state. Thus, the results show without any ambiguity that a revenue insurance that were to replace the yield insurance, maintaining the regime of production aids, would not offer important improvements for any of the proposed analysis criteria, neither at national level nor for each of the provinces analysed. This result is motivated by the combination of two circumstances. The first one is that yields of Spanish olive are subject to climatic effects that are common to a large extent, which means that the yields of farms are positively correlated with each other, and in consequence, with the production of the country. And, in second place, since the quantity of production aid (in €/kg) depends on the total production of the country, it happens that the high yields are associated with less aids and vice-versa. The resulting effect from both factors is to eliminate to a large degree the interest in substituting the yield insurance with revenue insurance, as long as the production aid is maintained

in its current formula. If the yields of Italy and Greece are equally subjected to climatic processes that affect most of their olive-growing farms, the results obtained in this study can be generalised in full for these two EU countries.

Another outstanding conclusion of this study is that when the level of support provided by a policy to a sector is very high, as is clearly the case of the olive oil sector in the EU, then a revenue insurance policy reveals itself incapable of replacing it in an efficient way, even supposing that it were to subsidise the overall premium of the producers. However, if a part of the support for the sector is totally decoupled from production and the other part is channelled by way of a revenue insurance, the resulting policy would be much cheaper and more efficient. This would be the case of the tree aids combined with revenue insurance (policy scenario 5 in this study).

From a methodological perspective, it is shown that using micro-level data, instead of area, county or province data, broadens the analysis and implications in a number of ways. First it allows for making cross-section comparisons not only based on geographical grounds but also on the level of market and yield risks that each individual grower faces. Secondly, it ensures that actuarially-based individual premiums are calculated more accurately, which in turn, permits making policy comparisons at the most disaggregate level. Lastly, it makes realistic assumptions about the expected receipts granted to each grower by policies that embody budget stabilising mechanisms, such as the EU production aid to olive growers.

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