Paper presented at the 2013 IATRC Symposium "Productivity and Its Impacts on Global Trade",
2-4 June 2013, Seville, Spain

The influence of agricultural support on sale prices of French farmland: A comparison of different subsidies, accounting for the role of environmental and land regulations

Laure Latruffe [a,b], Laurent Piet [a,b], Pierre Dupraz [a,b], Chantal Le Mouël [a,b]

[a] INRA, UMR1302 SMART, F-35000 Rennes, France

[b] Agrocampus Ouest, UMR1302 SMART, F-35000 Rennes, France

Corresponding author:

Laure Latruffe

INRA UMR SMART, 4 Allée Bobierre, CS 61103, 35011 Rennes cedex, France

Email address: Laure.Latruffe@rennes.inra.fr

Financial support from FP7 project Factor Markets (Comparative Analysis of Factor Markets for Agriculture across the Member States) grant agreement n°245123-FP7-KBBE-2009-3 is acknowledged.

The authors are grateful to Sylvain Cariou for his help in processing the data.

The influence of agricultural support on sale prices of French farmland:

A comparison of different subsidies, accounting for the role of environmental and land regulations

Abstract

We investigate the determinants of agricultural land price in several regions in France over the period 1994-2011 using individual plots transaction data, with a particular emphasis on agricultural subsidies and nitrate zoning regulations. We found a positive but relatively small capitalisation effect of the total subsidies per hectare. We found evidence that agricultural subsidies capitalised at least to some extent. However, the magnitude of such a capitalisation depends on the region considered, on the type of subsidy considered, and on the location of the plot in a nitrate surplus zone or not. Only land set-aside premiums significantly capitalise into land price, while single farm payments have a significant positive capitalisation impact only for plots located in a nitrate surplus zone.

Keywords

Farm land price; agricultural subsidies; capitalisation; regulations; nitrate surplus area; France

1. Introduction

The influence of agricultural subsidies on farm land prices is a question that has attracted a large body of research in the economic literature. The main issue is whether, and by how much, the subsidies increase agricultural land prices. A positive influence on price would indeed reveal that part of the subsidies are capitalised into land prices, indicating that land owners are beneficiaries of part of the public support, while it is in general not intended by governments. While this leakage of public funds to potentially non- or former-agricultural stakeholders instead of supporting active farmers' income is problematic, the increase of land prices caused by subsidies is, in addition, detrimental to young farmers willing to settle.

The literature is relatively consistent regarding the empirical evidence of the capitalisation of public subsidies into land prices. For example, Latruffe and Le Mouël (2009) provided a review of the existing empirical studies, and concluded that in the empirical literature government subsidies are major contributors to agricultural land price increases, and are generally found to account for 15-30% of the price of land.

This article aims at contributing to the empirical literature about the capitalisation of public subsidies in farm land sale prices, using a unique database of land transactions for several French regions in the period 1994-2011. Our contribution is threefold.

Firstly, we provide a recent analysis of the capitalisation of agricultural subsidies into land sale prices in France. With the exceptions of Goodwin and Ortalo-Magné (1992) and Cavailhès and Degoud (1995), no studies have investigated the effect of public support on agricultural land prices in France. Goodwin and Ortalo-Magné (1992) found a positive effect of wheat producer support estimate (PSE) on farm land prices in various regions in the United States, Canada and France (NUTS2[1] regions Centre and Picardie) over the period 1979-1989. Cavailhès and Degoud (1995) gave evidence of the capitalisation of support from the 1992 Common Agricultural Policy (CAP) reform in agricultural land prices in France. Moreover, theoretical studies such as Dewbre et al. (2001), Courleux et al. (2008), Kilian and Salhofer (2008) or Ciaian and Kancs (2012) consider the rental market of land and not the sale market.

Secondly, we consider several types of subsidies. The extended period 1994-2012 enables taking into account various forms of subsidies since their introduction, including rural development subsidies and Single Farm Payment (SFP). The existing studies generally focus on the total amount of subsidies provided to the agricultural sector or on one type of subsidies only. It could however be expected that different subsidies contribute differently to increasing land prices due to their different objective and implementation scheme and schedule. One can cite the study of the effect of direct payments on farm land rentals in Northern Ireland in 1994-2002 by Patton et al. (2008), who found that less favoured area (LFA) payments had a stronger positive impact on rentals than sheep premiums and beef and suckler cow premiums. These authors also provided evidence of a negative impact of slaughter premiums. Based on experts' opinions, Latruffe et al. (2008) indicated that in France in 2003-2007 the impact of various types of public support on agricultural land prices was differentiated, ranging from weak positive impact (SFP and coupled payments) to no impact (rural development payments including environmental payments and LFA payments).

Thirdly, we investigate the issue of public support capitalisation taking into account the fact that the market for farm land is affected by regulations, relating to land or not. As stressed by Latruffe and Le Mouël (2009) the influence of government support in farm land prices depends on the "land management laws and policies" in force in the region considered, as such regulations may affect the degree of land mobility between alternative land uses. These include, for example, prohibited land ownership for specific entities, regulated prices and pre-emptive rights for specific buyers (Ciaian et al., 2012). In France in particular, land regulations are among the strongest in Europe (Van Herck et al., 2012). Zoning regulations are also policies that may restrict the mobility of land uses. Considering the French NUTS2 region of Brittany as a case study, Latruffe et al. (2013) give evidence of a positive impact on agricultural land prices of zoning in the frame of the Nitrate Directive regulation.

The paper is organised as follows. Section 2 describes the case study regions and the land price database that we used. Section 3 specifies the estimation methodology implemented. In section 4 estimation results are analysed. Finally section 5 concludes.

2. The case study regions and the land price database

2.1. The case study regions

We use data from individual land sale transactions in several regions in France. These regions are very different in terms of farm structures and production specialisations and therefore in terms of main subsidies received, but also in terms of non-agricultural pressure on land. Figure 1 shows the studied regions' location in France and their main agricultural productions in 2010. Table 1 provides some characteristics for the regions in 2010, as well as a comparison to France as a whole.

- Brittany is a NUTS2 region located in Western France consisting of four NUTS3 sub-regions. The region has a strong agricultural character, with 61.8% of the region area being utilised agricultural area (UAA), compared to the French average of 51.4%. The farming structures are characterised by medium-size farms (47.6 hectares), young farmers, and dairy and granivores as main types of farming.

[1] The Nomenclature of Territorial Units for Statistics (NUTS) provides a single uniform breakdown of territorial units for the production of regional statistics for the EU. In France, NUTS2 corresponds to the French administrative regions ("régions"), NUTS3 corresponds to the French administrative sub-regions ("départements") and NUTS4 corresponds to the French administrative districts ("cantons"). France (excluding overseas territories) consists of 22 NUTS2 regions and 96 NUTS3 regions.
(source: http://epp.eurostat.ec.europa.eu/portal/page/portal/nuts_nomenclature/introduction).

A large part of the region's area is built land or other types of developed land. The urban and agricultural pressures on agricultural land are stronger in Brittany, due to its attractiveness for new inhabitants and for tourism, and due to the important livestock dejections which urge farmers to find manure spreading surfaces.

- Limousin, a NUTS2 region in Central France consisting of three NUTS3 sub-regions, is characterised by hilly landscape and cattle (beef and sheep) raising. A large part of the region's area is covered with permanent grass. Farms are middle-sized and own a larger share of their land, on average, than in the rest of France. They received on average more coupled direct payments to crops and livestock, in particular due to the suckler cow premium, and more LFA and agri-environmental payments to extensive grazing livestock, than in NUTS2 Brittany.

- Meuse is a NUTS3 region in Eastern France. As it is a NUTS3 region, compared to NUTS2 regions Brittany and Limousin, it has a smaller area and fewer farms. Farms are on average large (110.6 hectares) and tenanted. Field crop production, in particular production of cereals, oilseeds and protein crops prevails, followed by dairy farming. Arable and pasture land is on average less expensive than in the two other regions studied.

France has applied a two-stage zoning based on the European Nitrate Directive. Municipalities are first classified as belonging to a vulnerable zone or not. In such zones, the use of land for specific purposes may be prohibited, and farming practices may be restricted. The second stage, the nitrate surplus zoning (acronym ZES, for French "*zone d'excédent structurel*") which includes municipalities where nitrate from livestock source exceeds 170 kg per hectare of UAA, imposes stricter regulations. Brittany is affected by livestock pollution, resulting in the whole region classified as a vulnerable zone, and half of its municipalities coming under the nitrate surplus zoning. By contrast, NUTS3 Meuse is only partly classified in vulnerable zone (48% of its municipalities) but is not concerned by the nitrate surplus zoning, and NUTS2 Limousin is not classified in either zoning.

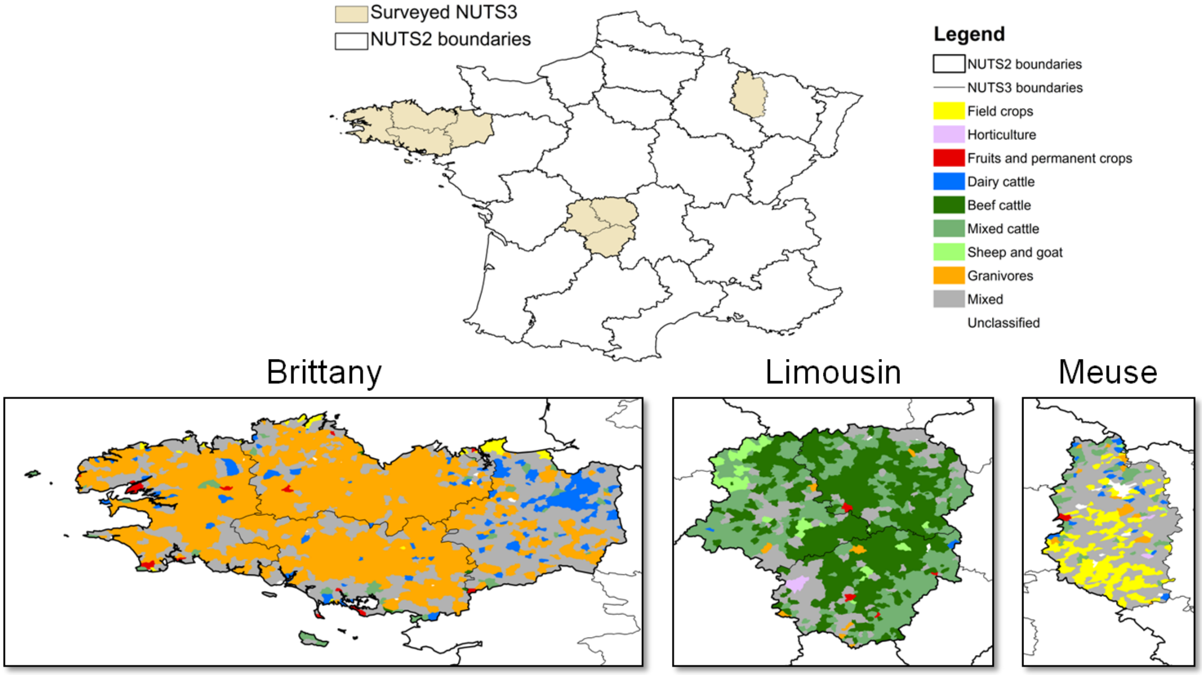
Table 1: Descriptive statistics of the case study regions and comparison to France in 2009, 2010 or 2012

	France	NUTS2 region Brittany	NUTS2 region Limousin	NUTS3 region Meuse
Average population density (inhabitants per square kilometre) [a]	114.0	116.7	43.8	31.2
Area (hectares) [b]	54,219,946	2,750,640	1,705,841	621,319
Share of UAA (cultivated land and permanent grassland) in area (%) [b]	51.4	61.8	49.6	56.4
Share of permanent grassland in area (%) [b]	17.2	9.4	35.2	16.6
Share of developed land in area (%) [b]	8.9	12.4	7.0	3.9
Share of municipalities located in vulnerable zone in 2012 (%) [c]	n.a.	100	0	48.0
Share of municipalities located in nitrate surplus zone in 2012 (%) [c]	n.a.	50.3	0	0
Number of farms [d]	489,977	34,447	14,641	2,975
Average UAA per farm (hectares) [d]	55.0	47.6	57.3	110.6
Share of UAA that is owned (%) [d]	23.3	22.5	37.5	13.8
Share of farmers aged 60 years or more (%) [d]	22.0	11.9	20.3	19.7
Shares of farms according to main production (%) [d]:				
Cereals, oilseeds and protein crops	17.3	9.4	2.4	29.0
Dairy	10.3	29.6	3.1	10.9
Beef cattle	12.1	7.5	49.5	6.7
Sheep and goat	6.2	2.4	13.8	4.8
Pork and poultry	4.3	19.0	2.3	1.5
Average subsidies per hectare of UAA (Euros) [b,e]:				
CAP first-pillar coupled direct payments to crops and herds	33.5	13.0	106.3	17.3
CAP first-pillar decoupled SFP	245.1	308.6	194.8	254.4
CAP second-pillar LFA	19.1	0	50.0	0
CAP second-pillar agri-environmental payments to extensive grazing livestock	8.5	0.2	25.2	1.1
Total subsidies	334.5	350.8	403.3	290.4
Average price of non-built arable and pasture land for plots above 0.7 hectares (Euros per hectare) [f]:				
Land without a farmer tenant	5,120	4,660	5,770	3,930
Land with a farmer tenant	3,720	3,770	3,090	3,320

Note: "n.a." means not available.

Source: authors' calculations based on [a] 2009 French Statistical Office INSEE, [b] 2010 Teruti-Lucas, [c] official law, [d] 2010 agricultural census, [e] 2010 Statistique Agricole Annuelle, and [f] 2010 SAFER-SSP-Terres d'Europe-SCAFR-INRA (SAFER-Agreste, 2012). Figures for France exclude overseas territories.

Figure 1: Location and main types of farming of the regions studied



Source: authors' 2010 SSP agricultural census – ©IGN 2011, Geofla®

2.2. The land price database

The land price database that we used was obtained from notaries (the "PERVAL" database) and consists of all transactions of agricultural land that occurred in the regions over the period studied. We considered only arable and pasture land (that is to say we excluded vineyards), that was non-built, and already tenanted by a farmer or not. During the period studied, 1994-2011, about 1,600 transactions occurred per year in NUTS2 Brittany, 400 in NUTS2 Limousin and 300 in NUTS3 Meuse.

The variable of interest, land price, was expressed per hectare as the ratio of sale price to sold area. It was deflated by the consumer price index with base 100 in 1998. We excluded transactions where the sale price was zero. In addition, outliers for the sale price and the sold area were removed based on visual inspection.

Table 2 presents the descriptive statistics of the area sold and the land price in the database after exclusion of inconsistent data and outliers. Relating the number of transactions to the UAA in the region shows that, during the period studied, NUTS2 region Limousin had a less active agricultural land market: 7.8 transactions per 100 hectares of UAA occurred, while figures for NUTS2 Brittany and NUTS3 Meuse are respectively 16.6 and 14.1. In all regions considered, plots sold were on average 4.1 hectares large. Larger plots were sold on average in NUTS3 region Meuse (5.3 hectares) and smaller plots in NUTS2 region Brittany (3.14 hectares). The average price of land sold is 5,595 Euros per hectare in the whole sample. It is lower on average in NUTS2 region Limousin (4,229 Euros) and higher in NUTS3 region Meuse (6,573 Euros). Some very small parcels (as small as 0.0005 hectare) and some very expensive parcels (up to 198,378 Euros per hectare) were sold during the period.

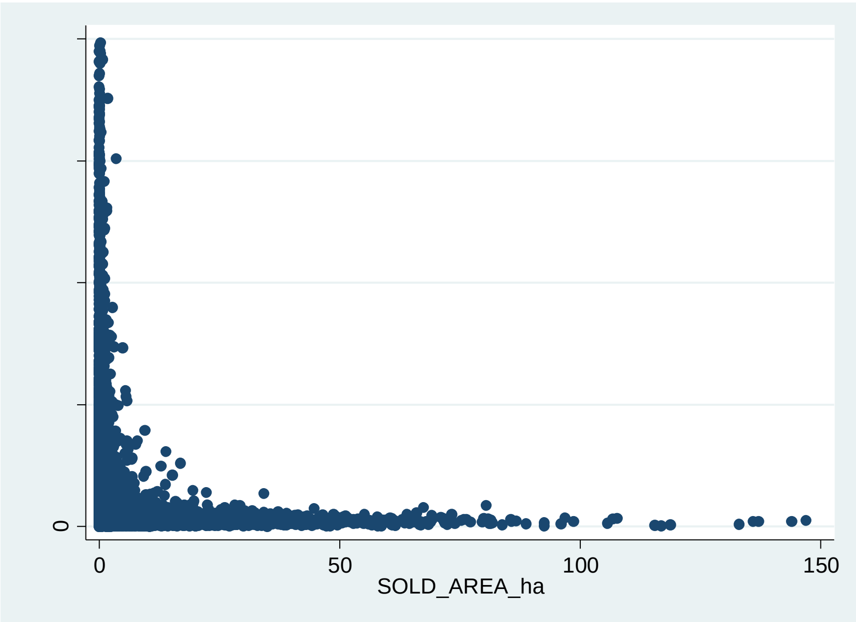
As shown by Figure 2, the smallest plots exchanged were sold at very high price, reflecting that future conversion to development use is highly probable for such plots. It is therefore meaningless to investigate the influence of agricultural subsidies on the price of those plots. For this reason, we restricted the database to plots with an area equal or above 10 hectares[2]. Table 3 presents the descriptive statistics of the area sold and the land price in this restricted database.

Table 2: Descriptive statistics of area sold and land price for all transactions over the period 1994-2011

	All regions together	NUTS2 region Brittany	NUTS2 region Limousin	NUTS3 region Meuse
Number of observations	39,749	28,209	6,594	4,946
Sold area (hectares)				
Average	4.1	3.4	4.6	5.3
Standard deviation	7.2	6.1	8.7	10.1
Minimum	0.0005	0.0005	0.0013	0.0007
Maximum	147.1	137.1	133.2	147.1
Price per hectare (Euros)				
Average	5,595	5,743	4,229	6,573
Standard deviation	12,640	12,700	10,353	14,756
Minimum	46	52	46	74
Maximum	198,378	198,379	185,017	195,014

Source: authors' calculations based on the notary land transactions' database PERVAL

Figure 2: Scatter plot of sale price per hectare and sold area in total sample



Source: authors' calculations based on the notary land transactions' database PERVAL

[2] We tried lower cutting values for the area but the regression results obtained were not significant in general and the R-squared were less than 5%.

Table 3: Descriptive statistics of area sold and land price for transactions of plots with a size equal or above 10 hectares over the period 1994-2011

	All regions together	NUTS2 region Brittany	NUTS2 region Limousin	NUTS3 region Meuse
Number of observations	4,285	2,772	774	739
Sold area (hectares)				
Average	19.9	18.4	22.3	22.6
Standard deviation	12.6	9.7	15.7	16.9
Minimum	10.0	10.0	10.0	10.0
Maximum	147.1	137.1	133.2	147.1
Price per hectare (Euros)				
Average	2,795	3,092	1,870	2,652
Standard deviation	1,591	1,675	1,267	1,105
Minimum	46	115	46	74
Maximum	30,639	30,639	13,247	13,800

Source: authors' calculations based on the notary land transactions' database PERVAL

The share of transactions of plots sized 10 hectares or more is 9.8% in NUTS2 Brittany, 11.2% in NUTS2 Limousin and 15.6% in NUTS3 Meuse. In all regions considered, plots sold with a size equal or above 10 hectares were on average 19.9 hectares large and priced 2,795 Euros per hectares. Smaller plots on average were sold in NUTS2 region Brittany (18.4 hectares against 22.3 and 22.6 in NUTS2 Limousin and NUTS3 Meuse respectively) but they were more expensive on average (3,092 Euros per hectare against 1,870 and 2,652 in NUTS2 Limousin and NUTS3 Meuse respectively).

Among others, the occupations of both the seller and the buyer are transaction characteristics which are available in the land sales database. From these data, and consistent with the figures provided by Courleux (2011) at the national level, it appears that two thirds of the plots are bought by farmers. In France specific private bodies have the public mission to regulate the transactions in order to limit price speculation, avoid farm fragmentation and favour young farmers' settlement. Each transaction is notified to these bodies, called the SAFER (French acronym standing for "*Sociétés d'Aménagement Foncier et d'Etablissement Rural*"), which operate at the NUTS3 level. If the SAFER reckons that the transaction is a threat to farm consolidation or settlement, or may be governed by price speculation, then it can stop the transaction. It then tries to convince the seller and buyer to change the transaction on an amicable basis, and, if not possible, it pre-empts the plot and has 5 years to sell it back at a lower price or to another buyer (for more details on the SAFER, see Latruffe and Le Mouël, 2006). In the PERVAL database, the SAFER intervenes (by buying or re-selling a plot) in 16% of the transactions.

The municipality where the plot is located is also available in the database PERVAL. It enables to relate each transaction to the agricultural subsidies and revenue estimated in the first stage of the analysis, and to other variables such as the municipality's demographic characteristics and the zoning it may come under.

3. Methodology and other data

3.1. First stage: estimation of agricultural revenue and subsidies

Data regarding agricultural subsidies and revenue are not directly available from public statistics at the municipality level but rather at the NUTS3 level. In order to use an approximation of subsidies received and revenue generated by farms in the municipality where the plot is located as explanatory variables in our land price regression, we performed a first stage estimation of subsidies and revenue.

On the opposite to subsidies and revenue, data regarding cultivated areas for crops and head numbers for herds are available at both levels, NUTS3 and municipality. Therefore, crop areas and livestock head numbers were used to reconstruct the subsidies and revenue at the municipality level with a two-step procedure: firstly, NUTS3 data were used to perform regressions; secondly, the resulting estimated coefficients were used to generate projections at the municipality level.

The first step was conducted as follows. At the NUTS3 level, agricultural subsidies and revenue were collected from the regional agricultural accounts database (or CRA, acronym for the French source "*Comptes Régionaux de l'Agriculture*"), and cultivated areas for crops and head numbers for herds were collected from the annual agricultural production survey (or SAA, acronym for the French source "*Statistique Agricole Annuelle*"). All variables at the NUTS3 level were extracted for the years 1994-2011. Six types of subsidies could be considered from the CRA database:

i) CAP first-pillar coupled direct payments to crops and herds (noted *CHP*);
ii) CAP first-pillar land set-aside premiums (*LSA*);
iii) CAP first-pillar decoupled single farm payments (*SFP*);
iv) CAP second-pillar least favoured area payments (*LFA*);
v) CAP second-pillar agri-environmental payments to extensive grazing livestock (*EGL*);
vi) total agricultural subsidies (*TOT*).

The only agricultural revenue variable available in the CRA database is the pre-tax profit, which includes subsidies. In order to avoid double counting, a pre-tax profit excluding subsidies was created by subtracting total agricultural subsidies (*TOT*) from the pre-tax profit available in the CRA database. The six subsidy variables $subs_{i,r}$ and the revenue variable rev_r were deflated by the consumer price index with base 100 in 1998. They were then regressed on crop areas and herd numbers as a system of stacked equations using the non linear Seemingly Unrelated Regression (SUR) estimator as follows:

$$\begin{cases} subs_{i,r} = \sum_c \alpha_{i,c} \times \left(area_{c,r}.\, d_{i,r}\right) + \sum_h \alpha_{i,h} \times \left(heads_{h,r}.\, d_{i,r}\right) + u_{i,r} \\ rev_r = \sum_c \beta_c \times area_{c,r} + \sum_h \beta_h \times heads_{h,r} + v_r \end{cases} \quad (1)$$

where i, r, c and h are indexes for, respectively, the six subsidy types (*CPH*, *LSA*, *SFP*, *LFA*, *EGL*, and *TOT*), NUTS3 regions, crops and herds; $d_{i,r}$ is a dummy variable with $d_{i,r} = 0$ if $subs_{i,r} = 0$ and $d_{i,r} = 1$ if $subs_{i,r} > 0$; $\alpha_{i,c}$, $\alpha_{i,h}$, β_c and β_h are the parameters to be estimated; and $u_{i,r}$ and v_r are standard error terms. Because subsidies are non negative, we imposed that $\alpha_{i,c} > 0$ and $\alpha_{i,h} > 0$ by actually estimating $a_{i,c} = \ln(\alpha_{i,c})$ and $a_{i,h} = \ln(\alpha_{i,h})$ rather than $\alpha_{i,c}$ and $\alpha_{i,h}$ as such.

The second step then consisted in using the estimated coefficients $\hat{\alpha}_{i,c} = \exp(\hat{a}_{i,c})$, $\hat{\alpha}_{i,h} = \exp(\hat{a}_{i,h})$, $\hat{\beta}_c$ and $\hat{\beta}_h$ to compute the subsidies and revenue projected at the municipality level:

$$\begin{cases} \widetilde{subs}_{i,m(r)} = \sum_c \hat{\alpha}_{i,c} \times \left(area_{c,m(r)}.\, d_{i,r}\right) + \sum_h \hat{\alpha}_{i,h} \times \left(heads_{h,m(r)}.\, d_{i,r}\right) \\ \widetilde{rev}_{m(r)} = \sum_c \hat{\beta}_c \times area_{c,m(r)} + \sum_h \hat{\beta}_h \times heads_{h,m(r)} \end{cases} \quad (2)$$

where $m(r)$ means that the municipality indexed by m is located in the NUTS3 region r. At the municipality level, the cultivated areas for crops and the head numbers for herds were collected from the agricultural census databases (or RA, acronym for the French "*Recensement de l'Agriculture*") for years 2000 and 2010.

Both steps were repeated for two sub-periods, 1994-2005 on the one hand and 2006-2011 on the other hand, for three reasons. Firstly, the CAP underwent an important reform in 2003, the Luxembourg agreement, which was implemented in France from 2006 onward (with, among other things, the introduction of the decoupled SFP and the abandonment of the land set-aside obligation); therefore, it seemed important to allow coefficients to vary from one sub-period to the other. Secondly, the nomenclature of crops and herds used in the SAA slightly differs from one sub-period to the other so that we could not always use the same regressors for the whole period. Thirdly, because the RA is conducted every ten years only, crop areas and herd numbers at the municipality level were available for 2000 and 2010 only; therefore, subsidies and revenue were projected thanks to the 2000 RA figures for the first sub-period and thanks to the 2010 RA figures for the second sub-period.

Finally, because, on the one hand, the nomenclature of crops and herds neither is fully consistent between SAA and RA and, on the other hand, a lot of product-specific data is missing at the municipality level for statistical secret reasons, the SUR estimations were conducted in two stages. A first set of crops and herds was identified in the SAA typology as regressors leading to the best SUR estimation results. Then, the system of equations was re-estimated with a subset of these regressors only, so that the NUTS3 level consolidated projections of subsidies and revenue were consistent with the original predicted figures, or, formally:

$$\begin{cases} \sum_{m(r)} \widetilde{subs}_{i,m(r)} \simeq \widetilde{subs}_{i,r} \equiv \sum_{c^*} \hat{\alpha}_{i,c^*} \times \left(area_{c^*,r}.\, d_{i,r}\right) + \sum_{h^*} \hat{\alpha}_{i,h^*} \times \left(heads_{h^*,r}.\, d_{i,r}\right) \\ \sum_{m(r)} \widetilde{rev}_{m(r)} \simeq \widetilde{rev}_{r} \equiv \sum_{c^*} \hat{\beta}_{c^*} \times area_{c^*,r} + \sum_{h^*} \hat{\beta}_{h^*} \times heads_{h^*,r} \end{cases} \tag{3}$$

where c^* and h^* constitute a subset of c and h respectively. Table A1 in Appendix reports the results of the SUR estimations for both sub-periods and with the best and optimal sets of crop and herd regressors.

3.2. Second stage: estimation of the determinants of land price

The dependent variable used for the second-stage estimation was the deflated price per hectare of agricultural land sold for plots with an area of 10 hectares or above. The explanatory variables which were expected a priori to influence land price are, firstly, the basic determinants of land price based on the present value model (Weersink et al., 1999; Plantinga and Miller, 2001; Goodwin et al., 2003): on the one hand, revenue from agricultural use, which is separated in a market-based component (*M*) and a government-based component (*G*); and, on the other hand, potential revenue from non-agricultural use. Both components of agricultural revenue, *M* and *G*, were estimated in the first stage. *M* was proxied by the projected pre-tax profit excluding subsidies which we call revenue. *G* was proxied by the projected subsidies separated in six categories as explained above: *CHP*, *LSA*, *SFP*, *LFA*, *EGL* and *TOT*. The total subsidy variable was included in one regression in order to explore the influence of all subsidies, while the five categories *CHP*, *LSA*, *SFP*, *LFA* and *EGL* were included in another regression in order to compare their respective capitalisation effect. In order to account for the size of the municipality, the revenue and subsidies variables were divided by the municipalities' UAA. All these variables representing income generated by land were expected to increase the price of land. Outliers for these variables were removed by visual inspection.

Potential revenue from non-agricultural use was not observed. For this reason, following the literature, we proxied it by two variables: the population density in the municipality where the plot is located, and a dummy indicating whether the municipality is part of an urban area or not[3]. We expected that both variables have a positive influence on the price of land, as they represent the potential opportunity to convert land for development.

In addition to these basic determinants, we controlled for the size of the plot sold, whether the buyer was a farmer, and the municipality's area. The expected influence of the first variable on the price of land was ambiguous. On the one hand, large plots may be highly valued due to economies of scale that may be generated during agricultural production; on the other hand, smaller plots may be more easily manageable and sellable, particularly in view of housing development. We expected that the buyer being a farmer should decrease the price of land as farmers are mostly interested to farm the land in the future rather than converting it to non-agricultural uses. The municipality's area was expected to decrease the land price, as a lower competition for land may occur in larger municipalities.

We considered regulations that may affect the price of agricultural land. The first regulation variable related to zoning based on the Nitrate Directive. The zoning dummy variable took the value one if the municipality was in the nitrate surplus zone, and the value zero otherwise. The second regulation variable considered took the value one if the seller or the buyer was a local SAFER, and zero otherwise. One objective of the paper is to investigate whether the capitalisation of subsidies is influenced by regulations. For this reason, we also tested the inclusion of the two regulation variables in interaction with the subsidy variables. However, based on non-significance, we included in the final model the zoning dummy interacted with the subsidies but not the dummy alone; also, we included the SAFER dummy variable alone but not its interaction with the subsidies.

---

[3] The information is rarely available. The most recent information is from 2010 and is used for all years 1994-2011. An urban area is defined as an area providing at least 10,000 jobs.

Finally, we included year dummies and NUTS3 region dummies, but we do not report the corresponding results.

Table 4 presents descriptive statistics of the explanatory variables used in the land price regression for the sample considered (plots with size equal or above 10 hectares) during the whole period 1994-2011. The average projected agricultural revenue per hectare of UAA in the municipality where the plot is located was 218 Euros, a positive value which is mainly due to the high value in NUTS2 Brittany (345 Euros, against 49 and -86 Euros in NUTS2 Limousin and NUTS3 Meuse respectively). The level of total subsidies was, by contrast to the revenue, more homogenous across the three regions considered: between 218 and 248 Euros per hectare of UAA in the municipality. LFA payments and agri-environmental payments for extensive grazing livestock (*EGL*) were present almost only in NUTS2 Limousin. NUTS2 Brittany is highly populated, and this is confirmed by the municipalities' population density and the share of municipalities located in urban areas, which were much higher in this region compared to the other two regions. Also, as mentioned above, NUTS2 Brittany is affected by livestock pollution and the whole region is classified as vulnerable zone. Regarding the nitrate surplus zoning, 60% of the municipalities of the database were in such a zone. Two thirds of the municipalities of NUTS3 Meuse sample were classified in vulnerable zone and none in nitrate surplus zone, and no municipalities of NUTS2 Limousin sample were classified in either zoning. Plots were mainly purchased by farmers (two thirds of the transactions), and the SAFER bodies intervened in 16% of the transactions (by purchasing or re-selling land).

Table 4: Descriptive statistics of the explanatory variables used in the land price regression for plots with size equal or above 10 hectares over the period 1994-2011

	All regions together	NUTS2 region Brittany	NUTS2 region Limousin	NUTS3 region Meuse
Plot's municipality's projected agricultural revenue per hectare of UAA (Euros per hectare): mean in the sample [a]	218	345	49	-86
Plot's municipality's agricultural subsidies per hectare of UAA(Euros per hectare): mean in the sample [a]				
CHP	137	136	144	133
LSA	7	8	1	9
SFP	68	77	30	74
LFA	5	0	28	0
EGL	3	0	17	1
TOT	243	248	246	218
Plot's municipality's area (hectares): mean in the sample [b]	3,192	3,595	3,223	1,653
Plot's municipality's population density (inhabitants per square kilometre): mean in the sample [b]	57	73	27	26
Plot's municipality located in urban area: share (%) in the sample [b]	4	5	2	0
Plot's municipality located in zoning areas: share (%) in the sample [c]				
In vulnerable zone	76	100	0	66
In nitrate surplus zone	39	60	0	0
Plots purchased by a farmer: share (%) in the sample [d]	66	65	62	77
Plots purchased or sold by a SAFER: share (%) in the sample [d]	16	15	27	11

Notes: the share of farms located in vulnerable zone is shown here but the dummy related to this share is not included as an explanatory variable; by contrast, the size of the plot sold, not shown here but in Table 2, is included as an explanatory variable; interacted variables included as explanatory variables are not shown here.

Source: authors' calculations based on [a] SSP, SAA 1994-2011 and SSP, CRA 1994-2011, [b] French statistical office INSEE, [c] official regulation, and [d] the notary land transactions' database PERVAL

4. Results

Tables 5 and 6 report the regression results of the second stage which consists in the estimation of the determinants of the land price for plots sized 10 hectares or more. Table 5 regards the regression where the total subsidy variable is included as an explanatory variable, while Table 6 regards the regression where the various categories of subsidies are used instead. In both cases, the model was estimated for all three regions altogether, and for each region separately. All models were highly significant and their R-squared values ranged between 0.133 and 0.275. The model explained the variation in land price the most for NUTS2 Limousin and the least for NUTS2 region Brittany.

Considering firstly the results for the sample including all regions together, Table 5 shows that the projected agricultural revenue per hectare (at the municipality level) does not have a significant influence on the price of land. By contrast, the projected total agricultural subsidies per hectare (at the municipality level) have a positive influence. The coefficient is 0.6853, indicating the existence of capitalisation of subsidies in land price. The extent of capitalisation is rather small however and there is a strong dilution effect: considering the most simplifying assumptions of the PVM[4], our estimated coefficient of the total subsidy variable represents the capitalisation effect of a one Euro subsidy increase discounted over an infinite horizon. Hence, excluding the discount effect, the "pure" capitalisation effect remains very limited: for a 4% discount rate for instance, a one Euro subsidy increase induces a 0.027 Euro increase in the price of land. As reported by Latruffe and Le Mouël (2009) this dilution may be due to land supply price elasticity, input substitution possibilities, conditional requirements that farmers have to fulfil in order to receive the payments (e.g. cross compliance), and partial absorption of the capitalisation by input suppliers. However, this diluted effect of 0.027 is only for land located outside nitrate surplus zones, as the coefficient of the interaction between the dummy relating to this zoning and the total subsidy variable is significant. The coefficient of this interacted variable is 1.3693, indicating that the subsidy coefficient is 2.0546 in the nitrate surplus zones. Hence, in such zones, that is to say for 39 percent of the plots exchanged (which are all located in NUTS2 Brittany), the capitalisation effect is three times the effect outside the zoning. In the zoning, keeping a 4% discount rate, a one Euro subsidy rise increases the price of land by 0.082 Euro. This confirms the usual theoretical result (see, e.g., Latruffe and Le Mouël, 2006) that the lower the land supply elasticity, that is to say the lower the mobility of land between uses, then the higher the capitalisation effect. The zoning regulation may indeed reduce land mobility, and therefore increase the capitalisation of subsidies in such areas.

Regarding the other explanatory variables, results in Table 5 show that, for all regions taken together, the size of the plot has a negative influence on land price per hectare, suggesting increased competition on the demand side for smaller plots. The area of the municipality where the plot is located also negatively influences the price of land, confirming the expectation that competition for land is lower in larger municipalities. The variables which proxy revenue from potential non-agricultural uses, namely the municipality's population density and the location in an urban area, both have a positive influence on land price, as expected. Also conforming to intuition, plots purchased by farmers are less expensive as farmers buy land for agricultural use and not for future development uses. Finally, plots purchased or re-sold by a SAFER are more expensive. This finding is counterintuitive as the SAFER are expected to contribute to alleviate speculation on land prices. Two reasons may explain this finding. Firstly, the SAFER do not always use their pre-emptive right in the view of keeping land price low; they may also pre-empt land that is up for sale to change the buyer, in order to limit farm fragmentation and support young farmers' settlements. Secondly, SAFER's intervention in the view of keeping low price may occur for specific land, which is more expensive than the average agricultural land, for example land located in peri-urban areas.

Table 5 also reports estimation results for the three regions separately. The main difference between the regions is the effect of the total subsidies on land price. In NUTS2 Brittany, there is evidence of the capitalisation of subsidies only in nitrate surplus zones, with a coefficient of 1.6144 (i.e., 0.065 Euro capitalised in land price for a one Euro subsidy increase, provided that the discount rate is 4%). In the two other regions, the subsidies are capitalised in non-nitrate surplus zones (as nitrate surplus zones do not exist in the regions) with a differentiated effect. In NUTS3 region Meuse, the coefficient of the subsidy variable is 0.9539 (i.e., 0.038 Euro capitalised in land price for a one Euro subsidy increase, provided that the discount rate is 4%), while in NUTS2 region Limousin, the effect is greater: the coefficient being 1.2346, meaning 0.049 Euro capitalised in land price for a one Euro subsidy increase (provided that the discount rate is 4%).

Table 6 presents the estimation results when various categories of subsidies are included as explanatory variables instead of the total subsidy, both as independent variables and as interacted

[4]According to the PVM, the equilibrium price of an asset at the beginning of time period t (L_t) may be written as: $L_t = \sum_{i=0}^{\infty} \frac{E(R_{t+i})}{(1+r_{t+1})(1+r_{t+2})......(1+r_{t+i})}$, where R_t is the net real return at the end of time period t (including government subsidies), generated from owning the asset, r_t is the time-varying real discount rate for year t and E is the expectation on return conditional on information in period t. If it is assumed that the net return is constant in each period (R^*), that the discount rate is constant, that agents are risk neutral and that differential tax treatments of capital gains and rental income are ignored, then the present value formula simplifies to the basic capitalisation formula: $L_t = \frac{R*}{r}$

variables with the location or not in nitrate surplus zones. For the sample including all regions, outside nitrate surplus zones only the premiums received for letting land aside (*LSA*) are capitalised. The capitalisation effect is very high, since the coefficient is 31.8957. This may suggest a scarcity effect due to the requirement to withdraw land from production. Location in nitrate surplus zones greatly reinforces the capitalisation effect of these subsidies, as the coefficient for the interacted variable is 46.4733. Hence, in such zones, the total capitalisation effect is 78.4, meaning 3.13 Euros capitalised in the price of land for a one Euro *LSA* premium increase (provided that the discount rate is 4%).

Such results for *LSA* are well above our benchmarks and one may suspect some collinear effects, especially with crop subsidy payments. In our database, the variable *CHP* (CAP first pillar coupled direct payments to crops and herds) do not allow to distinguish crop payments from herd payments. Results in Table 6 indicate that for the sample including all regions, the coefficient for *CHP* is not significant. Small or negligible capitalisation effects were expected for these rather coupled payments. However, the capitalisation coefficient of crop payments should be higher than the one of the herd payments, because crop payments are based on area while herd payments are provided per head. Given that the *LSA* payments are calculated with the same regional reference yield and the same crop reference price as crop payments, it is likely that the estimated *LSA* capitalisation coefficient captures part of the crop payment capitalisation effect.

Still for the sample including all regions, the price of land located in nitrate surplus areas is also affected by the capitalisation of *SFP* (CAP first-pillar decoupled SFP) with a coefficient of 2.4166. This decoupled payment was expected to be associated with the highest capitalisation coefficient among all types of subsidy, be the plot located in a surplus zone or not. Hence, once again, collinear effects may be present.

Regarding the regional estimations, one must admit that obtained results are a little bit puzzling. In NUTS2 Brittany, only land set aside premiums (*LSA*) and coupled direct payments to crops and herds (*CHP*) have a significant capitalisation effect, whether located in a nitrate surplus zone or not. In addition, the capitalisation of land set aside premiums is greater outside nitrate surplus zone (coefficient of 233.82) than inside (coefficient of 151.9) and the estimated effect of the coupled direct payments to crops and herds is negative both for plots located outside (coefficient of -14.42) and inside (coefficient of -7.44) nitrate surplus area. As for the estimation with the three regions' sample, we suspect collinear effects between land set aside premiums and crop payments.

In NUTS2 Limousin, only the decoupled SFP (*SFP*) and the agri-environmental payments to extensive grazing livestock (*EGL*) are found to have a significant capitalisation impact. While for *SFP* the impact is positive as expected (coefficient of 12.94), the *EGL* effect is negative (coefficient of -42.24) which may be surprising. This negative effect may in fact reflect the lower productivity of the corresponding lands, since *EGL* payments are not supposed to bring additional profit to farmers, by construction, because they are calibrated to compensate farmers' environmental efforts and additional costs. Although these voluntary measures are not expected to be adopted when they decrease farm profit, Mettepeningen et al. (2009) observe almost as many profit decreasing situations as profit increasing ones.

Finally, in NUTS3 Meuse, only the agri-environmental payments to extensive grazing livestock (*EGL*) have a significant capitalisation effect. But in this case the effect is positive. Once again, one may suspect collinear effects which would explain this very high *EGL* capitalisation impact. In this region the average EGL payment is 1.1 Euro per hectare. Over the period, these per hectare agri-environmental payments range between 45 Euros and 150 Euros. This means that less than 2.5% of the regional UAA is concerned by such payments. This suggests that the *EGL* variable mainly indicates rare production systems which are more profitable than others in the region.

Table 5: Results of the estimation of the determinants of land price for plots with size equal or above 10 hectares in 1994-2012, using the total subsidy variable

	All regions together		NUTS2 region Brittany		NUTS2 region Limousin		NUTS3 region Meuse	
	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
Constant	2,097.5	**	2,497.0	***	1,590.4	***	2,279.0	***
Plot's municipality's projected agricultural revenue per hectare of UAA	0.0644		0.0692		-0.5603		-0.0669	
Plot's municipality's projected agricultural subsidies per hectare of UAA: total subsidies (*TOT*)	0.6853	**	0.1310		1.2346	***	0.9539	***
Area of sold plot	-8.0308	***	-14.5872	***	-6.8347	***	-2.4657	
Plot's municipality's area	-0.0545	***	-0.0752	***	0.0320		-0.0159	
Plot's municipality's population density	3.3169	***	3.4714	***	5.7655	***	1.1346	
Dummy equal to 1 if plot's municipality located in urban area	237.07	*	134.93		909.09	***	-622.32	
Dummy equal to 1 if plot purchased by a farmer	-228.87	***	-192.12	***	-214.56	**	-425.60	***
Dummy equal to 1 if plot purchased or sold by a SAFER	230.10	***	234.31	***	99.16		618.24	***
Interacted variable *TOT* × Dummy equal to 1 if plot's municipality located in nitrate surplus zone	1.3693	***	1.6144	***	n.i.		n.i.	
Model's statistics								
F-value	31.7	***	14.3	***	7.1	***	5.2	***
R-squared	0.200		0.133		0.205		0.157	
Number of observations	4,222		2,720		773		729	

Notes: The dependent variable is the deflated price of non-built arable and pasture land per hectare for plots sized 10 hectares or more; Results for year dummies and NUTS3 region dummies are not shown; Sig. means "Significance"; n.i. means "not included"; *, **, *** indicate significance at the 10, 5, 1% levels respectively.

Source: authors' calculations

Table 6: Results of the estimation of the determinants of land price for plots with size equal or above 10 hectares in 1994-2012, using the subsidy categories' variables

	All regions together		NUTS2 region Brittany		NUTS2 region Limousin		NUTS3 region Meuse	
	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.	Coefficient	Sig.
Constant	2,165.9	***	2,221.5	***	2,021.1	***	2,127.1	***
Plot's municipality's projected agricultural revenue per hectare of UAA	0.2559	***	0.4991	***	0.2301		-0.0650	
Plot's municipality's projected agricultural subsidies per hectare of UAA:								
CAP first-pillar coupled direct payments to crops and herds (*CHP*)	-0.9645		-14.4155	***	1.2803		0.3688	
CAP first-pillar land set-aside premiums (*LSA*)	31.8957	**	233.8178	***	3.2054		-1.2452	
CAP first-pillar decoupled single farm payments (*SFP*)	0.7962		0.2676		12.9379	***	0.0884	
CAP second-pillar least favoured area payments (*LFA*)	4.3644		n.i.		10.7674		n.i.	
CAP second-pillar agri-environmental payments to extensive grazing livestock (*EGL*)	-1.5909		n.i.		-42.2370	***	140.1253	***
Area of sold plot	-7.7295	***	-13.5935	***	-5.0567	**	-1.6611	
Plot's municipality's area	-0.0524	***	-0.0679	***	0.0628	***	-0.0499	
Plot's municipality's population density	3.1837	***	3.1181	***	4.9387	***	1.4226	
Dummy equal to 1 if plot's municipality located in urban area	237.11	*	139.10		1,036.96		-701.94	
Dummy equal to 1 if plot purchased by a farmer	-231.94	***	-201.34	***	-225.24	***	-374.72	***
Dummy equal to 1 if plot purchased or sold by a SAFER	267.81	***	268.77	***	69.68		548.66	***
Interacted variable Subsidy × Dummy equal to 1 if plot's municipality located in nitrate surplus zone								
Interaction with CHP	-1.3435		6.9780	***	n.i.		n.i.	
Interaction with LSA	46.4733	*	-81.9208	**	n.i.		n.i.	
Interaction with SFP	2.4166	***	1.1633		n.i.		n.i.	
Interaction with LFA	n.i.		n.i.		n.i.		n.i.	
Interaction with EGL	n.i.		n.i.		n.i.		n.i.	
Model's statistics								
F-value	27.8	***	14.9	***	9.1	***	6.7	***
R-squared	0.206		0.155		0.275		0.212	
Number of observations	4,224		2,721		773		730	

Notes: The dependent variable is the deflated land price per hectare; Results for year dummies and NUTS3 region dummies are not shown; Sig. means "Significance"; n.i. means "not included"; *, **, *** indicate significance at the 10, 5, 1% levels respectively.

Source: authors' calculations

5. Conclusion

In this paper we have investigated the determinants of agricultural land price in several regions in France over the period 1994-2011 using individual plots transaction data, with a particular emphasis on agricultural subsidies and nitrate zoning regulations.

We found several main results. Firstly, agricultural revenue has in general no significant influence on land price contrary to what can be expected from the present value model. Of course, we can first question the methodology that we used to proxy it at the municipality level from the original NUTS3 data, a limit which would also apply to subsidies. However, two other reasons may explain such a poor relationship. Firstly, it may be that the original variable (namely, pre-tax profit) used to construct our proxy variable, which is the only one that was available from the statistics, may not be the best representation of income generated by farming activities on land because it is too low in the accounting balance sheet; the gross margin would be a better candidate but it was not available in the original database. Another reason may be that the revenue variable was proxied at the municipality level and not at the plot level itself.

Secondly, we found evidence that agricultural subsidies actually capitalised at least to some extent in the price of land in the regions studied over 1994-2011. However, the magnitude of such a capitalisation depends on several factors. One varying factor is the region considered. For the sample including the three regions, we found a positive but relatively small capitalisation effect of the total subsidies per hectare. However, this effect is differentiated according to the considered region. In NUTS2 Brittany the positive effect is significant only for plots located in nitrate surplus area and is greater than in both other regions. Then, the effect is greater in NUTS2 Limousin than in NUTS3 Meuse. Another varying factor is the type of subsidy considered. When considering the whole sample, we found that only land set-aside premiums significantly capitalise into land price, be the plot located in a surplus zone or not, while SFP have a significant positive capitalisation impact only for plots located in a surplus zone. We suspect however some collinear effects between the various types of subsidy considered which impedes disentangling the own effects of each type. This suspicion is confirmed by the rather puzzling estimation results obtained when all types of subsidy are considered. Hence, at this stage we recognise that further work is needed for improving our econometric specification.

For this reason, it is felt premature to undertake simulations of the potential impacts of the future CAP proposals on agricultural land price in France, based on our estimated capitalisation coefficients. Collinear effects problems must be dealt with in priority. From our obtained preliminary results, we can expect contrasted effect of the future CAP reform. In France the basic decoupled allowance, which is similar to the SFP, will be reduced by half, and so will be its positive impact on the price of land. The new green payments, which must amount as much as 30% of the present first pillar CAP payments at the national level, themselves present as a mix between SFP, *LSA* premiums and *EGL* payments. Ecological compensation areas resembles *LSA* premiums but are supposed to be larger, with a positive effect on land price. However, the prescribed management plan for these areas may imply costs similar to the ones implied by agri-environmental schemes. Hence, the resulting effect is highly uncertain and very dependent on the new CAP implementation decisions.

The different extent of capitalisation according to the type of subsidy and the region has already been shown in other studies, although not in France. However, another varying factor that has never been investigated in the literature is the zoning regulation. We found that, in NUTS2 Brittany, where the nitrate surplus zoning is implemented, the capitalisation of subsidies is different whether the plot was inside or outside the zone, revealing a restriction on land mobility. This confirms the suggestion by Latruffe and Le Mouël (2009) that laws and policies may affect the degree of land mobility between the different potential uses of land. As underlined by Latruffe and Le Mouël (2006), public intervention may affect land mobility in favour of a specific use of land, which may go against the government objective of supporting farmers' income. In this paper we found that nitrate zoning regulations may increase the degree of capitalisation of subsidies in agricultural land price, implying a potential leakage of subsidies to non-agricultural stakeholders (non-farmer owners) and difficulties for farm succession and settlement.

References

Cavailhès, J. and S. Degoud (1995), "L'évaluation du prix des terres en France: une application de la réforme de la PAC", *Cahiers d'Economie et Sociologie Rurales*, Vol. 36, pp. 49-77.

Ciaian, P. an D. Kancs (2012), "The capitalization of area payments into farmland rents: micro evidence from the new EU Member States", *Canadian Journal of Agricultural Economics*, Vol. 60, No. 4, pp. 517-540.

Ciaian, P., Kancs, d'A., Swinnen, J., Van Herck, K. and L. Vranken (2012), Sales Market Regulations for Agricultural Land in EU Member States and Candidate Countries, FP7 project Factor Markets (Comparative Analysis of Factor Markets for Agriculture across the Member States) grant agreement n°245123-FP7-KBBE-2009-3, Working paper No. 14.

Courleux, F. (2011), "Augmentation de la part des terres agricoles en location : échec ou réussite de la politique foncière ?", *Economie et Statistique*, Vol. 444-445, pp. 39-53.

Courleux, F., Guyomard, H., Levert, F. and L. Piet (2008), How the EU Single Farm Payment should be modelled: lump-sum transfers, area payments or… what else?, Working Paper SMART–LERECO, n°08-01, Rennes, France.

Dewbre, J., Anton, J. and W. Thompson (2001), "The transfer efficiency and trade effects of direct payments", *American Journal of Agricultural Economics*, 83(5), pp. 1204-1214.

Goodwin, B. and F. Ortalo-Magné (1992), "The capitalization of wheat subsidies into agricultural land values", *Canadian Journal of Agricultural Economics*, Vol. 40, No. 1, pp. 37-54.

Goodwin, B., Mishra, A. and F. Ortalo-Magné (2003), "What's wrong with our models of agricultural land values?", *American Journal of Agricultural Economics*, Vol. 85, No. 3, pp. 744-752.

Kilian, S. and K. Salhofer (2008), "Single payments of the CAP: where do the rents go?", *Agricultural Economics Review*, Vol. 9, No. 2, pp. 96-106.

Latruffe, L., Desjeux, Y., Guyomard, H., Le Mouël, C., L. Piet (2008), Study on the Functioning of Land Markets in the EU Member States under the Influence of Measures Applied under the Common Agricultural Policy – Report for France, Report for the Centre for European Policy Studies (CEPS), Brussels, Belgium, 22 July.

Latruffe, L. and C. Le Mouël (2009), "Capitalisation of government support in agricultural land prices: what do we know?", *Journal of Economic Surveys*, Vol. 23, pp. 659-691.

Latruffe, L., and C. Le Mouël (2006), Review of Policies Affecting Farmland Mobility in France, Report for the OECD, Directorate for Food, Agriculture and Fisheries, Paris.

Latruffe, L., Minviel, J. J. and J. Salanié (2013), The Role of Environmental and Land Transaction Regulations on Agricultural Land Price: The Example of the French Region Brittany, FP7 project Factor Markets (Comparative Analysis of Factor Markets for Agriculture across the Member States) grant agreement n°245123-FP7-KBBE-2009-3, Deliverable 17.1.

Mettepenningen, E., Verspecht, A. and G. Van Huylenbroeck (2009), "Measuring private transaction costs of European agri-environmental schemes", *Journal of Environmental Planning and Management*, Vol. 52, No.5, pp. 649-667.

Patton, M., Kostov, P., McErlean, S. and J. Moss (2008), "Assessing the influence of direct payments on the rental value of agricultural land", *Food Policy*, Vol. 33, pp. 397-405.

Plantinga, A. and D. Miller (2001), "Agricultural land values and the value of rights to future land development", *Land Economics*, Vol. 77, No. 1, pp. 56-67.

SAFER-Agreste (2012), *Le Prix des Terres – Analyse des Marchés Fonciers Ruraux 2011*, Edition Mai 2012, Paris, France.

Van Herck, K., Swinnen, J. and L. Vranken (2012), A Regulatory Index for Agricultural Land Markets in Europe, Contributed paper presented in the conference of the Italian Association of Agricultural and

Applied Economics (AIEAA), “Towards a Sustainable Bio-economy: Economic Issues and Policy Challenges”, Trento, Italy, June 4-5.

Weersink, A., Clark, S., Turvey, C. and R. Sarker (1999), “The effect of agricultural policy on farmland values”, *Land Economics*, Vol. 75, No.3, pp. 425-439.

Appendix

Table A1: First-stage SUR estimation results

Equation		1994-2005 sub-period		2006-2011 sub-period	
		Best model	Adjusted model	Best model	Adjusted model
CHP	Obs.	96	96	40	40
	SMSS	*0.9814*	*0.9813*	*0.9300*	*0.9235*
	Cereals	-7.545 (0.017)***	-7.556 (0.019)***	.	.
	Oilseeds	.	.	-8.878 (0.491)***	-10.623 (2.509)***
	Grassland	-9.923 (0.352)***	-9.762 (0.298)***	.	.
	Dairy cows	.	.	-9.510 (0.170)***	-9.332 (0.137)***
	Suckler cows	-8.242 (0.049)***	-8.252 (0.049)***	-8.498 (0.038)***	-8.498 (0.038)***
LSA	Obs.	96	96	.	.
	SMSS	*0.9427*	*0.9253*	.	.
	Cereals	-10.779 (0.447)***	-10.115 (0.036)***	.	.
	Oilseeds	-10.321 (0.912)***	.	.	.
	Protein crops	-8.602 (0.446)***	.	.	.
	Fodder maize	-11.124 (0.986)***	.	.	.
	Starch	-7.323 (0.243)***	.	.	.
SFP	Obs.	.	.	40	40
	SMSS	.	.	*0.9944*	*0.9719*
	Cereals	.	.	-8.271 (0.159)***	-7.419 (0.036)***
	Oilseeds	.	.	-8.320 (0.390)***	.
	Protein crops	.	.	-6.125 (0.164)***	.
	Fodder maize	.	.	-7.323 (0.101)***	.
	Suckler cows	.	.	-8.990 (0.087)***	-9.116 (0.107)***
LFA	Obs.	96	96	40	40
	SMSS	*0.9450*	*0.9450*	*0.9817*	*0.9818*
	Suckler cows	-9.492 (0.038)***	-9.493 (0.038)***	-9.951 (0.064)***	-9.969 (0.062)***
	Dairy ewe	.	.	-4.672 (0.118)***	-4.644 (0.109)***
EGL	Obs.	96	96	40	40
	SMSS	*0.9688*	*0.9688*	*0.9432*	*0.9432*
	Rangeland	-9.284 (0.240)***	-9.273 (0.235)***	.	.
	Suckler cows	-10.553 (0.150)***	-10.559 (0.150)***	-10.181 (0.059)***	-10.182 (0.059)***
TOT	Obs.	96	96	40	40
	SMSS	*0.9868*	*0.9869*	*0.9976*	*0.9977*
	Cereals	-7.458 (0.017)***	-7.468 (0.018)***	-8.146 (0.140)***	-8.212 (0.106)***
	Oilseeds	.	.	-8.123 (0.385)***	-7.933 (0.240)***
	Fodder maize	.	.	-7.904 (0.297)***	-8.729 (0.710)***
	Grassland	-9.470 (0.228)***	-9.362 (0.208)***	.	.
	Dairy cows	.	.	-8.509 (0.176)***	-8.124 (0.144)***
	Suckler cows	-7.775 (0.037)***	-7.781 (0.037)***	-7.608 (0.024)***	-7.593 (0.023)***
Revenue	Obs.	96	96	40	40
	SMSS	*0.9518*	*0.9195*	*0.9205*	*0.7682*
	Soft wheat	-0.0034 (0.0006)***	-0.0031 (0.0005)***	0.0013 (0.0007)*	-0.0011 (0.0009)
	Barley	0.0023 (0.0007)***	0.0028 (0.0006)***	-0.0020 (0.0007)***	0.0013 (0.0009)
	Corn maize	.	.	-0.0028 (0.0006)***	.
	Protein crops	.	.	0.0256 (0.0042)***	.
	Fodder maize	.	.	-0.0095 (0.0010)***	.
	Total maize	0.0014 (0.0006)**	.	.	.
	Ley	0.0607 (0.0103)***	.	.	.
	Meadows	-0.0007 (0.0003)***	.	.	.
	Grassland	-0.0009 (0.0002)***	.	.	.
	Dairy cows	0.0011 (0.0004)***	0.0018 (0.0002)***	0.0036 (0.0004)***	0.0009 (0.0003)***
	Suckler cows	0.0013 (0.0002)***	0.0002 (0.0000)***	0.0002 (0.0001)***	-0.0001 (0.0000)**
	Pigs	.	.	0.0001 (0.0000)***	.

Notes: *CHP*, *LSA*, *SFP*, *LFA*, *EGL*, and *TOT* are the six types of subsidies considered (see text); SMSS means 'Share of Model Sum of Squares' and represents the share of the total sum of squares explained by the model; Obs. means "Number of observations"; Standard deviations appear in brackets after the estimated coefficient; *, ** and *** indicate significance at, respectively, 10, 5 and 1% levels.

Source: authors' calculations based on SSP, SAA 1994-2011 and SSP, CRA 1994-2011