

# Beyond income transfers to farmers, the macroeconomic spillover of CAP payments in Aragon (Spain), 2007-2013

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## 1. Introduction

Rural areas represent more than 77 percent of the EU territory and host about half of the 500 million people who make up the total EU population. The EU has 13.7 million full-time farmers who practice many different production systems, from intensive agriculture, through conventional to organic agriculture. This diversity has increased with the joining of Central and Eastern Europe countries to the European Union. In general, these are family farms with an average size of 12 hectares.

The Common Agricultural Policy (CAP) aims to support agriculture to ensure food security in the context of climate change and facilitate a balanced development in all rural areas of Europe, even in areas where production conditions are more difficult. At the same time, European agriculture must be multifunctional, since it has to respond to citizens' concerns about food (availability, price, range, quality and safety), protect the environment and allow farmers to live in dignity in their work.

The reform of CAP in 2003 introduced a new system of payments, known as the single payment scheme, which will no longer be linked to production aid. The single pay-

## Abstract

*This paper provides an assessment of the macroeconomic impact of the Common Agricultural Policy (CAP) on Aragon (Spain) through a computable general equilibrium (CGE) model. During the EU programming period 2007-2013, Aragon received agricultural subsidies worth 4,055 million Euros. These grants are received by farmers and then redistributed through their spending towards other institutional sectors. CAP funds carry in Aragon an average annual GDP growth of 2.6 % or an average annual increase of agricultural GVA by 19.6% among other results. This analysis is important because CAP is changing and resources for this EU policy are expected to be reduced. In February 2013, the European Council approved the Multiannual Financial Framework 2014-2020 in which the overall EU budget decreases, is redistributed and clearly restricts allocations for agricultural policies.*

**Keywords:** Computable General Equilibrium Model, European Agricultural Guarantee Fund, European Agricultural Fund for Rural Development, Common Agricultural Policy, Aragon.

## Résumé

Dans ce travail, nous allons présenter une évaluation macroéconomique de la politique agricole commune (PAC) en Aragon (Espagne) en nous appuyant sur un modèle d'équilibre général calculable (MEGC). Au cours de la période de programmation 2007-2013 de l'UE, l'Aragon a reçu des subventions agricoles totalisant 4,055 millions d'euros. Ces subventions ont été perçues par les agriculteurs qui les ont ensuite redistribuées à travers des dépenses en faveur d'autres secteurs institutionnels. En Aragon, les fonds PAC génèrent une augmentation annuelle moyenne du PIB de 2,6% ou une augmentation annuelle moyenne de la VAB agricole de 19,6%, entre autres résultats. Cette analyse s'avère être très importante puisque les objectifs de la PAC sont en train de changer et les ressources disponibles devraient diminuer. Le Conseil Européen a approuvé en février 2013 le Cadre Financier Pluriannuel 2014-2020 qui comporte une réduction du budget global de l'UE, sa redistribution et une limitation évidente des allocations pour les politiques agricoles.

**Mots-clés:** Modèle d'équilibre général calculable, Fonds européen de garantie agricole, Fonds européen agricole pour le développement rural, Politique Agricole Commune, Région d'Aragón.

ment scheme is the largest budget component of CAP. It aims to support the income of farmers and in return, they undertake to meet the standards of environmental protection, animal welfare and food safety and ensure proper maintenance of the territory. Secondly, the CAP contains measures which regulate the agricultural markets that maintain a number of specific payments to products and industries that process and sell them. In third place, regarding rural development policy, the CAP aims to improve agriculture and forestry competitiveness while protecting the environment and the natural conditions and improving the quality of life and diversification of the rural economy. Finally, the *Leader* initiative provides funding opportunities to local rural development initiatives. The CAP

budget covers two types of expenses:

- The income support for farmers through direct single payment scheme is subject to compliance with the European standards in food safety, environmental protection and health and animal welfare. These payments are funded entirely by the EU and account for about 70 percent of the budget of the CAP. Market support measures are also included, as for example, when natural disasters destabilize agricultural markets. These payments represent less than 10 percent of the CAP budget.
- Rural development measures are to help farmers to

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modernize their farms and become more competitive, while protecting the environment and contribute to the maintenance of rural communities. These payments are financed by the EU and the Member States and they represent about 20 percent of the budget of the CAP. The rural development measures are intended not only to support farmers, but also to other agents who are present in rural areas through, *inter alia*, *Leader* programs. The *Leader* initiatives are to strengthen the rural economy by encouraging local and non-agricultural actors. Currently, Member States must allocate at least 5 percent of their budget to finance *Leader* rural development projects.

All these measures are interrelated and must be managed consistently. For example, direct payments help ensuring a stable income for farmers and get paid in return for meeting to provide environmental public goods. Similarly, rural development measures encourage additional public services, while facilitating the modernization of farms. For over 50 years, the CAP has been, and still is, the most important common policy of the EU although in recent years its participation in the EU budget has been declining slightly. Currently, the communitarian CAP spending is financed by two funds from the general budget of the EU:

- The European Agricultural Guarantee Fund (EAGF), which fully finances direct payments to farmers and the measures to regulate agricultural markets. Direct payments help to support farmers' income not linked to the agricultural production. In return, farmers are committed to comply with environmental protection, animal welfare and food safety and ensure proper maintenance of the territory. Direct payments help keep agriculture throughout the EU to ensure a stable income for farmers. Such payments allow ensuring long-term viability of farms and make them less vulnerable to price fluctuations.
- The European Agricultural Fund for Rural Development (EAFRD), which co-finances rural development programs of the Member States. These funds are intended to contribute to improving the competitiveness of agriculture and forestry, protecting the environment, improving the quality of life and diversification of the rural economy and funding local rural development projects. Under the CAP, rural development aims to preserve the vitality of rural areas by supporting investment programs, modernization and support for agricultural and non-agricultural activities in these areas. Member States shall develop and carry out their own development programs and the EU co-finances a portion of its cost, taking into account that Member States must devote at least 10 percent of their budget to strengthen the competitiveness of agriculture and forestry, at least 25 percent to improving the environment and landscape and at least 10 percent to the diversification of the rural economy.

Aragon, meanwhile, has a total population of 1.3 million people surveyed on January 1, 2013, a total area of 47,719 km<sup>2</sup> and a population density of 28 inhabitants/km<sup>2</sup>. It is therefore a large territory, with the majority of the population concentrated in the capital, 704,239 inhabitants in 2013, and small populations spread across the rest of the 730 municipalities, of which more than 600 do not get to have a thousand neighbors.

The agricultural sector in this region has a special social and economic relevance. According to the last agricultural census, in 2009 Aragon had 2.3 million hectares of utilized agricultural area, of which 1.6 million corresponded to arable land, and the rest to permanent grassland. Total agricultural area was divided into 52,774 farms, with an average size of 45.5 hectares.

In 2012, the agricultural sector in the region generated about 36,000 jobs, which employed 31,300 people and accounted for 4.3 percent of the regional Gross Value Added (GVA). The number of food industries rounds 1,200 and they employed more than 11,000 workers. Despite the economic crisis, agricultural income in Aragon experienced a 2.3 percent increase in 2012 in current terms over the previous year. The CAP support granted in 2012 amounted up to 504 million Euros, representing a third of Aragon's agricultural income (Tables 1 and 2).

Funding programs for regional economic development have been an important support for agricultural income

Table 1 - *Aragon's agricultural sector macromagnitudes.*  
(Figures in Million € and thousands of people)

	2010	2011	2012
Agricultural Final Production	1,184	1,291	1,214
Livestock Final Production	1,639	1,860	2,121
Agrarian Final Production	2,918	3,247	3,437
% Agrarian GVA/Total GVA	4.19%	4.29%	4.29%
Net Value Added (revenue)	1,435	1,507	1,543
Employees	34.5	32.1	31.3

Sources: Department of Agriculture, Livestock and Natural Environmental of the Government of Aragon, General Treasury of the Social Security and the National Statistics Institute (INE).

Table 2 - *CAP funds in Aragon during 2007-2013.*  
(Figures in Euros)

Year	EAGF	EAFRD	EAFRD + National Payments	Total CAP
2007	456,241,849	20,413,402	51,541,797	507,783,646
2008	442,632,364	72,250,273	187,372,603	630,004,967
2009	451,533,371	48,735,783	138,229,799	589,763,170
2010	471,650,696	54,586,135	137,527,499	609,178,195
2011	462,451,885	58,382,626	135,981,943	598,433,827
2012	459,781,660	44,411,263	100,331,853	560,113,512
2013 (*)	459,781,660	44,411,263	100,331,853	560,113,512
Total	3,204,073,484	343,190,745	851,317,346	4,055,390,830

Source: European Agricultural Guarantee Fund (EAGF). (\*) Estimated Data.

from the origins of the EU in the middle of last century. Agricultural aids represent around 7,240 million Euros for Spain as a whole, according to recent data referring to 2012 (FEGA, 2013). Such a figure implies almost a third of farms income or 0.7 percent of GDP for that year.

The macroeconomic effects of CAP expenditure in a regional economy can be analyzed in detail through a Computable General Equilibrium (CGE) model. The economic impact is the result of the comparison between the following alternative scenarios:

- The benchmark equilibrium refers to the Aragonese economy prior to receiving EU agricultural funds in the period 2007-2013.
- The simulated equilibrium considers the balanced figures through the model once Aragon has received the CAP support.

Among these types of models developed in Spain we might particularly note the work of Lima and Cardenete (2007), where, at regional level, the model is applied to analyze the impact of European Structural Funds for the period 2000-2006, evaluating their effects on production, prices and rent in Andalusia. Furthermore, mention must be made, on the one hand, of the work by Monrobel *et al.* (2013), which develops a model for the economy of Madrid in order to estimate the impact of the European Regional Policy for this region in the period 2007-2013 and, on the other, of the work by Cardenete and Delgado (2013), which assesses the impact of the hypothetical abolition of European Funds in Andalusia during the period 2007-2013. Finally, Cámara *et al.* (2014) synthesize SAM and CGE models developed at the regional level in Spain.

After this introduction, the paper is organized in two core sections and final conclusions. The second section of this paper presents the methodological development of the CGE model, describing its main features and formulation, the interaction in the economy between factor markets and composition of goods and the data specification for calibrating the model. The third section analyses the macroeconomic effects of CAP aids in Aragon along the period 2007-2013. Finally, main results and discussion are detailed.

## 2. Material and methods

### 2.1 The CGE model

The effects of these agricultural aids on recipients and on their subsequent redistribution, through spending to other productive activities and institutional sectors, can be analyzed through a CGE Model. A CGE model is a system of nonlinear equations which includes the equilibrium conditions of an economy, the functioning of markets and the linkages between sectors and institutions, assuming a rational and optimizing behavior of different agents.

One of the most important utilities of these simulation models is the ability to quantitatively assess the macroeconomic effects of certain economic policies, through the variation of the exogenous variables representing the policy measures analyzed.

This type of analysis through model simulation is only possible if a Social Accounting Matrix (SAM) is available for the economy under analysis. A SAM represents the economic structure studied and it is used as the database which replicates the initial benchmark equilibrium in the model in the base year.

The aim of a CGE model is to make an empirical representation of the real characteristics of the economic structure to be analysed. The calculation of the equations is obtained through its theoretical formulation. This begins with the specification of the goods and services and the agents that make up the economy, with the determination of the conditions of the functioning of markets for goods and factors and based on the rational optimizing behavior of all agents.

The formulation of this CGE model for Aragon includes five types of institutional sectors involved in the economy: producers, households, companies, public sector and foreign sector. More detail on the properties of these institutional sectors can be found in Pérez y Pérez and Monrobel (2012).

### Producers

The model consists of 26 regional production sectors or industries, compiled according to the Regional Accounts published by the National Statistics Institute (INE). It is considered that they produce and sell goods and services with the goal of maximizing their benefits.

The total production of each of them is a three level nested production function. Under the assumption that goods from different countries or regions are imperfect substitutes, in the first production level domestic production,  $Y_j$ , is combined with the imports of sector  $M_j$  through a Cobb-Douglas function to obtain the total production function:

$$Q_j = \beta_j Y_j^{\alpha_j} M_j^{1-\alpha_j} \quad [1]$$

At the second level, domestic output of each sector of production is obtained by combining the use of intermediary goods and a primary factor composite, value added, in fixed proportions by means of a Leontief-type function:

$$Y_j = \min_{i=1,\dots,26} \left\{ \frac{X_{ij}}{a_{ij}}, \frac{VA_j}{v_j} \right\} \quad [2]$$

Finally, at the third level, to allow substitution amongst capital and labour, the value added of each sector of production is incorporated through a Cobb-Douglas function with constant returns to scale:

$$VA_j = \delta_j K_j^{\theta_j} L_j^{1-\theta_j} \quad [3]$$

The goal of each producer is to maximize their benefits, considering constant returns to scale, resulting in the minimization of production costs, given their technological function. Therefore, the model equations that determine the

various values of the variables are obtained by solving the optimization programs, so that the producer's behavior consists in minimizing costs on each of the three levels of nesting. That is, they minimize total and domestic production costs and value added costs.

At the first nesting level, with the minimization of total production costs optimal, the levels of domestic production and imports are obtained:

$$M_j = \frac{Q_j}{\beta_j} \left( \frac{\alpha_j p_j^m}{1 - \alpha_j p_j} \right)^{-\alpha_j} \quad [4]$$

$$Y_j = \frac{Q_j}{\beta_j} \left( \frac{\alpha_j p_j^m}{1 - \alpha_j p_j} \right)^{1-\alpha_j} \quad [5]$$

At the second nesting level, the choice of *inputs*, intermediate consumption and value added are independent of prices, due to the Leontief technology chosen. Therefore, the minimization of the costs of domestic production leads to optimal utilization of intermediate consumption and value added, represented by the following functions of demand for goods and value added:

$$X_{ij} = a_{ij} Y_j \quad [6]$$

$$VA_j = v_j Y_j \quad [7]$$

At the third nesting level and with the assumption that producers minimize the cost of the value added given their technological restrictions, we obtain the amount of capital and labour demanded by each sector:

$$L_j = \frac{VA_j}{\delta_j} \left( \frac{\theta_j}{1 - \theta_j} \frac{w(1 + T_j^{CSS})}{r} \right)^{-\theta_j} \quad [8]$$

$$K_j = \frac{VA_j}{\delta_j} \left( \frac{\theta_j}{1 - \theta_j} \frac{w(1 + T_j^{CSS})}{r} \right)^{1-\theta_j} \quad [9]$$

Introducing constant returns to scale in the production side on the three levels, their marginal costs coincide, at each level, with average costs. Therefore, the production unitary prices coincide with the minimum average cost, a cost which is obtained by substituting the optimal values of the *input* in the respective cost objective functions.

Regarding taxes, social contributions paid by employers have been disaggregated. It is also considered that the final consumer price of each good is taxed by a single indirect tax rate. This tax ( $T_j^{IP}$ ) groups the taxes on production, products, import taxes and VAT.

$$p_j' = \frac{1}{\beta_j} \left( \frac{p_j}{\alpha_j} \right)^{\alpha_j} \left( \frac{p_j^m}{1 - \alpha_j} \right)^{1-\alpha_j} 1 + T_j^{IP} \quad [10]$$

## Households

In this CGE model, households are represented by a single private consumer, considering that all households have

the same preferences. The decisions on consumption and savings are determined assuming an optimizing behavior of their welfare. This welfare is represented by maximizing a Cobb-Douglas utility function which depends on demand for consumer goods and savings, subject to households disposable income ( $YD$ ).

$$\begin{aligned} \max u(C_s) &= \prod_{j=1}^{26} C_j^{\mu_j} \cdot C_{AH}^{\lambda} \\ \text{s.t.} \quad \sum_{j=1}^{26} p_j' C_j &= YD \end{aligned} \quad [11]$$

Where  $C_j$  represents the consumption of the produced good  $j$  and  $C_{AH}$  the part devoted to savings.

Therefore, the equations of the model that determine the level of consumer demand for each consumer good and households' savings are obtained from the previous optimization program:

$$C_j = \frac{\mu_j YD}{p_j'} \quad [12]$$

$$C_{AH} = \frac{\lambda YD}{p_s} \quad [13]$$

Families devote their income,  $YD$ , to current consumption of the different goods produced and to savings for future consumption, after deducting the paid taxes and assuming that the Public Sector taxes such income at a constant rate ( $T_D$ ). Income available for consumption and savings is therefore determined as follows:

$$YD = (1 - T_D) \cdot wL_H \cdot (1 - u) + rK_H + ipc \cdot (TSP^H + TDES + TSO^H + TRM^H) \quad [14]$$

The gross household income is obtained, on the one hand, from the productive sector, by selling its production factors labour and capital for which it will receive compensation wages and returns on capital, respectively. And, on the other hand, by transfers received from other institutional sectors: public sector transfers are related to unemployment payments ( $TDES$ ) and other benefits ( $TSP^H$ ); transfers from companies ( $TSO^H$ ) and those from foreign sector ( $TRM^H$ ). Although the latest transfers and so factor endowment are considered constant (exogenous), households' income is endogenously determined by variations in wages and returns on capital.

## Companies

The model considers that companies are the direct managers of the productive activity sectors or mere intermediaries between production sectors and the rest of institutional sectors, households, public sector and foreign sector.

Gross operating income of these industries come from their returns on capital,  $K_{SO}$ , being  $r$  their marginal price, so they pay taxes on them at a tax rate,  $T_{SO}$ . Besides, they make net transfers to other institutional sectors, public sector ( $TSP^{SP}$ ), households ( $TSO^H$ ) and the rest of the world ( $TSO^{RM}$ ). The budget constraint of industries will be balanced by their savings amount  $AH_{SO}$ , according to the following equation:

$$AH_{SO} = (1 - T_{SO}) \cdot r \cdot K_{SO} + ipc \cdot TSP^{SO} - TSO^H - TSO^{RM} \quad [15]$$

## Public Sector

In this CGE model, the public sector represents all public administrations and its main role is to act as a consumer of goods and services and as tax collector, although its income comes from different sources: reported income from its own capital,  $r \cdot K_{SP}$ ; different taxes collected and the income received from the net transactions carried out in the rest of the world ( $TRM^{SP}$ ).

This tax collection is disaggregated between those derived from taxes on production and VAT, ( $RTP$ ), the social security contributions by employers, ( $RTCS$ ), corporate taxes, ( $RSO$ ), and finally, the income tax imposed on consumers, ( $RD$ ).

The public sector uses these revenues to finance expenditure on consumer goods, which is considered constant, although its expenditure may vary as a result of changes in prices. That is, consumption in each of the assets by the public sector is considered to be exogenous variables,  $C_j^{SP}$ . In addition to the consumption of goods, the public sector performs various transfers to the rest of institutional sectors: to the foreign sector ( $TRM^{SP}$ ), to companies ( $TSP^{SO}$ ) and to households in the form of social benefits ( $TSP^H$ ) and unemployment benefits ( $TDES$ ).

Therefore, the public deficit or surplus is endogenously determined as the difference between income minus public expenditure and transfers mentioned, which are weighted by a consumer price index, and are intended to complement private savings to finance their investment.

$$DP = r \cdot K_{SP} + RTP + RTCS + RSO + RD - \sum_{j=1}^{26} p_j^1 C_j^{SP} - ipc \cdot TSP^H + TDES + TSP^{SO} - TRM^{SP} \quad [16]$$

### Foreign Sector

The foreign sector appears as the only aggregated account in the model, which buys and sells goods and services to Aragon's producers, in addition to making various transfers to private and public agents.

Under the assumption that the regional economy of Aragon is a small open economy, import supply is perfectly elastic and the price of goods in international markets is assumed to stay on the same levels. Regarding export levels consumer goods, these are considered to remain constant (exogenous). Thus, the trade balance of the regional economy by the foreign sector will be determined endogenously as:

$$DRM = \sum_{j=1}^{26} p_j^m \cdot M_j - \sum_{j=1}^{26} p_j^1 \cdot EP_j + ipc \cdot TSO^{RM} - TRM^H - TRM^{SP} \quad [17]$$

## Markets of factors

The model has introduced two inputs. With regard to labour, it comes from a representative consumer who is assumed to have a constant working capacity ( $L_H$ ). That is, labour supply is inelastic. On the other hand, it is considered as moving between different productive branches of the re-

gional economy, but still to and from the foreign sector. It is also assumed that salaries are flexible and, therefore, they are considered as an endogenous variable of the model. Finally, the model incorporates the imbalance in the labour market not to consider full employment. Therefore, it includes an unemployment rate ( $u$ ), an endogenous variable which underestimates households labour endowment with respect to the demand for this factor by the productive system in Aragon.

$$(1 - u)L_H = \sum_{j=1}^{26} L_j \quad [18]$$

With the assumption that capital is not internationally mobile but is perfectly flexible to changes between regional productive sectors, and taking into account that the supply of capital comes from the different institutional sectors, the market clearing condition of this factor is determined under these conditions:

$$K_H + K_{SO} + K_{SP} = \sum_{j=1}^{26} K_j \quad [19]$$

## Equilibrium

Taking into account the conditions described on model agents behavior, along with the equations of the emptying of goods and equality between savings and investment and macroeconomic closure, the model formulation is completed with the introduction of the concept of equilibrium generally used.

## 2.2. Model calibration

After describing the model specification and once the concept of the theoretical equilibrium is defined, it is now possible to perform an analysis of the impact of different economic policies. For such objective it is necessary to determine the numerical values of all the coefficients of functions and exogenous variables. That is, it is necessary to calibrate the model (Mansur and Whalley, 1984). It is therefore essential to have a Social Accounting Matrix (SAM) of the studied economy, which can provide the data required for the calculation of the parameters and the values of the exogenous variables.

In this CGE model for Aragon, the calibration has been performed using the SAM database of Aragon by base year 2005 (Pérez y Pérez and Cámara, 2010). As this original SAM was valued at basic prices, in order to transform it into one valued at acquisition prices, an adjustment of the sub matrix of intermediate and final consumption by the Cross-Entropy Minimization method was performed using the last *Input-Output* Framework available in the region (Pérez y Pérez and Parra, 2009). This method has been previously applied to update SAM matrices, among others, by Robinson *et al.* (2001), Cardenete and Sancho (2006) or Monrobel *et al.* (2013). Nevertheless, the modifications performed do not change the initial data matrix. Such a fact only represents an adjustment into the model variables changing their valuation from basic prices to acquisition prices.

As a result of these adjustments, a new SAM was obtained valued at acquisition prices which serves as the straightforward database for the formulation of the ARAGON-CGE model and constitutes the starting point for its initial calibration. This matrix, used as the database for the model, is structured in a total of 37 accounts.

It is assumed that the economic reality reflected in the SAM corresponds to the equilibrium levels of the Aragonese economy described in the model. Solving the system of equations represented by the model leads to the calculation of the endogenous accounts. This implies that it replicates the overall equilibrium which is reflected in the SAM solution obtained as the initial equilibrium values. Later on this equilibrium will have to be compared with those obtained by introducing or changing the values of the variables affected by certain economic policies.

Once the model has been formulated and calibrated, it is an ideal tool for evaluating the impact that certain economic policies would have on the regional economy. Simulations are introduced in the model as variations in some of its exogenous variables and/or the equation coefficients. Specifically, in this paper we analyze the effects of CAP on the Aragonese economy. Macroeconomic effects are analyzed in Aragon of the total aid coming from the European Agricultural Guarantee Fund and the European Agricultural Fund for Rural Development (co-financed by the Spanish public administrations) received during the period 2007-2013. The model has been solved using the GAMS software with its CONOPT solver.

### 3. Results

Once the benchmark equilibrium without funds is set, the model is ready to perform various simulations by changing some parameters or some exogenous variables, obtaining new balances. The simulated rebalancing must collect the incorporation of CAP support in the Aragonese economy. Thus, changes in the exogenous variables of the model should reflect both the amount of the aid and its distribution between the productive sectors of Aragon.

The resources allocated by the EU through CAP to Aragon have been introduced in the CGE model as a variable, denoted by  $F_{RM}$ , which represents the foreign sector spending. This investment modifies the model equation with respect to foreign sector balance set out in equation [17].

$$DRM = \sum_{j=1}^{26} p_j^m \cdot M_j - \sum_{j=1}^{26} p_j^i \cdot EP_j + ipc \cdot TSO^{RM} - TRM^H - TRM^{SP} - F_{SP} \quad [20]$$

Along with resources coming from the EU, CAP funds in Aragon are completed with internal investment (Table 2). Variable  $F_{SP}$  represents such an investment in the model and it is considered as a public sector spending which has been included in the equation that determines the deficit.

According to data collected in Table 2, the total amount invested by EAGF and by EAFRD in Aragon during the period 2007-2013 is estimated at 3,547.2 million Euros and national funding at 508.1 million Euros. Therefore, the exo-

genous variables of the model,  $F_{RM}$  and  $F_{SP}$ , which in the initial equilibrium were null, will be increased up to the total sum of such amounts in the simulation.

According to Monrobel *et al* (2013), the CAP and the internal funds in Aragon have been incorporated as a positive *shock* over the regional final demand materialized in the increase of the  $F_j$  variables which have been introduced in the model in an *ad hoc* manner. These  $F_j$  variables measure the *shock* in the demand for the corresponding good to the *j*-th branch of production as a result of receiving CAP funds directly. Thus, the demand increase in monetary terms will be determined by,  $p_j' F_j$  being that  $p_j'$  is the final sale price of the good. Consequently, the amount of money received by each productive industry matches the total regional funds coming from the CAP.

$$\sum_{j=1}^{26} p_j' F_j = F_{RM} + F_{SP} \quad [21]$$

In conclusion, by increasing the representative CAP funds variables, a new solution to the model has been obtained with a new equilibrium of the regional economy “with CAP funds”. This first study has assumed that all of the CAP support is received directly by the “Agriculture, livestock and fishing” account.

The effects of CAP support in Aragon during 2007-2013 are obtained by comparing the benchmark scenario “without funds” and the simulated scenario “with CAP funds”. This makes it possible to analyze the effects of CAP, to objectively quantify the multiplier effects resulting from interdependencies between the productive and other institutional sectors when incorporating the CAP funds to the regional circular flow of income through the model simulation.

#### 3.1. Effects on the regional productive sector

Aragon received from CAP an estimated total amount of 4,055 million Euros between 2007 and 2013. This represents an increase on the total demand in the region of 0.65 percent on annual average. The CAP funds represent a direct push of 1.14 per cent per year on the regional value added. In particular, for the agriculture sector, as the only one receiving this aid, CAP funds represent annually about 29 per cent of its value added. Considering the circular flow of income, the CAP subsidies involve a 2.4 percent increase per annum out of the regional value added (Table 3).

It must be emphasized that all productive sectors of the economy benefit from the CAP aids showing an increase in their respective value added. Notable increase of 137 percent in value added can be observed in the “Agriculture, livestock and fishing” sector, being the only one that receives direct aid. However, emphasis must be given to the value increases above 20 percent, in sectors such as “Wholesale and retail trade” (28.6 percent), “Electricity, gas and water supply” (24.6 percent) and “Food, beverage and tobacco industry” (21 percent), although these three branches have important links with agriculture in terms of intermediate consumption (Figure 1). By contrast, “Metallurgy and ma-

Table 3 - *Effects of CAP on GDP.*  
(Figures in Thousand EUR)

GDP Computation (Income approach)	Scenario "Without funds"	Scenario "With CAP funds"	Total increase 2007-2013 (%)	Annual increase (%)
Wages and Salaries	12,474,772	14,233,913	14.10%	2.01%
Gross Operating Surplus	11,657,035	15,269,899	30.99%	4.43%
Taxes	4,303,869	4,261,851	-0.98%	-0.14%
GDP	28,435,675	33,765,663	18.74%	2.68%
GDP Computation (Expenditures approach)				
Household consumption	16,228,206	18,680,089	15.11%	2.16%
Public Sector expenditure	5,620,620	5,948,097	5.83%	0.83%
Gross Capital Formation	9,283,490	14,056,455	51.4%	7.34%
Exports	19,813,701	20,927,451	5.62%	0.80%
Imports	22,510,341	25,846,429	14.82%	2.12%
GDP	28,435,676	33,765,663	18.74%	2.68%
GDP Computation (Supply approach)				
Agrarian Value Added			137.50%	19.64%
Industrial Value Added			9.09%	1.30%
Services Value Added			10.72%	1.53%
Regional Value Added			17.01%	2.43%

Source: Own elaboration.

nufacture of metal products", "Electrical, electronic and optical equipment" and "Education" have increased their value added by less than 3.2 percent, due to their little linkages with agriculture.

### 3.2. Effects on key macroeconomic aggregated figures

CAP funds represented to Aragon an average increase of 2.68 percent of regional GDP per year in the period 2007-

2013 (Table 3). On the income side, it is estimated that salaries in this period have grown, as a result of the aid, by 2.0 percent per year while the Gross Surplus of Exploitation or corporate profits have grown by 4.4 percent per year. Meanwhile, net taxes on production and imports fell by 0.14 percent per year, a clear example of the importance of public subsidies, especially in the agricultural sector.

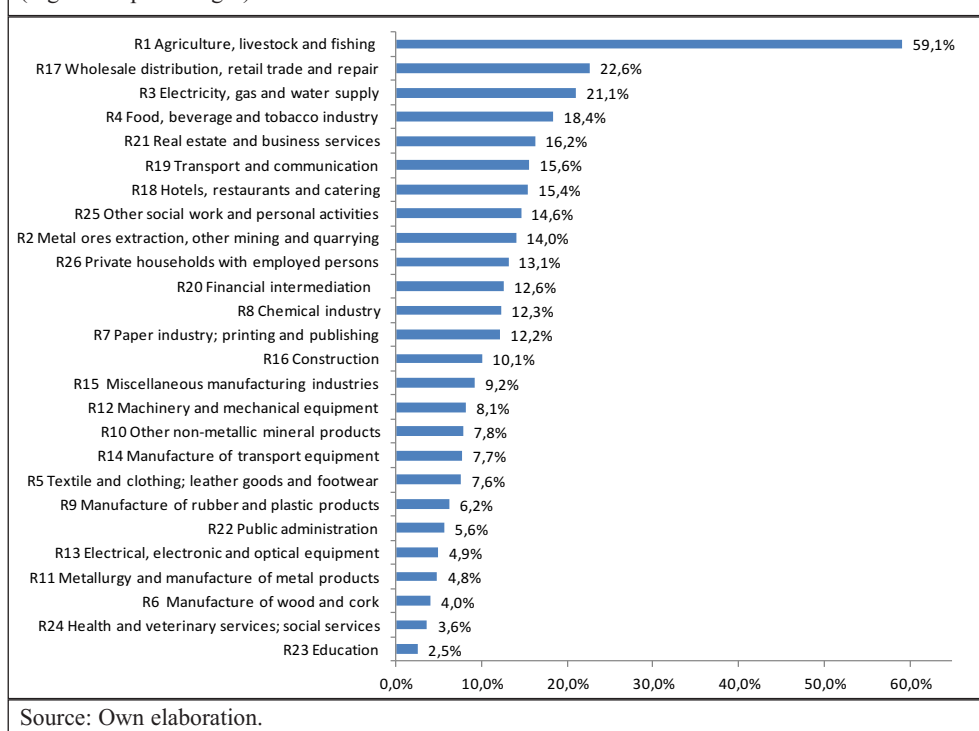
On the demand side, the CAP drives private households' consumption to a 2.16 per cent increase per year, while collective consumption makes it only by 0.83 percent. Besides, Gross Capital Formation, a magnitude that incorporates the amount of funds received, achieves a growth of up to 7.34 percent per year, while foreign trade has a negative balance; exports increased by 0.8 percent and imports by 2.12 percent per year.

### 3.3. Effects on prices of goods production

Referring to changes in prices of goods as well as in other price indices of the model, it should be noted that their variations after the model simulation are to be considered as related to wages, given that this price has been fixed as the numeraire of the model.

Regarding changes in prices of goods that are produced thanks to CAP, it should be noted that "Agriculture" is not the only one experiencing the greatest increase in its price. We find "Electricity, gas and water supply" with an increase of 14.6 percent, a sector that is closely linked to the primary sector, and also "Real estate and business services" with a similar increase in prices. While this branch is not directly related to farming, its large increase may be due to the importance that the housing market still had, in the beginning of the programming period, both in the Spanish and in the Aragonese economy (Figure 2). On an overall basis, the effect of including Aragon in the CAP program would imply, on average, a 9.5 percent increase of their Consumer Price Index.

Figure 1 - *Increase in the value added of productive sectors in 2007-2013.*  
(Figures in percentages)

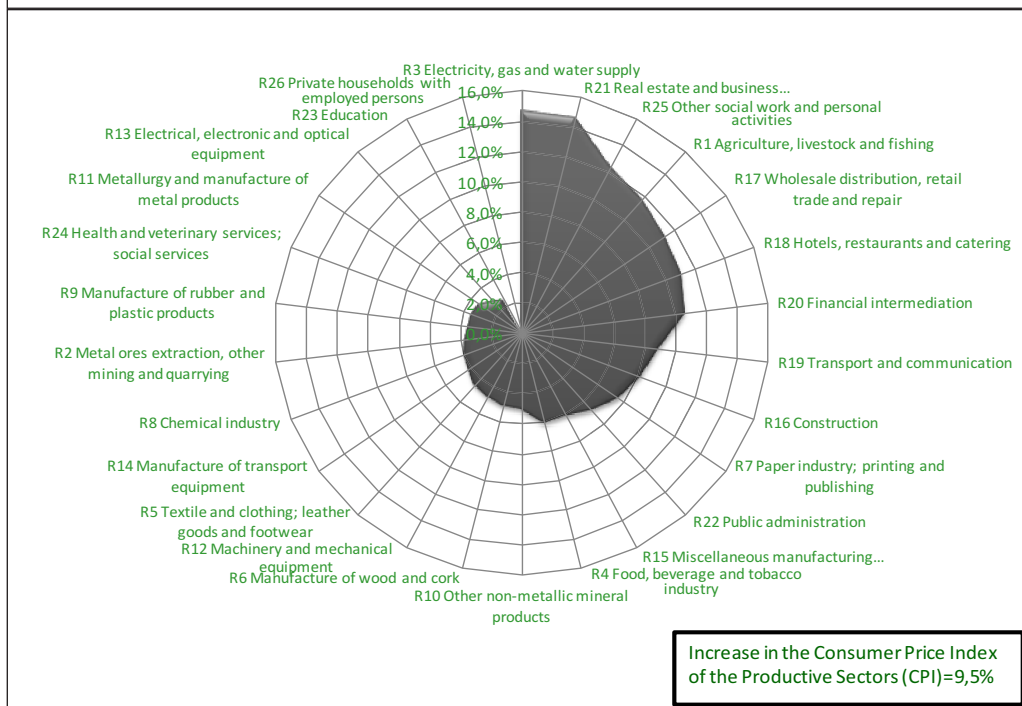


### 3.4. Effects on labour market

Finally, we would like to highlight the impact of CAP on salaries, in terms of the variation of labour demand by different economic sectors after incorporating the CAP funds in the model.

When analyzing variations in salaries and taking into account the effects of CAP funds, it must be in-

Figure 2 - Price index variation in productive sectors during the period.  
(Figures in percentages)



Source: Own elaboration.

indicated that such funds involve more than half of the salary of Aragon’s agricultural sector. In addition to such a direct benefit of the CAP, the funds represent a demand rise over 20 percent in “Wholesale and retail trade” and “Electricity, gas and water supply”. In summary, we can see in Table 4, after the incorporation of the CAP funds in the regional economy, that they represent a 12.3 percent of wages and salaries in Aragon.

#### 4. Discussion

The importance of the use of CGE models for the analysis of the CAP is based on the possibility to analyze not only the effects of agricultural aids on recipients productive sectors, but also to deduct all the induced effects in the rest of productive and institutional sectors of a specific regional economy as well as in its main macro-magnitudes. When evaluating the

Table 4 - Effects of the CAP funds on the labour factor.

WAGES AND SALARIES BY PRODUCTIVE SECTORS ("Labour Factor" Account)	Scenario "Without funds"(Thousand EUR)	Scenario "With CAP funds"(Thousand EUR)	Percentage increase "With CAP funds"
R1 Agriculture, livestock and fishing	98,492.29	240,887.54	59.1%
R17 Wholesale distribution, retail trade and repair	861,702.55	1,113,651.22	22.6%
R3 Electricity, gas and water supply	113,111.46	143,281.95	21.1%
R4 Food, beverage and tobacco industry	216,825.73	265,751.49	18.4%
R21 Real estate and business services	770,646.10	920,168.47	16.2%
R19 Transport and communication	360,471.77	427,154.67	15.6%
R18 Hotels, restaurants and catering	383,604.71	453,700.89	15.4%
R25 Other social work and personal activities	199,760.09	233,863.32	14.6%
R2 Metal ores extraction, other mining and quarrying	39,212.97	45,619.97	14.0%
R26 Private households with employed persons	84,404.30	97,156.75	13.1%
R20 Financial intermediation	350,347.05	400,847.62	12.6%
R8 Chemical industry	151,480.04	172,727.46	12.3%
R7 Paper industry; printing and publishing	126,110.41	143,612.16	12.2%
R16 Construction	1,126,741.81	1,253,256.30	10.1%
R15 Miscellaneous manufacturing industries	141,611.49	155,940.72	9.2%
R12 Machinery and mechanical equipment	282,770.38	307,723.11	8.1%
R10 Other non-metallic mineral products	117,781.83	127,756.30	7.8%
R14 Manufacturing of transport equipment	510,605.81	553,254.33	7.7%
R5 Textile and clothing; leather goods and footwear	86,198.91	93,280.78	7.6%
R9 Manufacture of rubber and plastic products	100,346.29	106,931.59	6.2%
R22 Public administration	907,427.41	961,139.60	5.6%
R13 Electrical, electronic and optical equipment	179,753.86	189,052.21	4.9%
R11 Metallurgy and manufacture of metal products	326,505.63	342,972.37	4.8%
R6 Manufacture of wood and cork	51,460.46	53,610.63	4.0%
R24 Health and veterinary services; social services	804,594.90	834,928.86	3.6%
R23 Education	559,066.00	573,401.45	2.5%
<b>Total</b>	<b>8,951,034.23</b>	<b>10,211,671.77</b>	<b>12.3%</b>

Source: Own elaboration.

results of this European policy it can be seen that CAP funds represented to Aragon an average increase of 2.68 percent of regional GDP per year over the period 2007-2013. In terms of income, wages and salaries have increased at an average annual rate of 2.01 percent, which shows the strong dependence of the agricultural sector and the Aragon regional economy as a whole on European aids. Aragon’s GDP responds significantly to the agricultural subsidies and it should seek to reduce the dependence on European agricultural subsidies and improve the competitiveness of its products in domestic and European markets.

When comparing the simulated results of GDP by the supply side, we can emphasize that the agricultural sector is the main beneficiary in terms of the value added, being the direct recipient sector of CAP funds. The results of this study highlight the importance of agriculture as a sector with a major role within the economy, for the effects over other sectors are significant, as a result of the circular effects of the incorporation of the funds. The increase in value added in the services sector is smaller than in agriculture. This difference between the two sectors is consistent with the lower weight that the industrial sector has in the regional economy.

This work has added a new method, so far not



used for economic policy analysis in Aragon and many other Mediterranean regions, revealing the importance of the CAP in Aragon and its very significant role played, not only in the Agricultural sector, but in the regional economy as a whole.

On one hand, it is of great importance to defend such funds by the regional and state governments when facing the forthcoming programming periods, as a part of the European Union. On the other hand, given that future cuts in agricultural EU funds are not discardable and they would affect several European regions in the future, this analysis is crucial to predict the macroeconomic effects resulting from the next EU agricultural policy.

In sum, to improve regional agricultural efficiency and lessen environmental problems, and to ensure uninterrupted food supply and sustainable growth, national and regional governments should continue to incorporate and explore more efficient and cost-effective agricultural practices, in particular supporting those good quality agrarian products which are more competitive in international markets and less dependent on European public aids.

Lastly, this work poses some limitations that must be taken into account and constitute further research avenues on the topic. Future research should include the examination of the relationship between agricultural production and subsidies to determine which agricultural subsectors are more dependent on subsidies. One might also consider the emergence of new food chains reflecting the spectrum of sensitivities to food, and the need to adopt a position of greater efficiency and equity in times of crisis. It should not be forgotten the social and economic situation of rural society and adaptation strategies in particular changing times. Finally, other limitation is that the analysis had been only conducted in the Mediterranean region of Aragon in Spain and results must take into account this geographical coverage. Further research extending the analysis to other European regions should be done.

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