Introducing Different Land Uses (Irrigated and Non-Irrigated) in Policy Analysis Modelling for Mediterranean Countries

Jose Maria CASADO
Azucena GARCIA

Contributed paper prepared for presentation at the International Association of Agricultural Economists Conference, Gold Coast, Australia, August 12-18, 2006

Introducing Different Land Uses (Irrigated and Non-Irrigated) in Policy Analysis Modelling for Mediterranean Countries[1]

Jose Maria CASADO & Azucena GRACIA

Centro de Investigación y Tecnología Agroalimentaria

Contributed paper prepared for presentation at the International Associationof Agricultural Economists Conference, Gold Coast, Australia, August 12-18, 2006

Abstract

The arable crop sector in Spain is highly dependent of the Community subsidies and account for 33% of total transfers received by the Community. Then, it is expected that the introduction of the Single Farm Payment (SFP) will drive important changes in the arable crop production in Spain. The quantitative assessment of the SFP impacts on the arable crop sector in Spain is the overall objective of this paper. To achieve this goal, an econometric, dynamic, multi-product and partial equilibrium commodity model has been built disaggregating between irrigated and non-irrigated land use for cereals called Spanish Econometric Simulation of Agricultural Policies (SESAP).

Results indicate that the introduction of the SFP has only induced considerable changes from the Agenda 2000 in the supply side, having found only small changes in imports and exports, and insignificant or null changes in domestic use. Cereals and oilseeds production is expected a higher decrease under the SFP scenario than under the Agenda 2000. The main differences between irrigated and non-irrigated production of the different cereals are two. Wheat and barley are mainly produced in non-irrigated land where production shows less dependence on policy changes in the case of wheat and have a positive impact in the case of barley. However, barley and maize irrigated production would have remained constant under the Agenda 2000 but a decrease of 25% is predicted under the SFP scenario. In addition, maize is mainly produced in irrigated land, and the non-irrigated production will enormously decrease until almost disappear in the near future.

Keywords: CAP reform, partial equilibrium model, policy modelling, irrigated Agriculture, simulation.

JEL Clasiffication: Q12;Q18

1 Introduction

The Common Agricultural Policy (CAP) has greatly influenced in the Spanish Agricultural sector due to the substantial amount of EU funds received mainly since the end of transitory adhesion period and after the 1992 CAP reform. Grants have represented 17% of Final Agricultural Production (FAP) and direct grants to producers account as average for a quarter of their income. Spain is the third ranking recipient of the Community funds (14.6%) behind France and Germany. In this context, any change in the CAP will have important impacts on the Spanish Agriculture. Therefore, the new measures implemented in the latest reform of the CAP (Luxembourg Agreement) will have a direct influence on the Spanish Agricultural Sector.

In order to quantify the effects of the Luxembourg Agreement, an econometric model was developed, under the 5th framework program, to evaluate the impact of the latest CAP reform on the European Countries (Agricultural Sector in the Member States and EU and Newly Associated States: Econometric Modelling for Projection and Analysis of EU policies on Agriculture, Forestry and the Environment - AGMEMOD Project). In this model, it was necessary to have homogenous models for each country to compare the EU aggregate results. This requirement did not allow considering the irrigated-non-irrigated land uses peculiarity of the Mediterranean Countries agriculture.

The distinction between irrigated and non-irrigated cultivation is very relevant in the case of the EU Mediterranean countries for their economic implications to farmers. In Spain, irrigated Final Agricultural Production accounts for up to 50% of total FAP while, the harvested irrigated area represents 15% of the total area harvested. Irrigated production has economic implications to farms because one hectare in irrigated land produces six times more than one non-irrigated hectare and gives four times higher returns. Moreover, direct payments are related to the yield in reference areas and yields are different and higher for irrigated than for non-irrigated land.

When we do not take into account the irrigated peculiarity of the Spanish Agriculture, unexpected results of the impact of the CAP reform are obtained (Casado and Gracia, 2005). Although the direct payments of the Agenda 2000 were supposed to be fully decoupled in a Single Farm Payment, no impact on either area harvested or production for cereals was found. In spite of these results, we could not conclude that the implementation of a Single Farm Payment will not induce any change in projection from the Agenda 2000 scenario for cereals. The reasons behind this result are mainly two. First, only the new Single Farm Payment instrument was implemented. Second, and most important, in the specification and estimation of the area harvested for cereals, direct payments were not statistically significant. Then, no differences between results from the Agenda 2000 and the Single Farm Payment scenario could have been found. However, this does not mean that the new Single Farm Payment has null impact on harvested cereals area. The insignificance of direct payments might be due to the aggregate nature of the cereals analysis. In other words, in Spain, cereals production is obtained from both, irrigated and non-irrigated land. This distinction had not been taken into account in the Spanish model in order to accomplish the common format required by the composite EU model. Therefore, direct payments had not influenced the harvested area decision at aggregated level while it is expected to have some influence once it will be disaggregated into irrigated and non-irrigated land use.

That is the main reason because in this paper we will provide a model that distinguishes between cereals in irrigated and non-irrigated land, called Spanish Econometric Simulation of Agricultural Policies (SESAP). In particular, the specific goals are: i) build a more realistic, adapted to the EU Mediterranean Countries Agriculture characteristics econometric model for policy analysis, ii) provide results of the implementation of the Single Farm Payment in Spain; and iii) analyse the different impacts of the SFP on the irrigated and non-irrigated Spanish agriculture.

The paper is structured as follows. Section two gives a revision of existing agricultural models for policy analysis and describes the general structure of the model. Section three presents the baseline scenario and the simulation results of the impact of the Single Farm Payment on the Spanish agricultural sector. Finally, last section shows main conclusions, limitations and extension of the model and alternative scenarios.

2 The Model

2.1 Previous experiences

Several European and world agricultural models have been designed to analyse the impact of agricultural policy changes on both, the agricultural sector and the whole economy[1]. Most of them provide results for the impact of agricultural policies on large world regions (Europe, Asia, etc.) or some selected countries. On the other hand, many countries such as USA and

[1]A revision of those models can be seen in Tongeren et al., (1999), Conforti, (2001); Conforti and Londero, (2001); and De Muro and Salvatici, (2001).

some EU countries, have also built their own policy analysis models. Among others: i) Austria: AGTRACES-AGricultural TRade and ACtivities Evaluation and Simulation model; ii) Denmark: ESMERALDA model (Jensen, 1996; Jensen et al., 2001); iii) Finland: DREMFIA model (Lehtonen, 2001); iv) France: MEGAAF model (Gohin, 1998 and Gohin et al., 1998); v) Great Britain: Manchester model (Burton, 1992); vi) The Netherlands: WAGEM model (Komen and Peerlings, 1996); vii) Ireland: TEAGASC model (www.tnet.teagasc.ie/fapri); and viii) USA: The FAPRI model (www.fapri.org). All these models are general partial market equilibrium models for one country covering a diversity of agricultural products. The main objective of them is to simulate the impact of changes in the agricultural policies on their agricultural sectors.

In Spain, there does not exist a tradition to build such models and the pioneer works have mainly built only models for some specific commodities, i.e. oranges (Albisu y Blanford, 1983), pepper (Berbel, 1987), olive oil (Mili, 1990), pork meat (Albiac y Garcia, 1991), cereals (Astorquiza y Albisu, 1994), oilseeds (Fernandez Salido, 1997) etc. One of the whole agricultural sector models is the MESTA model (Modelo Econométrico Sectorial para la Agricultura-Econometric Model for the Agricultural Sector) build in the 90's to analyse the impact of the 1992 CAP reform in the Spanish Agriculture (Ibáñez and Pérez Hugalde, 1993; Ibáñez and Pérez Hugalde, 1995 Ibáñez and Pérez Hugalde, 1996; and Ibáñez and Pérez Hugalde, 1999). The MESTA model is a sectorial econometric model consisting of four sub-models (crop production, livestock production, expenditures on inputs and prices). Main agricultural products considered are: arable crops (grains, oilseeds, roots, vegetables and cotton), perennial crops (grapes, olives and fruits) and livestock. The model is used to provide analysis of both, Spanish agriculture as a whole and one selected Spanish region. The other model, the DESPA model (Diagnóstico Económico y Simulación de Politicas Agrarias-Model of Economic Diagnosis and Simulation of Agricultural Policy) was also designed to simulate the impact of changes in the CAP on the Spanish agricultural sector. The DESPA model is a system of sub-models to simulate the effects of changes in the exogenous variables (product prices, inputs, direct aids and other subsidies) on area allocation, output, production cost,and farmers' income. The DESPA's methodological approach is mixed because it combines the postulates of economic theory, econometrics, agronomic technical knowledge and expert opinion (García and Rivera, 1995). This model is adapted to the analysis of both, Spanish agriculture as a whole and the five regional subsystems into which Spanish agriculture is divided.

Although the three simulation models share the same objective, analysing the effect of agricultural policy changes on the Spanish agriculture, they have some similarities but also some differences among them. The model provided in this paper shares more similarities with the first one (MESTA model). Both of them are econometric models for the crop and livestock sectors and, they take into account the distinction between cultivation in irrigated and non-irrigated land while the other does not present such as characteristics. However, the three models use historical annual data for the Spanish agriculture and different ex-post and ex-ante assumptions for the simulated scenarios. The other two models were built in the early 90's to analyse the impact of the 1992 CAP reform, while the current model has been built ten years after to analyse the impact of the Luxembourg Agreement and subsequent reforms.

2.2 Overview of the Model

The SESAP model is an econometric, dynamic, multi-product and partial equilibrium commodity model. The aim of the SESAP model is to provide a tool for projection and policy simulation under alternative assumed conditions. Then, policy instruments will be explicitly introduced in order to allow quantitative analysis of CAP reform scenarios. The model consists of two different sub-models, the arable crop and the livestock model. Some links between both sub-models exist, mainly through feed demand equations and input costs. The products covered in each of the sub-models are the following: i) cereals (wheat, barley and maize); ii) oilseeds (soybeans and sunflower seed); iii) root crops (sugar beet and potatoes); iv) livestock (cattle, pig, poultry, and sheep); and v) milk.

In this paper we use the SESAP model to give the result of the impact of the Single Farm Payment only on the arable crop sector. This sector has been selected for his higher dependency on the Community grants. Grants by area indicate that arable crops are the first recipients of grants with 33% of total transfers, in particular, cereals with 22%. Moreover, cereals are the most important crops in Spain representing 43.2% of the total area harvested followed, by far, by fruits and vegetables (11.8%) and industrial plants (10.4%).

The SESAP partial equilibrium model consists of a set of behavioural equations, a set of equilibrium relations between supply and demand and a set of identities. Equations can be grouped into supply component (harvested area, yield, animal ending stocks, slaughter animal, etc.), demand or utilisation side (domestic use, feed use and food use), trade (import and export), stocks change and price transmission. The specification of the behavioural equations is based on economic theory, particular characteristics of the Spanish agricultural sector together with expert opinion. Historic data from 1973 to 2000 are used to estimate the behavioural equations. The model is solved for a set of assumptions related to policy and macroeconomic variables, and world prices over the period 2001-2010, providing the baseline projections. Finally, the impact of the SFP is simulated over the period 2001-2010.

2.3 Specification of behavioural equations

In this section we will focus on explaining the Spanish arable crop model in order to focus on the differentiation between irrigated and non-irrigated production. The arable crop model consists of three sub-models: the cereals sub-model (wheat, barley and maize), the oilseeds sub-model (sunflower and soybean[2]), and the root sub-model (sugar beet and potatoes).

In the arable crop sub-model, it is assumed that land allocation is made in a two-step process driven by prices and yields. First, producers determine the total land allocated to cereals, oilseeds, and root crops. Then, in a second stage, total grains, total oilseeds, and total root crops area are allocated to each crop within these main groupings. The supply side of the irrigated and non-irrigated cultivation will depend on cereal real price and cereal compensatory payments.

Area harvested for crop i in year t is determined by:

$$ah_{i,t} = Iah_{i,t} + Nah_{i,t} \tag{1}$$

$$Iah_{i,t} = f\left(p^{j}_{i,t-1}, Pol^{j}_{i,t}, V^{j}_{i}\right) \tag{2}$$

$$Nah_{i,t} = f\left(p^{j}_{i,t-1}, Pol^{j}_{i,t}, V^{j}_{i}\right) \tag{3}$$

[2] In Spain neither rape production nor consumption and trae exist

i : represent the main crop groups (cereals, oilseeds and roots[3])

j: represents the different crops within the main group (wheat, barley, maize, sunflower, sugar beet, and potatoes)

where $ah_{i,t}$ is the area harvested for crop i in year $t, Iah_{i,t}$ is the irrigated area harvested for crop i in the year t, $Nah_{i,t}$is the non-irrigated area harvested for crop i in year$t$,$p^j_{i,t-1}$ [4] is the real price or price *ratio* for the specific crop j within the crop group i for year $t-1$. $Pol^j_{i,t}$ consists of a set of policy variables that might directly affect area harvested decision, (i.e. set aside, compensatory payment,...). Finally,V^j_i are other exogenous variables that might determine area harvested for the analysed commodity (i.e., other crops area harvested, trend, lags, etc).

Area harvested for each of the sub-crops j is determined calculating the irrigated and non-irrigated area share for each sub-crop j within crop i for year t as follows:

$$Ish^j_{i,t} = f\left(p^j_{i,t-1}, Pol^j_{i,t}, V^j_i\right) \tag{4}$$

$$Nsh^j_{i,t} = f\left(p^j_{i,t-1}, Pol^j_{i,t}, V^j_i\right) \tag{5}$$

where $Pol^j_{i,t}$ is the set of policy variables affecting crop j, (i.e. intervention price).

In order to satisfy the adding-up restriction, irrigated and non-irrigated area share for the most important crop n is dropped for the estimation and

[3]Remember that in this paper we only distinguished irrigated and non-irrigated area harvested for the cereal sector.

[4]Instead of including receipts per hectares and in order to differentiate the effect of prices and policy variables, the last one have been included

is calculated afterwards by adding-up the estimated values for the rest of the crops:

$$Ish_{n,t} = 1 - \sum_i Ish^j_{i,t} \forall i \neq n \tag{6}$$

$$Nsh_{n,t} = 1 - \sum_i Nsh^j_{i,t} \forall i \neq n \tag{7}$$

where

$$\sum_i Ish^j_{i,t} = 1; \sum_i Nsh^j_{i,t} = 1 \qquad \text{and} \quad 0 \leqslant Ish^j_{i,t} < 1,\ 0 \leqslant Nsh^j_{i,t} < 1 \tag{8}$$

Multiplying [4],[5],[6] and [7] with [2] and [3], respectively, the area harvested for each of the sub-crops j within crop i is obtained:

$$Iah^j_{i,t} = Iah_{i,t} * Ish^j_{i,t} \tag{9}$$

$$Nah^j_{i,t} = Nah_{i,t} * Nsh^j_{i,t} \tag{10}$$

The irrigated and non irrigated yield per hectare equation for each crop$j$ within group$i$, $Iy^j_{i,t}$ and $Ny^j_{i,t}$ is determined by prices of the crop and substituted crops, and other exogenous variables V^j_i (i.e. technological change, weather indicators such as raining level, ...),

$$Iy^j_{i,t} = f\left(p^j_{i,t-1}, V^j_i\right) \tag{11}$$

$$Ny^j_{i,t} = f\left(p^j_{i,t-1}, V^j_i\right) \tag{12}$$

Given area harvested and yield per harvested hectare, production for each crop j is calculated by the following identity:

$$IPR_{i,t}^{j} = Iah_{i,t}^{j} * Iy_{i,t}^{j} \tag{13}$$

$$NPR_{i,t}^{j} = Nah_{i,t}^{j} * Ny_{i,t}^{j} \tag{14}$$

$$PR_{i,t}^{j} = IPR_{i,t}^{j} + NPR_{i,t}^{j} \tag{15}$$

Total domestic use for each crop j within group i, $DU_{i,t}^{j}$ consists of three different uses: feed use $Fu_{i,t}^{j}$ non-feed use (human) $NFu_{i,t}^{j}$, and industry use $CR_{i,t}^{j}$ as follows,

$$DU_{i,t}^{j} = Fu_{i,t}^{j} + NFu_{i,t}^{j} + CR_{i,t}^{j} \tag{16}$$

Feed demand equation for each crop j within group i depends on prices and livestock crops as follows:

$$Fu_{i,t}^{j} = f(p_{i,t-1}^{j}, ac_{k,t-1}) \tag{17}$$

where, $p_{i,t-1}^{j}$ is price or price ratio for different cereals and/or oilseeds used to feed animals and $p_{i,t-1}^{j}$ is price or price ratio for different cereals and/or oilseeds used to feed animals and k (cattle, pork , sheep and poultry).

Non-feed demand equation for each crop j within group i (human demand) depends on traditional demand theory, it means, prices $p_{i,t-1}^{j}$, and per capita income GDP_t (real per capita GDP as a proxy) and a set of other exogenous variables V_i^j that might affect human demand of the product.

$$Fu^j_{i,t} = f(p^j_{i,t-1}, ac_{k,t-1}) \tag{18}$$

Finally, in the case of oilseeds, there is a crushing use to get either oil or meal. The crushing use depends on oilseeds prices as well as output prices (oil or meal) and other exogenous variables affecting crushing use:

$$CR^j_{i,t} = f(p^j_{i,t-1}, p^d_{i,t-1}, V^j_i) \tag{19}$$

where, $p^d_{i,t-1}$ is the price for the oil and/or meal obtained from the oil seeds and V^j_i are other exogenous variables affecting the crushing demand.

Finally, trade and stocks change equations complete the supply and demand specification. These equations depend on production, domestic use, and price,

$$St^j_{i,t} = f(PR^j_{i,t}, DU^j_{i,t}, p^j_{i,t-1}) \tag{20}$$

$$Ex^j_{i,t} = f(PR^j_{i,t}, DU^j_{i,t}, p^j_{i,t-1}) \tag{21}$$

$$\operatorname*{Im}^j_{i,t} = f(PR^j_{i,t}, DU^j_{i,t}, p^j_{i,t-1}) \tag{22}$$

where, $St^j_{i,t}, Ex^j_{i,t}, \mathrm{Im}^j_{i,t}$ are stock change, exports and imports for each crop $j$within group i in year t respectively, and $PR^j_{i,t}, DU^j_{i,t}, p^j_{i,t-1}$ are production, domestic use and prices for each crop j within group i.

2.4 Estimation and validation of behavioural equations

All previous equations have been estimated using annual data from the period 1973-2000. These data were obtained from EUROSTAT's, AGRIS and New-Cronos, FAO and OECD databases, FAPRI projections and from the Spanish Ministry of Agriculture when information was not available in the European databases. The estimation of the parameters for the behavioural equations was done with the Eviews software.

2.5 Price transmission and market closure

In order to complete the building of the model, it is necessary to add an equation describing the equilibrium for each commodity market. This condition requires production plus beginning stocks plus imports to equal domestic use plus ending stocks plus exports. In a closed economy, this supply and use equilibrium condition is sufficient for an endogenous determination. However, this model will include the impact of other economies through price linkage equations to account for the relations between Spain and the European Union and/or the rest of the World. Then, the price in Spain depends on the key market price together with the degree of self-sufficiency of Spain and that in the key market. The previous years price in Spain is in the linkage equation too. For most commodities the French market has been used as the leader.

There is no guarantee that variables computed with the econometric model satisfy the necessary supply and use equilibrium condition noted above. To solve this problem, a closure variable ensuring that the supply and use identity holds for all markets has been used. In other words, for each market there exists one endogenous variable that closes the model and thus is determined by a supply and use identity. Generally, this closure variable is the export or import variable, but, in Spain not ending stocks information is available. Then, for many commodities, the stock change has been the closure variable.

Finally, the SESAP model is solved with the estimated parameters in a recursive way for the projection period. It means, the equilibrium for one period is the starting point to solve the next equilibrium. The equilibrium has been solved from 2001 to 2010 using the GAMS software.

3 Scenario and simulation results

This section provides the results of the potential effects of introducing the Single Farm Payment on the Spanish arable crop sector over the period 2001-2010. The starting point for the analysis is the baseline scenario (Agenda 2000) to be used as a reference for evaluating the effects of any policy changes (Luxembourg Agreement). Once the baseline projections are set, they are used as a comparison point for the policy scenarios under the Luxembourg agreement.

3.1 Model assumptions and policy scenarios

Projections have been made under the given set of assumptions regarding policy variables, macroeconomic variables and key and world prices over the period 2001-2010. The macroeconomic assumptions come from external sources. Population projections are from EUROSTAT, projections of most macro economy variables are from the econometrics unit in DG Economics and Finance. Other sources include macroeconomics from the Spanish Central Bank. World market prices projections are not endogenous for the SESAP model. Then, world market prices projections come from the FAPRI-Missouri EU GOLD model (FAPRI-Ireland Outlook, 2003). It is assumed that all national and international agreements remain in place over the projection period.

The policy scenarios examined are those contained in the Presidency compromise document (Council of the European Union, 2003). Under the Luxembourg Agreement and the negotiations that have followed, the biggest change in the Common Agricultural Policy is the introduction of the Single Farm Payment (SFP). This SFP can be implemented as early as 2005, but no later than 2007. In the case of Spain, the least decoupled option allowed by the reform has been chosen in order to have as many payments as possible directly linked to production. Decoupling is delayed until 2006, and afterwards the following percentage of the payments will be still coupled to the production. Twenty-five per cent of the payment will remain coupled for the arable crops, 50% of the ewe premiums, 100% of the suckler cow premiums and 40% of the slaughter premiums. Decoupling is introduced in the SFP scenario reducing direct payments or premiums. In this analysis, no attempt has been made to incorporate either the cross-compliance or modulation elements of the Luxembourg Agreement or other specific instruments.

This scenario was simulated by changing the levels of the policy variables from those used to generate the baseline results according to the percentage of decoupling mentioned above. This scenario was simulated for the SESAP model (disaggregated into irrigated and non-irrigated cereals) and for the Spanish AGMEMOD model (this distinction was not considered). The first policy scenario is called SFP scenario 1 and the second, SFP scenario 2. Then, in the rest of the paper we are interested in focusing on two types of results: i) the impact of the SFP on the arable crop sector and the different effects of the SFP on irrigated and non-irrigated cereals; and ii) the evaluation of the results obtained from both models, SESAP and Spanish AGMEMOD, in terms of their adequacy to policy analysis for the Spanish agriculture.

3.2 Evaluation of the SESAP and Spanish AGMEMOD models. Introduction of Irrigated and Non-irrigated Land Uses.

In this section, both models, the SESAP and the Spanish AGMEMOD, are compared in order to show the misestimation of the effect of the CAP reform incurred when we do not take into account the irrigated land use peculiarity. Table I shows the evolution of area harvested for the SFP scenario 1 (SESAP model, disaggregated into irrigated and non-irrigated cereals) and SFP scenario 2 (Spanish AGMEMOD model, this distinction was not considered) in comparison to the Agenda 2000 for cereals and oilseeds. However, the last column shows different figures, the percentage change of the corresponding SFP scenario from 2001 to 2010.

Main results indicate that the new policy instrument only influences the supply side, having found only some small changes in imports and exports for those products, and insignificant o null changes in the domestic use. Then, we only provide most significant results for area harvested and production for cereals and oilseeds.

The projections of total cereals area harvested are the same under the Agenda 2000 and the SFP scenario 2 while we have found a negative evolution of the SFP scenario 1 in comparison to the Agenda 2000. It means that while under the Agenda 2000 it was expected a decrease of 2% in the area harvested, under the SFP scenario 1 it is anticipated a 6% decline. In particular, it is expected that cereals area harvested will decrease around 2% under the SFP scenario 2 while it is anticipated a 6% decrease under the SFP scenario 1. Similar results have been found for wheat area harvested. Projections for both, the Agenda 2000 and the SFP scenario 2, are the same while the evolution of SFP scenario 1 in comparison to the Agenda 2000 is negative (around 3%). Moreover, under the SFP scenario 1 a lower decline in wheat area harvested (-10%) than under the SFP scenario 2 (-17%) is expected. These results indicate that the SESAP model is more adequate to analyse policy changes because it provides the effects of the introduction of the SFP on total cereals and wheat area harvested, unpredicted by the Spanish AGMEMOD model[5] .

In the case of barley, the evolution of the SFP scenario 1 in comparison to the Agenda 2000 is negative while the evolution of the SFP scenario 2 is positive. However, it is expected that barley area harvested will increase under both policy scenarios For maize, results for both policy scenarios are also very different although the evolution in comparison to the Agenda 2000 is negative in both cases Finally, oilseeds area harvested for the Spanish AGMEMOD model is expected to decrease 63% under the SFP scenario 2 while it was anticipated to decrease 39% under the Agenda 2000.

Finally, when we analyse the evolution of cereals production we observe some contradictory and unexpected results for total cereals and maize under

[5] The main reason of this unexpected finding is that when we estimated the supply equations for cereals, the payments variable have result no significant explaining the supply behaviour. This might be due to the aggregated analysis of cereals land uses

the SFP scenario 2 (Table II). In both cases, an increase in production is anticipated while a decrease in the area harvested is expected. This is another shortcoming of the aggregated model (Spanish AGMEMOD). Moreover, for the rest of products, the SESAP model (SFP scenario 1) anticipated lower increasing or decreasing trend than Spanish AGMEMOD model (SFP scenario 2), which seems more realistic taking into account that cereals and oilseeds payments are still 25% coupled to production.

3.3 The impact of the Single Farm Payment in the irrigated-non irrigated arable crop sector

Following the results of the previous section, we conclude that the SESAP model is more adequate to analyse EU policies changes, and, in this section, we compare the supply result of the SFP with the baseline scenario results (Agenda 2000) for the SESAP model.

Under the projection results for the SFP scenario 1 (2001-2010), cereals and oilseeds area harvested in Spain is expected to decrease 6% and 34%, respectively while it was expected to decrease 2% and 18%, respectively under the Agenda 2000 scenario (Table III).

Under the SFP scenario 1, the area harvested for irrigated cereals is expected to decrease more than cereals in non-irrigated land (30% and 1%, respectively). However, under the Agenda 2000 scenario, the area harvested for irrigated cereals was also expected to decrease but at a lower rate (8%) while the decrease anticipated for non-irrigated ones is almost the same.

In table IV we can observed that under the SFP scenario 1, wheat production is expected to decrease 4% while it was anticipated to remain constant under the Agenda 2000 scenario. However, the impact of the SFP differs depending on land use (irrigated or non-irrigated). While under the SFP scenario 1 non-irrigated wheat production will slightly decrease (less than 1%), irrigated production will decrease 25%. Moreover, the decline anticipated by the Agenda 2000 scenario was very small and almost the same for both types of land uses. On the other hand, barley production is expected to increase 5% under the SFP scenario 1 although it would have increase 9% under the Agenda 2000. However, non-irrigated barley production is expected to increase around 10% under both scenarios, irrigated barley production is anticipated to decrease 25% under the SFP scenario 1, although it would have remained almost constant under the Agenda 2000. Maize production will decrease 27% under the SFP scenario 1 although it was expected to decrease only 4% under the Agenda 2000. Both irrigated and non-irrigated maize will decrease but the highest decrease is anticipated for non-irrigated maize, which will drive in the future to be inexistent. Then, maize will be mainly produced on irrigated land and production will decrease as a consequence of the implementation of the SFP scheme.

Summarizing, the main differences between irrigated and non-irrigated production of cereals are two. Wheat and barley are mainly produced in non-irrigated land and this type of production shows less dependence on policy changes in the case of wheat and has a positive impact in the case of barley (it is expected that non-irrigated production will increase 10%). However, maize is mainly produced in irrigated land, and the non-irrigated production will enormously decrease until almost disappear in the near future. The second important result is that barley and maize irrigated production would have remained constant under the Agenda 2000 but it is predicted to decrease 25% under the SFP.

4 Summary and conclusions

The arable crop sector in Spain is highly dependent on the Community subsidies and it account for 33% of total transfers received by the Community. It is expected that the new measure introduced by the Luxembourg Agreement Reform, the Single Farm Payment, would drive important changes on arable crop production in Spain. To quantitative assess the impacts of the Single Farm Payment on the arable crop sector in Spain is the overall objective of this paper. With this aim, an econometric, dynamic, multi-product and partial equilibrium commodity model has been built. In order to reach more realistic results than previous modelling experiences recently undertaken (Casado and Gracia, 2005) a disaggregated specification into irrigated and non-irrigated land use for cereals has been considered, called Spanish Econometric Simulation of Agricultural Policies (SESAP).

This model has been used to analyse two specific points: i) the impact of the Single Farm Payment on the arable crop sector and the different effects of the SFP on irrigated and non-irrigated uses, and ii) the evaluation of the results from this model (SESAP) in comparison to those previously mentioned (Spanish AGMEMOD).

Results indicate that the introduction of the SFP has only induced considerable changes from the Agenda 2000 for those arable crop products included in the SFP, cereals and oilseeds. Moreover, the new policy instrument only influences the supply side, having found only small changes in imports and exports and insignificant or null in domestic use.

A higher decrease is expected in cereals and oilseeds area harvested is expected to higher decrease under the SFP scenario 1(6% and 34%, respectively) than under the Agenda 2000 (2% and 18%, respectively) over the projection period 2001-2010. It means that the decline anticipated by the implementation of the SFP scenario 1 is double than the expected under the Agenda 2000. Moreover, the effects of the SFP on irrigated and non-irrigated cereal area harvested are different. While area harvested for non-irrigated cereals is expected to decrease slightly under both, the SFP scenario 1 and the Agenda 2000, area harvested for irrigated cereals is expected to decrease under the SFP scenario 1 more than under the Agenda 2000 (30% and 8%, respectively).

The production trend under both, the SFP scenario 1 and the Agenda 2000, differs for the different cereals. While wheat and maize production is expected to decrease under both, the SFP scenario 1 and the Agenda 2000, barley production is expected to increase. However, the decreasing trend for wheat and maize is lower under the Agenda 2000 while the increasing trend for barley is higher. It means that, in any case, a reduction in the cereals production under the SFP in comparison to the Agenda 2000 is expected. The main differences between irrigated and non-irrigated production of the different cereals are two. Wheat and barley are mainly produced in non-irrigated land and this type of production shows less dependence on policy changes in the case of wheat and has a positive impact in the case of barley. However, maize is mainly produced in irrigated land, and the non-irrigated production will enormously decrease until almost disappear in the near future. The second important result is that barley and maize irrigated production would have remained constant under the Agenda 2000 but it is predicted to decrease 25% under the SFP scenario 1.

Finally, the evaluation of results from the SESAP model (disaggregated into irrigated and non-irrigated land use) and the Spanish AGMEMOD model shows that the first one is superior in terms of policy analysis. First, the SESAP model allows analysing the different effects of the new CAP instruments on the irrigated and non-irrigated land use for cereals missing in the Spanish AGMEMOD model. Second, when this distinction is not considered, no impact of the introduction of the Single Farm Payment on total cereals and wheat area harvested and production has been found because the Spanish AGMEMOD model concludes that cereals projection under the SFP and the Agenda 2000 are the same. Moreover, in the Spanish AGMEMOD model oilseeds area harvested is expected to decrease 63% under the SFP and 39% under the Agenda 2000 over the period 2001-2010. However, in the SESAP model oilseeds area harvested was predicted to decrease 36% under the SFP and 18% under the Agenda 2000. This last result seems more plausible in terms of policy analysis because the decrease anticipated in oilseeds area harvested for the Spanish AGMEMOD model under both scenarios is almost double than the one predicted by the SESAP model. The evolution of total cereals and maize production in the Spanish AGMEMOD is positive while area harvested was negative in this model, and also both, area harvested and production evolution, were negative in the SESAP model. This is another shortcoming of the aggregated model. Moreover, for the rest of products, the SESAP model (SFP scenario 1) anticipated lower increasing or decreasing trend than Spanish AGMEMOD model (SFP scenario 2), which seems more realistic taking into account that cereals and oilseeds payments are still 25% coupled to production.

Finally, we should mention that disaggregating between irrigated and non-irrigated land uses for cereals has driven to a better econometric model for policy analysis. Then, the following extension of the model will be to disaggregate other crops into irrigated and non-irrigated uses together with the inclusion of other important crops for the Spanish Agriculture such as, vegetables, fruit, grapes, and olive oil. In addition, further work should be done in order to analyze other alternative policy scenarios. For instance, the impact of specific measures, such as the decrease in durum wheat supplementary payment, on the Spanish agricultural sector.

References

[1] Albiac J., y Garcia P., 1991. "Modelización econométrica del sector porcino español", Investigación Agraria. Economía 6(2), 175-196.

[2] Albisu L.M., y Blandford D., 1983. "An area response model for perennial plants and its application to Spanish oranges and mandarins". European Review of Agricultural Economics, 10, 175-184.

[3] Astorquiza I., Albisu L.M., 1994. "Análisis econométrico de las superficies y rendimientos del trigo, cebada y maíz cultivados en España". INIA. Monografía n. 86.

[4] Berbel, J., 1987. Análisis de la oferta y demanda del pimiento en España. Investigación Agraria. Economía, 2(1), 73-84.

[5] Burton M., 1992. An Agricultural policy model for the UK. Averbury, Aldershot, 315 pág.

[6] Casado J.M., Gracia A., 2005. An assessment of the Luxembourg Agreement on the Spanish agricultural sector: An econometric model. 89th EAAE Seminar "Modelling agricultural policies: state of the art an new challenges. Parma (Italy). 3-5 Febrero. 2005 (www.unipr.it/arpa/dipseq/EAAE/PR/Homepage.htm)

[7] Conforti P., 2001. The Common Agricultural Policy in Main Partial Equilibrium Models. Documento de trabajo del INEA (Istituto Nazionale di Economia Agraria). Roma. 39 pp.

[8] Conforti P., Londero P., 2001. AGLINK: the OCDE partial equilibrium model. Documento de trabajo del INEA (Istituto Nazionale di Economia Agraria). Roma. 13 pp.

[9] Council of the European Union, 2003, CAP – Reform – Presidency Compromise (in agreement with the Commission). Brussels June 30, 2003.

[10] De Muro P., Salvatici L., 2001. The Common Agricultural Policy in Multisectoral Models. Documento de trabajo del INEA (Istituto Nazionale di Economia Agraria). Roma. 53 pp.

[11] Fernandez Salido J., 1997. Análisis econométrico de la oferta de Girason en España. Investigación Agraria. Economía, 12 (1, 2 and 3), 215-230.

[12] García J.M., Rivera L.M., 1995. Un modelo de diagnóstico económico y la simulación de las políticas agrarias (DESPA). Revista Española de Economía Agraria, 173, 113-144.

[13] Gohin A., 1998. Modelisation du complexe agro-alimentaire francais dans un cadre d'equilibre general. Tesis Doctoral, Universidad de Paris.

[14] Gohin A., Guyomard H., Herrard N., Le Roux Y., y Trochet T., 1998. Modelling agricultural policy instruments in a single-country, multisector general equilibrium frameworkd: application to France. En: Brockmeier M., Francois J.F., Hertel T.W., Schmitz P.M., eds. Economic Transition and the Greening of Policies: Modelling New Challenges for Agriculture and Agribusiness in Europe, Wissenschaftsverlag Vauk Kiel, 329-348.

[15] Ibáñez J., Pérez Hugalde C., 1993. Un modelo econométrio multiecuacional de asignación de superficies a cultivos. Aplicación a los subsectores cerealistas de Navarra y de toda España. Investigación Agraria. Economía, 9(1), 127-137.

[16] Ibáñez J., Pérez Hugalde C., 1995. Modelización econométrica del sector agrario: una aplicación de ámbito nacional y regional (Navarra). Revista Española de Economía Agraria, 173, 145-180.

[17] Ibáñez J., Pérez Hugalde C., 1996. Efectos de una reducción del precio de los cereales sobre el subsector cárnico en España. Investigación Agraria. Economía, 12(1,2 y 3), 203-214.127-137

[18] Ibáñez J., Pérez Hugalde C., 1999. Impactos de la reforma de la PAC de 1992 sobre el subsector agrícola español. Estudios Agrosociales y Pesqueros, 185, 9-30.

[19] Jensen J.D., 1996. An applied econometric model for Danish Agriculture (ESMERALDA). Danish Institute of Agricultural and Fisheries Economics, report no. 90.

[20] Jensen J.D., Andersen M., and Kristensen K., 2001. A Regional Econometric Sector Model for Danish Agriculture, Danish Institute of Agricultural and Fisheries Economics, report no 129.

[21] Komen M.H.C., Peerlings J.H.M., 1996. WAGEN: an applied general equilibrium model for agricultural and environmental policy analysis. Working Paper n^o 04-96. Wageningen Agricultural University.

[22] Lehtonen H., 2001. Principles, Structure and Application of Dynamic Regional Sector Model of Finnish Agriculture. Doctoral Thesis. Helsinki University of technology.

[23] Mili S., 1990. Análisis económico del mercado español de aceite de oliva. Master of Science Thesis. Zaragoza. Instituto Agronómico Mediterráneo de Zaragoza.

[24] Tongeren van F., Meijl van H., 1999. Review of applied models of international trade in agriculture and related resource and environment modelling. Agricultural Economics Research Institute (LEI) Report 5.99.11. The Hague. 120 pp.

Table I

Evolution of the area harvested for SFP scenario 1 and SFP scenario 2 in comparasion to the Agenda 2000.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2001/2010
Cereals											
SFP1/Agenda 2000	0.00	0.00	0.00	0.00	0.00	-3.71	-03.64	-3.57	-3.51	-3.44	**-5.9**
SFP2/Agenda 2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	**-1.8**
Total Wheat											
SFP1/Agenda 2000	0.00	0.00	0.00	0.00	0.00	-2.79	-2.81	-2.81	-2.80	-2.79	**-10.57**
SFP2/Agenda 2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	**-17.77**
Barley											
SFP1/Agenda 2000	0.00	0.00	0.00	0.00	0.00	-2.18	-2.12	-2.07	-2.03	-2.00	**1.01**
SFP2/Agenda 2000	0.00	0.00	0.00	0.00	0.00	0.84	1.33	1.61	1.78	1.87	**9.42**
Maize											
SFP1/Agenda 2000	0.00	0.00	0.00	0.00	0.00	-23.68	-23.67	-23.70	-23.74	-23.81	**-24.82**
SFP2/Agenda 2000	0.00	0.00	0.00	0.00	0.00	-6.17	-9.91	-12.19	-13.58	-14.42	**-14.18**
Oilseeds											
SFP1/Agenda 2000	0.00	0.00	0.00	0.00	0.00	-22.41	-22.36	-22.29	-22.22	-22.14	**-34.16**
SFP2/Agenda 2000	0.00	0.00	0.00	0.00	0.00	-24.15	-34.02	-38.12	-39.88	-40.72	**-63.73**

Table II

Evolution of the production for SFP scenario 1 and SFP scenario 2 in comparasion to the Agenda 2000.

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2001/2010
Cereals											
SFP1/Agenda 2000	0	0	0	0	0	-7.97	-7.79	-7.69	-7.57	-7.41	**-4.27**
SFP2/Agenda 2000	0.00	0.00	0.00	0.00	0.00	-0.01	-0.02	-0.02	-0.03	-0.03	**6.83**
Wheat											
SFP1/Agenda 2000	0.00	0.00	0.00	0.00	0.00	-3.84	-3.86	-3.84	-3.82	-3.80	**-4.07**
SFP2/Agenda 2000	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	-0.01	-0.01	**-13.09**
Barley											
SFP1/Agenda 2000	0.00	0.00	0.00	0.00	0.00	-3.36	-3.25	-3.18	-3.14	-3.06	**5,43**
SFP2/Agenda 2000	0.00	0.00	0.00	0.00	0.00	0.84	1.33	1.61	1.78	1.87	**20,48**
Maize											
SFP1/Agenda 2000	0.00	0.00	0.00	0.00	0.00	-24.61	-24.42	-24.25	-24.09	-23.94	**-26.76**
SFP2/Agenda 2000	0.00	0.00	0.00	0.00	0.00	-6.17	-9.91	-12.19	-13.58	-14.42	**3.34**
Oilseed											
SFP1/Agenda 2000	0.00	0.00	0.00	0.00	0.00	-22.41	-22.36	-22.29	-22.22	-22.14	**-35,07**
SFP2/Agenda 2000	0.00	0.00	0.00	0.00	0.00	-24.15	-34.02	-38.12	-39.88	-40.72	**-62,54**

Table III

Area harvested for cereals and oilseeds under the baseline and the SFP scenario 1 from 2001 to 2010

Cereals	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Agenda 2000	5875.82	5830.53	5807.64	5783.89	5768.41	5760.14	5751.89	5743.25	5733.63	5725.95
SFP Scenario 1	5875.82	5830.53	5807.64	5783.89	5768.41	5546.71	5542.64	5538.11	5532.51	5528.77
Irrigated cereals										
Agenda 2000	791.80	781.48	765.10	756.71	745.48	737.27	731.25	725.00	718.51	712.03
SFP Scenario 1	791.80	781.48	765.10	756.71	745.48	552.29	549.90	547.21	544.20	541.14
Non-irrigated cereals										
Agenda 2000	5084.02	5049.05	5042.54	5027.18	5022.94	5022.86	5020.64	5018.25	5015.12	5013.92
SFP Scenario 1	5084.02	5049.05	5042.54	5027.18	5022.94	4994.41	4992.74	4990.90	4988.31	4987.64
Oilseeds										
Agenda 2000	959.43	922.00	910.23	897.12	882.81	867.55	852.53	838.12	824.36	811.25
SFP Scenario 1	959.43	922.00	910.23	897.12	882.81	673.15	661.94	651.27	641.17	631.65

Table IV

Production for cereal by products under the baseline and SPF scenario 1 from 2001 to 2010

	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Total wheat										
Agenda 2000	5229.53	5131.91	5171.59	5145.08	5172.25	5199.63	5205.94	5209.79	5208.66	5214.68
SFP Scenario 1	5229.53	5131.91	5171.59	5145.08	5172.25	5000.01	5005.03	5009.57	5009.49	5016.74
Irrigated wheat										
Agenda 2000	731.38	747.16	688.57	693.00	681.13	693.92	709.38	716.63	722.13	726.70
SFP Scenario 1	731.38	747.16	688.57	693.00	681.13	519.82	533.45	540.88	546.94	552.29
Non-irrigated wheat										
Agenda 2000	4498.15	4384.74	4483.02	4452.08	4491.12	4505.71	4496.57	4493.17	4486.53	4487.98
SFP Scenario 1	4498.15	4384.74	4483.02	4452.08	4491.12	4480.19	4471.58	4468.68	4462.54	4464.45
Total barley										
Agenda 2000	8529.52	7843.15	8192.82	8056.27	8214.71	8631.68	8886.13	8955.25	9053.26	9277.27
SFP Scenario 1	8529.52	7843.15	8192.82	8056.27	8214.71	8341.32	8597.53	8670.43	8769.36	8993.10
Irrigated barely										
Agenda 2000	1014.21	983.79	997.27	969.97	969.23	984.63	986.73	984.28	992.60	1003.30
SFP Scenario 1	1014.21	983.79	997.27	969.97	969.23	737.59	742.02	742.90	751.80	762.50
Non-irrigated barley										
Agenda 2000	7515.32	6859.36	7195.55	7086.30	7245.48	7647.04	7899.40	7970.97	8060.65	8273.97
SFP Scenario 1	7515.32	6859.36	7195.55	7086.30	7245.48	7603.73	7855.51	7927.53	8017.56	8230.60
Total maize										
Agenda 2000	3723.82	3618.73	3697.90	3715.13	3723.83	3679.06	3659.01	3648.71	3612.22	3585.58
SFP Scenario 1	3723.82	3618.73	3697.90	3715.13	3723.83	2773.67	2765.41	2763.91	2742.03	2727.27
Irrigated maize										
Agenda 2000	3585.37	3493.09	3584.91	3615.25	3637.41	3606.95	3601.88	3607.00	3586.33	3575.95
SFP Scenario 1	3585.37	3493.09	3584.91	3615.25	3637.41	2701.97	2708.60	2722.44	2716.28	2717.69
Non-irrigated maize										
Agenda 2000	138.45	125.63	112.99	99.88	86.42	72.11	57.13	41.70	25.89	9.63
SFP Scenario 1	138.45	125.63	112.99	99.88	86.42	71.70	56.81	41.48	25.75	9.58