

# Valuating single payment entitlements: Spain

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## Abstract

This paper attempts to develop a valuation method for estimating the market value of the single payment system (SPS) entitlements in the community agricultural policy (CAP) reform. These entitlements are a new agricultural intangible asset which is not linked to land and has a similar financial performance to bonds. After applying the PERT method, which was applied to the inherent risk involved in valuing fixed income assets, and specifically to the uncertainty of CAP after 2013, this methodology is applied to estimate the average value of entitlements in Spain.

**Additional key words:** agricultural intangible asset, CAP, PERT, value.

## Resumen

### Valoración de los derechos procedentes del régimen de pago único: aplicación al caso de España

El presente trabajo pretende desarrollar un método de valoración para estimar el valor de mercado de los derechos generados en el régimen de pago único (RPU) de la reforma de la política agraria comunitaria (PAC), que suponen un nuevo intangible de naturaleza agraria no ligado a la tierra, cuyo comportamiento financiero puede ser similar al de los bonos. Partiendo de la metodología PERT aplicada al riesgo inherente en la valoración de activos de renta fija y en concreto a la incertidumbre de la PAC después del 2013, este método se aplica a la estimación del valor medio de los títulos en España.

**Palabras clave adicionales:** intangible agrario, PAC, PERT, valor.

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## Introduction

Since its origins to the present-day, the Common Agricultural Policy (CAP) has had to change dramatically to overcome new challenges. At first, CAP focused not only on fulfilling the goals set out in Article 39 of the Treaty of Rome (increase productivity, assume an equal standard of living for farmers, and provide reasonable prices for commodities), but also on correcting the «changes» that might have emerged. After concentrating on prices cuts, CAP also granted subsidies to farmers. Finally, the current CAP reform (2003) (Di-

rective 1782/2003/CEE; OJ, 2003) modified the reform of 1992, that is, by substituting the measures of support prices for direct aids and by introducing the single payment system (SPS) in 2005/2006.

Furthermore, this reform supported the Rural Development Policy (RDP), which led to increasing interest towards aids for rural development in Spain during the period 1990-2007. As Table 1 shows, rural development subsidies increased by over 400% from 1992 to 2007.

Although most European countries (Belgium, Denmark, Germany, Ireland, Austria, Portugal, Sweden, the United Kingdom and Italy) adopted the SPS which

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Abbreviations used: AC (Spanish Autonomous Community), CAP (common agricultural policy), EAFRD (European Agricultural Fund for Rural Development), EC (European Commission), EU (European Union), FEAGA (Fondo Español de Garantía Agraria/Spanish Agrarian Guarantee Fund), GAEC (good agricultural and environment condition), INE (Instituto Nacional de Estadística/ Spanish National Statistics Institute), MAPA (Ministerio de Agricultura, Pesca y Alimentación/Spanish Ministry of Agriculture, Fishery and Food), MARM (Ministerio de Medio Ambiente y Medio Rural y Marino/Spanish Ministry of the Environment and Rural and Marine Affairs), PERT (program evaluation and review technique), RDP (rural development policy), SFP (decoupled single farm payments), SPS (single payment system), UAA (utilized agricultural area).

**Table 1.** Development of the payments derived from the aids received by Spain (in thousand of euros)

Variable	1990 <sup>a</sup>	1991	1992	1993	1994	1995
Total value of subsidies	2,243,476	3,096,246	3,265,611	3,855,877	5,327,303	6,230,301
Total direct payments	1,784,669	2,637,439	2,806,805	3,397,071	4,606,055	4,830,977
— Coupled direct payments: Total	1,784,669	2,637,439	2,806,805	3,382,893	4,472,095	4,631,063
• Coupled direct payments: crops	1,213,978	1,978,892	2,212,001	2,756,049	3,754,192	3,798,985
• Coupled direct payments: livestock	570,691	658,547	594,804	626,844	717,903	832,077
— Decoupled direct payments (SFP)	0	0	0	0	0	0
— Set-aside payments	0	0	0	0	89,190	92,502
— Other direct payments	0	0	0	14,178	44,769	107,413
Rural development policies	458,807	458,807	458,807	458,807	721,248	1,399,324
— RDP financed from EU budget	229,103	229,103	229,103	229,103	317,281	877,316
— RDP financed from national budget	229,704	229,704	229,704	229,704	403,968	522,008
Less Favoured Area	N/A <sup>b</sup>	N/A	N/A	N/A	N/A	N/A
	<b>1996</b>	<b>1997</b>	<b>1998</b>	<b>1999</b>	<b>2000</b>	<b>2001</b>
Total value of subsidies	5,272,982	5,378,882	5,829,725	6,478,043	5,474,793	6,410,873
Total direct payments	3,749,466	3,999,285	4,087,724	4,195,637	4,077,849	4,353,238
— Coupled direct payments: Total	3,445,583	3,629,194	3,672,629	3,858,463	3,988,334	4,264,931
• Coupled direct payments: crops	2,558,063	2,916,448	2,822,034	2,861,022	3,122,420	3,301,737
• Coupled direct payments: livestock	887,521	712,746	850,594	997,441	865,914	963,194
— Decoupled direct payments (SFP)	0	0	0	0	0	0
— Set-aside payments	123,075	140,306	140,649	66,424	67,199	62,637
— Other direct payments	180,808	229,785	274,446	270,750	22,316	25,669
Rural development policies	1,523,516	1,379,597	1,742,001	2,282,406	1,396,944	1,998,223
— RDP financed from EU budget	959,662	746,891	1,118,712	1,439,408	959,274	1,315,926
— RDP financed from national budget	563,854	632,705	623,289	842,998	437,669	682,297
Less Favoured Area	N/A	N/A	N/A	N/A	0	59,413
	<b>2002</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>
Total value of subsidies	7,021,854	7,240,665	7,760,383	7,562,958	7,800,080	7,665,247
Total direct payments	4,908,992	4,809,448	5,028,778	4,670,394	4,777,268	5,201,558
— Coupled direct payments: Total	4,661,679	4,553,308	4,995,907	4,649,301	4,471,610	4,810,691
• Coupled direct payments: crops	3,454,154	3,238,928	3,628,072	3,239,931	461,054	1,186,421
• Coupled direct payments: livestock	1,207,525	1,314,381	1,367,835	1,409,370	1,010,556	624,270
— Decoupled direct payments (SFP)	0	0	0	0	3,282,811	3,294,005
— Set-aside payments	236,565	246,045	20,983	8,384	6,581	10,497
— Other direct payments	10,748	10,095	11,888	12,709	16,267	86,365
Rural development policies	2,037,769	2,324,770	2,599,069	2,772,634	2,881,159	2,328,000
— RDP financed from EU budget	1,294,882	1,471,685	1,615,896	1,743,628	1,662,785	1,030,600
— RDP financed from national budget	742,888	853,085	983,173	1,029,006	1,218,374	1,297,400
Less Favoured Area	75,093	106,446	132,536	119,930	141,652	135,689

<sup>a</sup> The payments of each year are from the 1<sup>st</sup> of December of the current year. <sup>b</sup> N/A: not available. *Source:* Own performance from FEGA and MARM information.

granted decoupled aids from production in 2005, Spain, Greece, Finland, France and Netherlands adopted it one year later.

Currently, the European Commission (EC) has guaranteed and budgeted CAP until 2013. The SPS implies

direct aids being received by farmers. The SPS grants two kinds of aids, coupled and decoupled, whose distribution varies in accordance with the decision each country makes.

Spain has opted to partially apply the SPS from the year 2006. One part of the aid is paid to farmers as a

single payment, while the second part is paid as coupled payments for production, which are only received if crops continue to grow or livestock are still bred (see Table 1).

Decoupled aids have brought about important changes in the development of the agrarian sector. In particular, the impact of land use and its productivity was modelled by Gohin (2006), Tranter *et al.* (2007) and Gorton *et al.* (2008), while the influence on land rent was analysed by Roberts *et al.* (2003).

The objective of this system was to assure that farmers' incomes remained stable and that the competitiveness and the sustainability of European agriculture improved.

Each country member has opted for a different system to estimate and make SPS payments to farmers (Kilian and Salhofer, 2008); these payments are made by assigning entitlements to farmers.

One of the options consists in estimating the SPS on the direct payments that the farmer receives during a reference period, which may involve different levels of SPS for each farmer. This option is known as a historical model. France, Portugal, and Spain, among other countries, have opted for this model.

Another option for estimating the SPS involves calculating the average of all the payments at a national or regional level (regional model). Finally, the third option is the mixed model which combines the previous methods for estimating payments for the different regions in the same country.

As a result of the application of the SPS, a new agricultural asset has emerged: the entitlement. Farmers can manage entitlements in various ways, for instance: purchasing or selling them without land, linking them to land trade or renting the land. However, it is compulsory for both owners and tenants to justify any kind of eligible land to receive the entitlement payment. Entitlements are unquestionably a new intangible of an administrative nature that is not linked to land (Caballer, 2008)<sup>1</sup>, which may be traded in a more or less competitive and transparent market, and whose valuation is a necessity given its novel and special features.

In addition, entitlements may only be traded under certain conditions when they have been, and can be, assigned only to those farmers who are officially located in Spain; although they may be traded between regions, this practice involves paying a penalty.

Nevertheless farmers have to not only report any trade entitlement but also the reason why it has been

traded to the Spanish Agrarian Guarantee Fund (FEGA), there is no obligation to report the market price of the entitlements. Therefore, such information remains unknown. At the same time, it is not a speculative market given the consequences of the uncertain future of entitlements after 2013. This may imply an adjustment process within the agrarian sector a consequence of not having to justify lands to trade entitlements (Moreno-Pérez and Ortiz, 2008).

According to the FEGA (2007a), a total of 505,945.30 (3.39%) of normal entitlements, 24,535.01 (3.49%) of withdrawal entitlements and 1,638.50 (2.52%) of special entitlements, the average of which is 3.39%, were granted (traded or rented) in the period from 1 February 2007 to 13 September 2007. However, of the 505,945.30 normal entitlements granted, only 135,303.78 (26.7%) corresponded to traded entitlements as most were (44.6%) rentals involving lands.

The same occurred with the transfers of withdrawal entitlements as only 5,033 (20.5%) were owing to tradability reasons of the entitlements, although there was an even greater number corresponding to rentals involving lands (12,495.85; 50.9%).

On the other hand, 64.4% of withdrawal entitlements being transferred were owing to tradability reasons, while only 5% corresponded to rentals.

After analysing the status of the entitlements market in Spain, we discover two different parts: the annual rent received per entitlement and the market value of the entitlement.

As FEGA published rents each year, rents are certain and known facts. Nevertheless, there are notorious differences between the average values of entitlements among the Spanish Autonomous Communities (ACs). So the results and the factors that determine such differences are interesting to analyse.

Several studies have analysed the features that determine rental and land values (Gracia *et al.*, 2004; Caballer and Guadalajara, 2005), particularly the CAP subsidies received by farmers (Lagerkvist, 2005; Sala and Torres, 2007; Patton *et al.*, 2008), and also some of them have proposed a valuation model in accordance with these features.

Furthermore, according to Beard and Swinbank (2001), those bonds (entitlements), to which the owner confers the right to receive these future compensation payments, will have a value which reflects the market's

<sup>1</sup> Intangible assets may be of either an administrative nature, such as the milk production quotas, or a technological nature, such as official certificates of origin.

present valuation of these future payments. In this way, the market value of an entitlement is most probably the estimation of the value of an entitlement that could be traded in the free market.

By taking all this into account, we see that there is a need to evaluate new entitlements and that works which centre on this approach are lacking. Consequently, the main objective of this paper is to propose a valuation model to estimate the theoretical market value of SPS entitlements in Spain. The purpose of estimating this value is two-fold; on the one hand, it affords this market greater transparency and efficiency while, on the other hand, it enables aids to be put to better use and, possibly, better EU financing for Spanish agriculture. Furthermore, it would help resolve the problems related to valuing rural land in those cases in which entitlements do not correspond to the land owner.

This paper is structured as follows: Section 1 focuses on the application of the SPS and on the origin of farming entitlements in Spain. Section 2 analyses the differences in entitlement rents among the ACs. Besides, Section 3 develops a valuation model to estimate the theoretical value of the entitlements in the market, which takes this value as being similar to financial assets and securities. Section 4 shows the research results of the average entitlement rent in Spain in such a way that the market value obtained from the entitlement is merely a mean national value, which will vary in terms of the entitlement rent in each case. Finally, Section 5 presents the main conclusions of the paper.

## Application of the SPS in Spain

In Spain, the total direct payments received by farmers in 2006 and 2007 were €4,777 and €5,021 million, respectively. Of these amounts, 68.7% (3,282,811) and 63.3% (3,294,005) were received as decoupled aids, respectively, through the SPS each year (see Table 1).

A single payment is estimated by the mean aid received during the three-year period 2000/2001/2002, with some exceptions: a) olive oil, 1999-2003 (the 1999/2000 campaign to the 2002-2003 campaign); b) sugar cane (2003-2005); c) sugar beet (2004-2006); d) flax and hemp (2001-2002).

Given the considerable differences in the direct aids received by each sector and each AC during the reference period 2000-2002 as a result of the notable sectorial and territorial differences in Spanish agricultural

production, a historical model has been adopted. Likewise, this historical model has been adopted to maintain part of the coupled aids in order to face the risk of a more or less generalised abandonment of the farming activity owing to low productivity of dry crops and extensive cattle raising.

In order to receive entitlement payments, farmers have to justify land.

The surface areas for which SPS entitlements may apply are those farms whose lands are used for growing crops and permanent grazing, except for those lands occupied by permanent crops or forests or those used for activities other than agriculture. In Spain, approximately 75% of the utilized agricultural area (UAA) may put such entitlements to good use. The remaining 25% is made up of some 4.5 million hectares which have no entitlements because they are either fallow or forage lands.

Moreover, farmers will receive direct payments if cross-compliance requirements are met. Farmers must comply with the provisions of 18 European Directives (Directive 1782/2003/CEE; OJ, 2003) in the areas of public, animal and plant health, the environment and animal welfare, and in keeping land in good agricultural and environmental conditions (GAEC) (Annexe IV of this directive). More recently, the European Council Regulation 146/2008 (OJ, 2008) has amended both European Council Regulation 1782/2003, which establishes common rules for direct support schemes under the CAP as well as certain support schemes for farmers, and European Council Regulation 1698/2005 (OJ, 2005) on the support for rural development through the European Agricultural Fund for Rural Development (EAFRD). The amendments cover minor cases of non-compliance with the cross-compliance requirements established in the CAP.

In Spain, Royal Decree 2352/2004 (BOE, 2004) is the main legal act that addresses cross-compliance at a national level.

Several studies into the impact of Good Farming Practices requirements for being eligible to participate in European Rural Development Programmes have been carried out (*e.g.*, Calatrava *et al.*, 2007). This study concluded that the new environmental requirements regarding the SPS have a positive effect on the adoption of conservation practices.

Those entitlements derived from the aids available for surface areas, and from the bonuses and supplementary aids obtained by farms with surface areas, are accounted as follows: 1 entitlement = 1 hectare or fraction of hectare.

As regards supplementary livestock bonuses and aids obtained by farms without surface areas, the number of entitlements is calculated as so: number of entitlements = amount of reference/5,000. In this way, three kinds of entitlements exist: normal, special and withdrawal.

The value of each entitlement will be calculated by dividing the reduced reference amount once the 3% destined to the National Reserve, and any other applicable discount, have been deducted (applying Article 69 EC Regulation 1782/2003 and the financial discipline, for example) by the number of entitlements.

As Table 2 shows, the average value<sup>2</sup> of entitlements in Spain in the 2006 Campaign was €224.26, although there were many differences between types of entitlements:

— The average value of compulsory withdrawal of lands, or withdrawal entitlements (through the direct aids received for the compulsory withdrawal of lands) was €167.33. After the SPS was set up, the entitlement for the compulsory withdrawal of herbaceous crops (cereals, oil seed crops and protein crops) was set at 10%. In 2008, the EC proposed to set the percentage of compulsory withdrawal of lands for forthcoming sowing times at 0% as a reaction to the situation in which the cereal market is.

— The average value of each eligible hectare, or normal entitlement, was €217.26.

— The average values in those situations subjected to special conditions, that is, for special entitlements

**Table 2.** Assigned entitlements during 2006 and 2007

Autonomous community	Kind of entitlements <sup>a</sup>	Number of granters		Number of entitlements		Payments <sup>b</sup> (€)		Average value per entitlement (€)	
		2006	2007	2006	2007	2006	2007	2006	2007
Andalusia	E	6,916	5,146	9,416	6,989	24,279,572	17,535,361	2,579	2,509
	N	264,047	266,324	3,191,102	3,237,034	1,227,497,681	1,234,623,374	385	381
	R	10,651	10,807	97,224	98,878	20,573,854	20,568,918	212	208
	Total	270,598	271,197	3,297,742	3,342,900	1,272,351,107	1,272,727,653	386	381
Aragon	E	1,930	1,203	3,518	2,416	11,970,196	8,475,661	3,403	3,508
	N	50,604	49,583	1,232,409	1,233,517	271,846,088	271,141,932	221	220
	R	10,600	10,314	76,070	75,948	11,825,118	11,625,370	155	153
	Total	52,343	50,646	1,311,997	1,311,878	295,641,401	291,242,963	225	222
Asturias	E	4,058	1,736	4,881	1,999	8,780,767	2,790,479	1,799	1,396
	N	9,616	11,502	210,260	212,049	28,417,365	33,781,529	135	159
	R								
	Total	13,229	12,984	215,141	214,048	37,198,131	36,572,008	173	171
Balears	E	916	837	942	861	698,757	575,430	742	668
	N	4,893	4,957	84,780	84,557	14,430,652	14,302,631	170	169
	R	473	472	2,563	2,563	407,579	400,900	159	156
	Total	5,796	5,766	88,285	87,978	15,536,988	15,278,961	176	174
Cantabria	E	2,324	1,278	3,354	1,840	8,910,365	4,703,535	2,657	2,556
	N	3,264	4,215	134,094	136,161	16,491,658	20,272,396	123	149
	R	29	29	97	97	21,041	20,725	217	214
	Total	5,557	5,465	137,545	138,098	25,423,063	24,996,655	185	181
Castile-La Mancha	E	3,149	2,504	4,881	4,057	14,808,489	12,510,358	3,034	3,084
	N	129,718	130,199	2,734,430	2,767,219	388,216,987	395,740,127	142	143
	R	16,477	17,078	162,723	169,668	24,920,624	25,598,643	153	151
	Total	132,614	132,454	2,902,034	2,940,938	427,946,100	433,849,129	147	148
Castile-Leon	E	4,877	2,370	7,152	3,641	20,787,686	10,968,988	2,907	3,013
	N	95,684	94,492	3,517,924	3,547,144	573,564,522	587,366,120	163	166
	R	31,136	29,845	267,178	269,014	42,109,359	41,728,594	158	155
	Total	100,228	96,624	3,792,254	3,819,799	636,461,567	640,063,702	168	168

<sup>2</sup> In colloquial language, the value of entitlements is related to the annual income of the entitlements. This concept differs from the market or fair value of entitlements which would be the price an entitlement would be most probably traded at in the market.



**Table 2 (cont.).** Assigned entitlements during 2006 and 2007

Autonomous community	Kind of entitlements <sup>a</sup>	Number of granters		Number of entitlements		Payments <sup>b</sup> (€)		Average value per entitlement (€)	
		2006	2007	2006	2007	2006	2007	2006	2007
Cataluña	E	1,461	1,515	2,535	2,712	7,921,072	8,425,283	3,125	3,107
	N	53,255	55,371	710,476	704,404	179,871,501	181,625,638	253	258
	R	4,195	4,274	20,389	20,702	4,113,107	4,108,054	202	198
	Total	54,617	56,787	733,4	727,816	191,905,681	194,158,976	262	267
Extremadura	E	4,014	2,625	5,382	3,476	12,990,361	7,973,538	2,414	2,294
	N	70,843	72,072	1,770,645	1,777,855	272,875,086	275,109,457	154	155
	R	5,469	5,484	40,128	40,367	6,776,156	6,724,380	169	167
	Total	74,542	74,394	1,816,155	1,821,692	292,641,602	289,807,375	161	159
Galicia	E	8,045	7,419	9,406	8,733	17,336,678	15,979,305	1,843	1,830
	N	38,346	38,441	326,037	323,276	89,149,132	89,038,594	273	275
	R	34	34	118	119	24,144	23,896	205	201
	Total	44,927	44,384	335,561	332,128	106,509,953	105,041,795	317	316
Madrid	E	487	281	838	485	2,600,477	1,492,113	3,103	3,077
	N	7,347	7,522	208,888	206,328	25,373,687	26,036,951	121	126
	R	887	886	6,735	6,732	1,133,573	1,117,406	168	166
	Total	7,825	7,791	216,461	213,545	29,107,738	28,646,470	134	134
Murcia	E	1,265	1,149	2,148	2,105	6,691,748	6,616,168	3,115	3,143
	N	8,684	8,784	87,046	88,001	20,460,586	20,627,246	235	234
	R	448	448	4,554	4,588	522,437	523,396	115	114
	Total	9,888	9,869	93,748	94,694	27,674,771	27,766,810	295	293
Navarra	E	1,323	804	2,140	1,481	5,983,308	4,574,907	2,796	3,089
	N	17,467	17,703	304,252	308,189	58,695,367	59,784,046	193	194
	R	2,772	2,745	16,269	16,303	3,236,283	3,194,453	199	196
	Total	18,734	18,456	322,661	325,971	67,914,957	67,553,405	210	207
País Vasco	E	5,009	3,894	5,909	4,757	8,090,443	7,079,152	1,369	1,488
	N	6,739	7,757	123,713	124,438	22,794,503	23,738,207	184	191
	R	1,030	962	4,873	4,854	1,187,289	1,164,538	244	240
	Total	11,715	11,597	134,495	134,049	32,072,235	31,981,897	238	239
La Rioja	E	364	245	615	449	1,922,834	1,507,922	3,127	3,358
	N	6,646	6,668	117,654	116,400	16,380,931	16,739,582	139	144
	R	529	516	2,641	2,633	549,197	537,512	208	204
	Total	6,978	6,889	120,910	119,482	18,852,962	18,785,016	156	157
Valencia	E	1,316	1,150	1,926	1,740	5,434,117	4,883,110	2,821	2,806
	N	53,265	53,344	187,519	185,738	40,131,454	39,830,089	214	214
	R	320	324	2,103	2,104	342,557	337,719	163	161
	Total	54,487	54,397	191,548	189,580	45,908,128	45,050,918	240	238
TOTAL	E	47,454	34,156	65,043	47,741	159,206,869	116,091,311	2,448	2,432
	N	820,418	828,934	14,941,229	15,052,237	3,246,197,199	3,289,757,919	217	219
	R	85,050	84,218	703,665	714,561	117,742,317	117,674,504	167	165
	Total	864,078	859,700	15,709,937	15,814,513	3,523,146,385	3,523,523,735	224	223

<sup>a</sup> E: Special entitlements, N: normal entitlements, R: withdrawal entitlements. <sup>b</sup> This amount should be reduced a 4% of the modulation and «other reasons» for obtaining the real payments of the SPS in 2007 shown in Table 1. *Source:* Own performance from data provided by FEAGA (2006, 2007b).

(for livestock bonuses received by farms without a surface area basis), was €2,447.72.

In 2006, there were a total of 864,078 beneficiaries who received aids, most of which were normal entitlements

that amounted to 820,418, while there were 859,700 beneficiaries in 2007.

The total number of definitive entitlements in the 2006 Campaign was 15,709,937, of which 65,043 corres-

ponded to special entitlements, 14,941,229 to normal entitlements and 703,665 to withdrawal entitlements. In 2007, the total number of definite entitlements rose slightly to 15,814,513.

Non-usage of the entitlements assigned in 2006 was 2.94%, a percentage which went down to 1.21% in 2007.

Few variations were observed in 2007. The average value of the assigned entitlement was slightly lower, €222.8. The same occurred with the special entitlements and the withdrawal entitlements whose values were €164.68 and €2,431.69, respectively. On the other hand, the value of the normal entitlements increased slightly to the amount of €218.56.

Large differences exist among the ACs, as Figure 1 shows. The average entitlement value in Spain in 2006 was €224.26. The lowest entitlement value went to the Madrid Community, €134.47, while the highest entitlement value of €385.82 was received in Andalusia. Canary Islands are not included at Figure 1 since they are not affected by the SPS (see Table 2).

A similar situation took place with normal entitlements, whose lowest and highest values were €384.66 and €121.47, respectively, for the same two ACs. This situation was seen once more in 2007. The average value of entitlements was €222.8; the highest value

was noted in Andalusia (€380.73) while the lowest was reported in Madrid (€134.15).

With regard to special entitlements, Aragon received the highest average values with €3,402.56 in 2006 and €3,508.14 in 2007, which is possibly a result of this AC having a highly developed livestock sector.

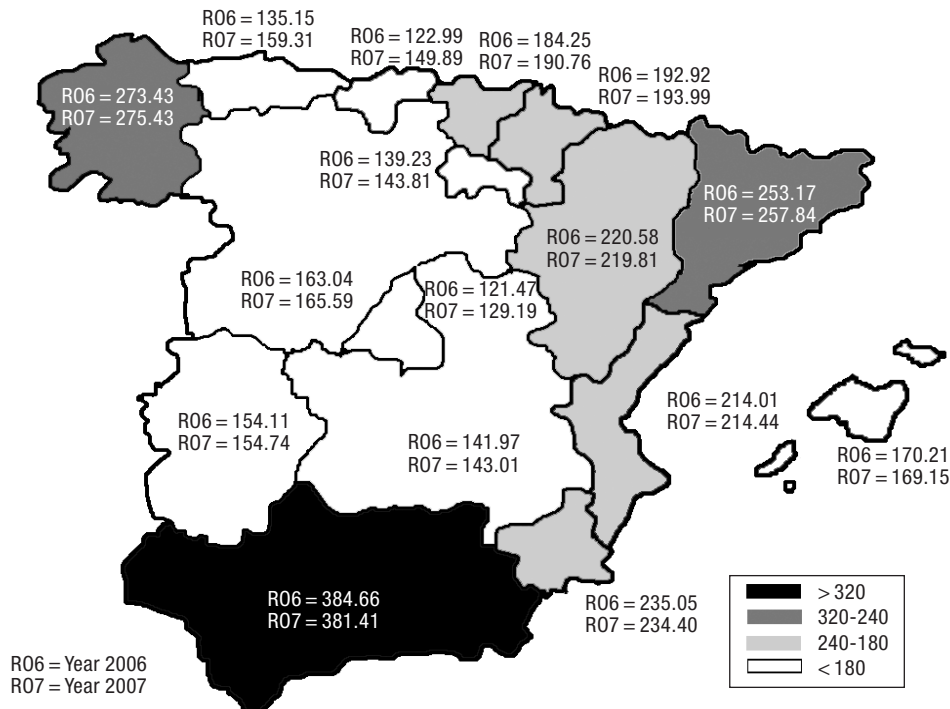
### Method and sources of information

The methodology used to explain the factors that determine the differences of entitlement rent (R) among the ACs was Pearson's coefficient correlation.

In addition, the fair value of entitlements (P) (bonds) was estimated by applying the Program Evaluation and Review Technique-Time (PERT-Time) methodology (Suárez, 2007). This method applies different distribution functions: rectangular, triangular, beta and, more recently, trapezoidal (Herrerías *et al.*, 1999, 2003; Van Dorp *et al.*, 2007).

This value (P) will depend on the possession, or not, of land. So, there are two possibilities:

- If an applicant does not own land:  $P = 0$ , so the rent (R) is null.
- If an applicant owns the land: the financial features of the entitlements are similar to bonds. Financial



**Figure 1.** Distribution of the average value of entitlements (R) by Autonomous Communities in 2006 and 2007.

assets exist where rents are known and constant. The theoretical market value of the entitlement may be expressed by the expression known in the financial world of capitalisation of rents (Suárez, 2007):

$$P_t = \frac{R_1}{(1+k)^1} + \frac{R_2}{(1+k)^2} + \dots + \frac{R_n + P_n}{(1+k)^n} = \sum_{i=1}^n \frac{R_i}{(1+k)^i} + \frac{P_n}{(1+k)^n} \quad [1]$$

where  $P_t$  = the theoretical value of the entitlement in year  $t$  or at the time of valuation;  $R_i$  = rent<sup>3</sup> to receive in year  $i$ ;  $P_n$  = the expected value of the entitlement traded in year  $n$ ;  $n$  = the number of years of the entitlement has been possessed;  $k$  = the interest rate, which is constant every year.

As the entitlement rent,  $R$ , is practically constant every year and given the hypothesis that the entitlement is in the owners' hands until it expires, equation [1] would be as follows:

$$P_t = R * \sum_{i=1}^n \frac{1}{(1+k)^i} = R * \sum_{i=1}^n \epsilon^i \quad [2]$$

where  $\epsilon$  is the discount rate.

In accordance with the current CAP regulation, rent  $R$  is only known and certain until 2013. After 2013, any risk will have to be considered. It is possible that the entitlement value will decrease, or we may even be pessimistic and contemplate the CAP disappearing, which would imply farmers not receiving any aids. Therefore, the annual rent to receive for entitlements is considered a random variable  $D_t^r$  after 2013.

The expression [2], therefore, is:

$$P_t = R * \epsilon^1 + \dots + R * \epsilon^{2013-t} + D * \epsilon^{2013-t+1} + D * \epsilon^{2013-t+2} \dots + D * \epsilon^{2013-t+v} \quad \text{if } 2006 \leq t \leq 2013$$

$$P_t = D * \epsilon^1 + \dots + D * \epsilon^{v-t} \quad \text{if } 2014 \leq t \leq n \quad [3]$$

where  $v$  is the number of years the entitlement is expected to continue beyond 2013, that is, the estimated period of risk.

$R$  is perfectly determined and  $D$  is the random variable  $D_t^r$  under the hypothesis of a rectangular distribution function where all the possible values are

between the minimum and maximum values ( $D_t^p, D_t^0$ ). Therefore, they have the same probability (Suárez, 2007). Such a distribution has the following density function:

$$f(D_t^r) = 0 \quad \text{if } D_t^r \leq D_t^p$$

$$f(D_t^r) = \frac{1}{D_t^0 - D_t^p} \quad \text{if } D_t^p < D_t^r < D_t^0 \quad [4]$$

$$f(D_t^r) = 0 \quad \text{if } D_t^r \geq D_t^0$$

The mean and the variance are shown by the following expressions:

$$E[D_t^r] = \frac{D_t^p + D_t^0}{2} \quad [5]$$

$$\sigma^2(D_t^r) = \frac{(D_t^0 - D_t^p)^2}{12} \quad [6]$$

From a financial perspective, farming entitlements may be considered bonds. This similarity makes it convenient to capitalise annual entitlement rents at the same rate of interest as bonds (10-30 years).

In the same way as evaluating land, the interest rate while evaluating entitlements may vary in the short or long term (Wong *et al.*, 2008). Accordingly, the interest rate risk considered is estimated as a random variable,  $k_t^r$ , which may vary in the numerical range ( $k_t^p, k_t^0$ ) in accordance with a density function  $f(k_t^r)$  (Pérez, 1992, 1997).

Obviously, the discount rate  $\epsilon_t^r = \frac{1}{1+k_t^r}$  will also be a random variable, and it will present values between the numerical interval  $\left[ \frac{1}{1+k_t^0}, \frac{1}{1+k_t^p} \right]$ .

In this particular case, triangular distribution was considered followed by  $k_t^r$  with a modal  $k_t^m$  value as there was enough information available to model it, it was more operative than the beta distribution (Romero, 1977; García *et al.*, 1999; Caballer, 2008) and fits the historic values better than the rectangular distribution.

If discount rate  $k_t^r$  is adjusted to the triangular model, its density function is:

<sup>3</sup> In financial terms, the hypothesis that incomes and payments are at the end of the year has always been considered. This explains why the rent of the first year is updated.



$$\begin{aligned}
f(k_i^r) &= 0 \quad \text{if } k_i^r < k_i^p \\
f(k_i^r) &= \frac{2(k_i^r - k_i^p)}{(k_i^m - k_i^p)(k_i^0 - k_i^p)} \quad \text{if } k_i^p < k_i^r \leq k_i^m \\
f(k_i^r) &= \frac{2(k_i^r - k_i^0)}{(k_i^m - k_i^0)(k_i^0 - k_i^p)} \quad \text{if } k_i^m \leq k_i^r < k_i^0 \\
f(k_i^r) &= 0 \quad \text{if } k_i^r > k_i^0
\end{aligned} \tag{7}$$

Pérez (1997) showed that the density function of the discount factor  $\varepsilon_i^r$  to be as follows:

$$\begin{aligned}
f(\varepsilon_i^r) &= 0 \quad \text{if } \varepsilon_i^r < \frac{1}{1+k_i^0} \\
f(\varepsilon_i^r) &= \frac{2}{(k_i^0 - k_i^m)(k_i^0 - k_i^p)} \frac{1}{(\varepsilon_i^r)^2} \left[ (1 - k_i^0) - \frac{1}{\varepsilon_i^r} \right] \\
&\quad \text{if } \frac{1}{1+k_i^0} < \varepsilon_i^r \leq \frac{1}{1+k_i^m} \\
f(\varepsilon_i^r) &= \frac{2}{(k_i^m - k_i^p)(k_i^0 - k_i^p)} \frac{1}{(\varepsilon_i^r)^2} \\
&\quad \text{if } \frac{1}{1+k_i^m} \leq \varepsilon_i^r \leq \frac{1}{1+k_i^p} \\
f(\varepsilon_i^r) &= 0 \quad \text{if } \varepsilon_i^r > \frac{1}{1+k_i^p}
\end{aligned} \tag{8}$$

The mean and variance may be expressed as:

$$\begin{aligned}
E[\varepsilon_i^r] &= \frac{2}{k_i^0 - k_i^p} \left[ \frac{k_i^0 + 1}{k_i^0 - k_i^m} \text{Ln} \left( \frac{1+k_i^0}{1+k_i^m} \right) - \right. \\
&\quad \left. - \frac{k_i^p + 1}{k_i^m - k_i^p} \text{Ln} \left( \frac{1+k_i^m}{1+k_i^p} \right) \right] \\
\sigma^2[\varepsilon_i^r] &= \frac{2}{k_i^0 - k_i^p} \left[ \frac{1}{k_i^m - k_i^p} \text{Ln} \left( \frac{1+k_i^m}{1+k_i^p} \right) - \right. \\
&\quad \left. - \frac{1}{k_i^0 - k_i^m} \text{Ln} \left( \frac{1+k_i^0}{1+k_i^m} \right) \right] - \\
&\quad - \left\{ \frac{2}{k_i^0 - k_i^p} \left[ \frac{k_i^0 + 1}{k_i^0 - k_i^m} \text{Ln} \left( \frac{1+k_i^0}{1+k_i^m} \right) - \right. \right. \\
&\quad \left. \left. - \frac{k_i^p + 1}{k_i^m - k_i^p} \text{Ln} \left( \frac{1+k_i^m}{1+k_i^p} \right) \right] \right\}^2
\end{aligned} \tag{9}$$

The information sources and the data used in the study to explain the normal entitlements rent for 2006 and 2007 per AC have been obtained from different sources. The regressions of the empirical studies conducted to account for land value in Spain, as cited earlier, in the United States (Xu *et al.*, 1993; Barnard *et al.*, 1997; Shi *et al.*, 1997) include variables related to the farms' characteristics (size), some which account for agricultural productivity (temperature, rainfall), and others with no agricultural influence given their possible alternative uses (tourism, demographic pressure, location), and others of an economic kind (inflation, taxes, salaries). Consequently, the data have been divided into four groups of variables, climatic features, economic context, location and demography, which are shown as follows:

### Climatic features

**Rainfall ( $X_1$ ):** the average annual rainfall (in mm) of each AC for the period 1971-2000. This information was obtained from the Food and Agriculture Statistics Year Book in Spain of 2006, published by the Spanish Ministry of Agriculture, Fishery and Food (www.marm.es; MAPA, 2006a). It has a constant value for each year.

**Average temperature ( $X_2$ ):** measured by the annual temperature (in °C) of each AC over the period 1971-2000. This information was also obtained from MAPA (2006a). It is a constant value for each year.

### Economic context

**Price of non-subsidised housing ( $X_3$ ):** a registry of the price per square metre for the third quarter of 2006 and 2007 of each AC. This information was obtained from the Spanish Ministry of Housing (www.mviv.es).

**Beds in hotels ( $X_4$ ):** a registry of the number of estimated beds in hotels of each AC for 2006 and 2007. The data were obtained from the Spanish National Statistics Institute (INE, www.ine.es).

**Number of apartments ( $X_5$ ):** a registry of the number of estimated beds in tourist apartments in each AC for 2006 and 2007. The data were obtained from the INE.

**Consumers price index ( $X_6$ ):** the variation of an annual index of consumer prices for each AC, for 2006 and 2007. The data were obtained from the INE.

**Interest rate ( $X_7$ ):** is published by the Exchequer ([www.tesoro.es](http://www.tesoro.es)).

**Occupational population in the agrarian sector ( $X_8$ ):** the rate of employment in each AC. It is presented as a percentage which is calculated as the total number of the working population in the agrarian sector over the total number of the working population for each AC in 2006 and 2007. The data were obtained from the INE.

**UAA ( $X_9$ ):** this is calculated in hectares for each AC. The data were obtained from the INE.

**Rural property tax /UAA ( $X_{10}$ ):** a total tax liability paid per hectare of the UAA in 2006. This value was estimated by the information provided by the State Property Registry of the Spanish Ministry of Economy and Finance and INE. Each AC presents a value.

**Land value per crop ( $X_{11}, \dots, X_{18}$ ):** the average land value in each AC was obtained from the survey of land prices published yearly by MAPA (2006b, 2007). Crops included dry lands ( $X_{11}$ ), irrigated lands ( $X_{12}$ ), dry land-transformed vineyards ( $X_{13}$ ), irrigation-transformed vineyards ( $X_{14}$ ), dried fruits grown on dry lands ( $X_{15}$ ), irrigation-transformed olive groves ( $X_{16}$ ), pastures ( $X_{17}$ ), and meadowlands ( $X_{18}$ ).

**Size of farms ( $X_{19}$ ):** this data was obtained by dividing the UAA by the number of farms (MAPA, 2006c).

## Geographical location

**Coastlines ( $X_{20}$ ):** calculated by the number of kilometres of coastline in each AC.

**Surface area of the ACs ( $X_{21}$ ):** the surface area of each AC is presented as km<sup>2</sup>.

## Demography

**Population Density ( $X_{22}$ ):** the number of inhabitants in the AC divided by the surface area of each AC presented as km<sup>2</sup>. This information was derived from the INE and was only available for 2001 since farming censuses are done only once every 10 years.

The values of the **annual rents per entitlement ( $X_{23}$ )** are those previously shown in Table 2.

Finally, a matrix was created with 23 columns or variables, and 32 rows or observations corresponding to the 16 ACs affected by the SPS in the years 2006 and 2007.

## Results

The statistically significant variables of 99% and 95% over the entitlements values are shown in Table 3. The non-significant variables have been omitted.

The price of olive groves shows a high correlation with the rents of normal entitlements for the years 2006 and 2007 and, to a lesser extent, with the price of irrigation land. This influence is due to the fact that the SPS-granted entitlement rents are estimated by considering historical subsidies which were mainly based on land productivity. The second factor in this correlation is the rural property tax. These taxes are higher on the more productive lands and entitlement values are also higher. In third place we find hotel occupancy. The ACs with more tourism, as a non-agricultural influence, more coastline and warmer temperatures, which lead to greater land productivity, are characterized by higher average values, just as the cited literature depicts. Finally, the surface area of each AC has a positive effect on the average value of normal entitlements, although this happens to a lesser extent in Andalusia and Castile-Leon.

In terms of estimating the theoretical market value of entitlements in Spain, it was assumed that one entitlement had an annual average rent value of €217.26 (see Table 2). The minimum, maximum and modal values of the discount rate have been established at 4.87%, 11.45% and 5.5%, respectively, according to the historical database from 1992-2008 published by the Exchequer.

A risk period time horizon is also considered and consists of 8 additional years beyond 2013, which takes us to 2021.

**Table 3.** Results of the Pearson's correlation coefficient with the «Normal Entitlements» variable for 2006/2007

Explanatory variable	Coefficient <sup>1</sup>
Value of olive groves	0.812**
Rural property tax	0.712**
Beds in hotels	0.643**
Coastlines	0.612**
Value of irrigation land	0.439*
Surface area of the ACs	0.436*
Average temperature	0.430*
Number of apartments	0.413*

<sup>1</sup> \*, \*\*: The correlation is significant at the level of 0.05 and 0.01 respectively (bilateral).

**Table 4.** Development of the theoretical value of the entitlement related to the annual average rent of €217.26 and a time horizon considered (2021)

Years	Rent (R and D)	Value in € of the entitlements (P)	Variance of P	Standard deviation of P	Variation coefficient (%)
2006	217	1,771	523	23	1
2007	217	1,667	593	24	1
2008	217	1,555	673	26	2
2009	217	1,434	765	28	2
2010	217	1,305	871	30	2
2011	217	1,167	993	32	3
2012	217	1,019	1,134	34	3
2013	217	860	1,295	36	4
2014	109	689	1,487	39	6
2015	109	622	1,708	41	7
2016	109	551	1,962	44	8
2017	109	474	2,255	47	10
2018	109	392	2,591	51	13
2019	109	304	2,977	55	18
2020	109	210	3,422	58	28
2021	109	109	3,933	63	58

The stochastic independence of the D' and  $\epsilon$  variables is assumed, whose means and variances are known: €109 and 0.9323 for the means and 3,933 and 0.0002 for the variances, respectively. These figures have been estimated according to the expressions [5], [6], [9] and [10], and by applying the known relationships for the addition and product of random variable (see Table 4 for the results).

The theoretical average market value of a normal entitlement in Spain in 2006 (the first year of entitlements) was €1,771, which reduces over time given its hypothetical existence until 2021, and whose value is the same as the rent of that year. In contrast, the risk increases over time with a variation coefficient from 1% to 58% in 2021.

Obviously, the value of those entitlements whose annual rent is higher than the annual average rent will be higher than the estimated value shown in Table 4, and vice versa.

## Conclusions

The CAP of 2003 has meant an important change in the way direct aids are received. The SPS consists in assigning entitlements to farmers which become a subsidy or annual rent. The single payment method adopted has been the historical model. Farmers receive a single payment per land. The single payment is

estimated by the mean aid received during the three-year period 2000/2001/2002, and important differences are noted among the ACs. As a result of the SPS, the ACs with more olive groves and irrigated lands, greater tourist development and warmer temperatures present higher average entitlement rent values.

In contrast, the fact that land entitlement became independent has brought about a new market of entitlements whose theoretical value can be estimated analogically with estimations of bonds. The application of the PERT method has conveniently introduced a risk factor into the proposed valuation model which is presented in two different ways: firstly in relation to the entitlement rent due to the uncertain future of the CAP after 2013, and secondly in relation to risk concerning the interest rate in the bonds market of recent years. Consequently, the theoretical market value of the entitlement decreases over time and its value will depend on not only the rent associated with the entitlement, but also on the time horizon considered.

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