The Capitalisation of Fixed per hectare Payment into Land Rental Prices: a Spatial Econometric Analysis of Regions in EU

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Summary

Following the decoupling of agricultural support from productions, the likelihood that payments get capitalised into farmland rent or sale prices has increased. In this study, the issue of capitalisation is examined for the case of regions in the EU and the three year (2006-2008) time span following the introduction of the reform is considered in an attempt to disentangle the effect of the decoupling. Evidence put forward in this study confirms the results of previous literature at the micro-level, suggesting that an additional 1% granted to farmers translates into an increase of 0.22% in farmland rents.

Keywords: European Union; subsidies capitalisation; land rents; spatial panel econometrics
JEL Classification codes: Q18

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1. INTRODUCTION

Farmland is by far the most important input in agricultural production. In EU27 land, alongside permanent crops and quotas, accounts for about 65% of total fixed assets of farms in 2009 and the figure rises to 75% when only farms specialized in field-cropping are considered (European Commission - EU FADN, 2013). Accordingly, much attention is paid in the theoretical and empirical literature to the determinants of agricultural land's prices. Following the implementation of the 2003 CAP reform, subsidies have been decoupled from productions and related to land, increasing the possibility that payments get capitalized into land price and hence transferred out of the agricultural sector.

Studying the functioning of land markets in the EU Swinnen et al. (2008) conclude that different factors affect the prices of agricultural land. Among others infrastructural expansion and urbanization pressures heavily affect the market for owned land while commodity prices and agricultural productivity shape the one for rented land. Although other external factors (e.g. agricultural subsidies) also have an incidence on land prices, perhaps because of relying on simple correlations, Swinnen et al. (2008) uncover only a weak relationship between agricultural payments and land values.

Different studies have attempted to empirically assess the incidence of EU payments on land prices (Patton et al., 2008; Breustedt and Habermann, 2011; Ciaian et al., 2011; Ciaian and Kancs, 2012; Guastella et al., 2013). These studies use farm-level data to relate land rents to subsidies per hectare, finding mixed evidence on the degree of capitalisation. Such diverse results can be associated to differences across studies in terms of country or region analysed, time span of the data, methodological approach and type of agricultural support considered.

The present work contributes to the empirical literature on the capitalisation effect in the EU studying the influence of decoupled subsidies on land prices at the regional aggregate level and considering all countries in the group of EU25. For the EU case, the study by Kilian et al. (2008) is the only to address the issue of capitalisation using territorial, namely municipality, data. The use of aggregate data is therefore innovative in this stream of literature and is deemed appropriate to analyse the issue of capitalisation. On the one hand, in fact, convergence of agricultural subsidies to a fixed per hectare amount at the regional level is among the objectives of the 2003 reform, which has introduced the decoupling scheme. Hence, the capitalization effect is likely to emerge in cross-regional comparisons more than in cross-farms ones. On the other hand, farm-level variation in rental prices are inherently related to the characteristics of land, which are usually unobservable to the econometrician. The use of fixed-effect estimation with farm level data may obscure the capitalisation effect to a great extent, provided that farm-level per-hectare payments are roughly constant over time.

Starting from FADN micro data, territorial aggregates are constructed for regions in the group of EU25 countries, for the years following the introduction of the reform. The empirical framework originally set-up by Lence and Mishra (2003) is used to derive a testable model to investigate the capitalisation effect. Since the hypothesis of independence between territorial units is undermined by possible unobserved spatial heterogeneity, spatial externalities and spatial contagion in land prices, several spatial panel data models are used for empirical estimation of the capitalisation effect.

The evidence in this paper suggests that approximately a 1% increase in the amount granted by the EU to farmers under either the Single Payment Scheme (SPS) or the Single Area Payment Scheme (SAPS) translates into and increase in land rents of 0.22%. There is no evidence, on the contrary, of capitalisation of Energy Crop Payments (ECP). Among the other determinants of the farmland rental price at the regional level, the role of the average farm size and of the rental markets conditions emerges. Evidence is robust to changes in the specification of the econometric model.

The remainder of the paper is organized as follows. The next section introduces the framework used to empirically assess the capitalisation effect and briefly describes the features of the sample used for the econometric analysis. Results are presented in the third section. A discussion of results concludes the work.

2. EMPIRICAL MODEL AND DATA

In agricultural production, rent represents the marginal cost of land and, in general equilibrium conditions, it is expected to equate the marginal productivity of land. An empirical equation for the price of rented land is formulated accordingly, hence taking into account the effect of (average) productivity on rents and, in addition, considering other factors which likely influence the price of land. Among others, subsidies have received particular attention (Kirwan, 2009; Lence and Mishra, 2003; Roberts et al., 2003).

Borrowing from the theoretical model of farm production initially proposed by Lence and Mishra (2003) it is assumed that profits at the farm level are related to productivity and payments according to equation (1):

$$\pi_i = \sum_{k=1}^{K} p_k y_{ik}\left(a_{ik}\right) a_{ik} + g\left(\sum_{k=1}^{K} a_{ik}\right) - r\left(\sum_{k=1}^{K} a_{ik}\right) . \tag{1}$$

In this equation, p_k is the price of k^{th} output, y_{ik} is the per-hectare quantity of product k which is produced by the farm i and is a function of a_{ik}, the number of hectares utilised by the farm i for the production of output k. Each farm receives a fixed per-hectare amount of subsidies g and pays a rent r for each hectare of land used in production. It is further assumed that all the land used is property of land-owners and rented to farmers.

When the relation between output and hectares used in production is expressed by a Cobb-Douglas, profit maximization leads directly to the equation (2)[1], where $\alpha_k = \frac{a_k}{\sum_k a_k}$, $Y_k = p_k y_k$ and β and γ are parameters to be estimated and are obtained as linear combinations of the parameters of the Cobb-Douglas production function.

$$r = \sum_{k=1}^{K} \beta_k \alpha_k Y_k + \gamma g . \tag{2}$$

[1] Omitting farm subscript for simplicity.

Assuming that all farmers in the same region face similar prices, regional productivity depends on the aggregate number of hectares used for a specific output and equation (2) can be used to explain variation in r at the regional level. An estimate of the γ parameter significantly different from zero is used to reject the null hypothesis that decoupled payments are not capitalised into land rental prices.

While the analysis in Lence and Mishra (2003) considers two agricultural productions only, and many studies for the EU consider aggregate measures of either productivity (Breustedt and Habermann, 2011) or market returns (Ciaian and Kancs, 2012), the empirical framework in this paper considers multiple productions. This is instrumental to capturing the large heterogeneity in the composition of aggregate production which characterizes agriculture in EU regions. More specifically, total production is divided in $k = 8$ output categories, namely, crop (including cereals, proteins, potatoes, sugar beet, oil-seed and industrial crops), energy crops, vegetables and flowers, fruits, wines and grapes, olives, forage crops and other crops. Therefore, equation (2) can be rewritten in augmented form as in equation (3), where k is defined as above; s and t identify the region and the year for which the value of the variables are observed, respectively; for each of the k products $X_{st} = \alpha_{st} Y_{st}$.

$$r_{st} = d_s + \sum_k \beta_k X_{k,st} + \gamma_1 SPS_{st} + \gamma_2 ECP_{st} + Z'_{st}\,\delta + \varepsilon_{st} \tag{3}$$

The augmented land price model in equation (3) in addition to productivity considers also different types of subsidies, SPS or SAPS and ECP, whose coefficients are expected to be positive to denote capitalisation in land rents. A list of controls is included in the matrix Z to account for the regional characteristics which are expected to have an impact on farmland rent variation while a set of region-specific intercepts (d_s) controls for time-invariant effects at the regional level. In particular the model controls for: the average size of farms $(Asize)$ in the region (expressed in ha); the average share of family labour $(FamLab)$ and the average capital per ha $(FixAss)$, animal density $(AnimalD)$ in the region and the average share of rented to total UAA in the region $(RentProp)$.The coefficient related to farm size is expected to be negative since larger farms have a substantially larger power to bargain into land markets. Family labour and fixed assets control for the managerial approach of farms in the regions. In regions where farmers use a more managerial approach to the agricultural activity the market for land is expected to be more dynamic and, consequently, farmland prices to be higher. The density of animals controls for the higher farmland prices generated by the demand for land to be used for manure spreading. In regions where animal density is higher such a demand may be more substantial and there is the possibility that renting land for the sole specialised use reduces the amount of land rentable for productive purposes driving rents higher. Finally, not all of the land is property of landowners who rented to farmers, contrary to the theoretical hypothesis. Much of the land used in agriculture is owned by farmers directly and higher farmland rents may be the consequence of the inelastic supply of land for rent.

Equation (3) can be estimated using simple linear models for panel data as long as the standard assumptions about the error term are satisfied. In presence of spatial data, these assumptions are often violated and alternative methods are required. LeSage and Pace (2009) provide an extensive review of the possible motivations leading to spatial correlation in data and an overview of the different models taking it into proper account. A non-exhaustive list includes spatial spillovers, unobserved spatial heterogeneity and omitted spatially correlated variables. Accordingly, different models can be estimated and tested to disentangle to what extent space and geography are relevant in the empirical application of interest.

In the case of the land price model described in this section, three main hypothesis are considered. Equation (3), which is used to test the capitalisation effect, can be rewritten in compact form and omitting subscripts to simplify the notation as equation (4) where the Q matrix now includes all the model covariates and θ is the parameter vector to be estimated.

$$r = Q'\theta + \varepsilon \tag{4}$$

Firstly, geography is introduced into the land price model modelling the spatial dependence in the dependent variable. In Equation (5), representing the Spatial Autoregressive Model (SAR), the average value of farmland rent in neighbouring regions is included in the model's right hand side, assuming that the land price in a region are also influenced by the land price in neighbouring regions through a spatial price contagion mechanism.

$$r = \rho W r + Q'\theta + \varepsilon \tag{5}$$

In model (5) and through the rest of the paper, neighbourhood relations are identified by means of a spatial weight matrix, a n-dimensional square matrix whose w_{ij} element is such that

$$w_{ij} = \begin{cases} \dfrac{d_{ij}^{-1}}{\sum_j d_{ij}^{-1}} & \text{if } d_{ij} < d^* \\ 0 & \text{otherwise} \end{cases} \tag{6}$$

where d_{ij} is the distance between region i and region j. Henceforth, for each pair of regions the geographical distance is measured and if this distance is lower than a pre-defined threshold $\left(d^*\right)$ the two regions are considered neighbours. According to the expression in equation (6), the matrix is row standardized such that, when it pre-multiplies a vector, the average value of the vector in neighbours is returned.

A second specification considers the case of spatial heterogeneity not accounted for by the model's covariates. Space and geography most likely influence the model residuals leading to a specification, known as the Spatial Error Model (SEM) in which errors are modelled accordingly. In equation (7), the spatial dependence in the error terms is modelled allowing the residual of a region to depend on the value of the residuals in neighbouring regions. Although no direct economic and policy relevance can be attributed to the spatial parameter, as opposed to the SAR case, the specification provides consistent estimates of the parameters in θ when unobservable spatial heterogeneity leads to the violation of the assumption of independent errors.

$$\begin{aligned} r &= Q'\theta + \varepsilon \\ \varepsilon &= \lambda W \varepsilon + u \end{aligned} \tag{7}$$

A final specification, named Spatial Durbin Model (SDM), considers spatial correlation in the dependent variable and in the covariates (equation (8)). It can be interpreted as a generalized extension of the SAR (model (5)), but it is algebraically derived from the SEM (equation (7))[2]. Both SAR and SEM are nested in SDM and it can be straightforwardly noted that SDM reduces to SAR if $\varphi = 0$ and (less straightforwardly) to SEM if $\varphi = -\rho\theta$. Both the hypotheses ($\varphi = 0$ and $\varphi = -\rho\theta$) can be tested by means

[2] Links between different spatial models, and in particular between SDM, SAR and SEM are detailed in Elhorst (2010).

of Likelihood Ratio (LR) tests, provided that the estimate of the ρ parameter is statistically different from zero. LeSage and Pace (2009) suggest using this specification whenever spatially auto-correlated variables may be omitted from the model.

$$r = \rho Wr + \theta Q + \varphi WQ + u \qquad (8)$$

All models are estimated and results are compared in the empirical section of this work. The estimated values of the parameters in the θ vector are expected to be similar across different models specification while the estimated values of parameters ρ and λ can guide to an appropriate model selection.

The dataset used to estimate the capitalisation effect comprises 208 NUTS regions belonging to the group of EU25 countries. In greater detail, NUTS II is used as the territorial reference for all countries but the UK, where NUTS I is used instead, and DK, where NUTS 0 is used. Romania and Bulgaria have been excluded from the analysis because of the lack of data from more than two years. Regional data are available for the whole period 2003-2008 for old member states and starting from 2005 for New Member States in the FADN database. However, since some countries implemented decoupling after 2005 only, data for SPS payments are available from 2006 for the complete set of regions.

Table 1: Description of variables and summary statistics

Variable	Description	Mean	SD	CV
R	Rent per ha	199.052	185.863	0.934
Y1	Output value per ha – Cereals	1466.269	1436.281	0.980
Y2	Output value per ha – Energy Crops	968.642	2511.057	2.592
Y3	Output value per ha – Vegetables and Flowers	34096.5	66345.69	1.946
Y4	Output value per ha – Fruits	7375.31	7309.231	0.991
Y5	Output value per ha – Wines and Grapes	10177.35	15064.98	1.480
Y6	Output value per ha – Olives	2483.117	2235.006	0.900
Y7	Output value per ha – Forage Crops	186.52	269.33	1.444
Y8	Output per ha – Other Crops	81805.05	697388.2	8.525
SAP	Payment per ha under either SAPS or SPS	482.77	1885.702	3.906
ECP	Payment per ha for Energy Crop	75.167	678.804	9.031
Asize	Average farm size (in ha)	81.926	116.214	1.419
FamLab	Share of family to total labour	0.725	0.229	0.316
FixAss	Value of Fixed Assets (Machinery and Equipment) per ha	3381.808	4048.983	1.197
AnimalD	Number of animal units (in livestock equivalent) per ha	1.031	1.188	1.152
RentProp	Ratio between rented and total UAA	0.541	0.241	0.445

Geographical coordinates are used to compute the Euclidean distance between each pair of regions. Coordinates are extracted from the official shapefile of EU regions that is available at the Geographical Information System at the Commission (GISCO). Since Atlantic islands are considered too far for any spatial relation with continental regions to exist, these regions are excluded from the sample. The distance used as the threshold to define contiguity between regions $\left(d^*\right)$ is set at 500 km. Although this choice is arbitrary, it is deemed appropriate to describe the spatial structure of connectivity links. In particular, using 500 km as the cut off distance implies that every region has at least one neighbour such that each of the rows of the weight matrix has at least a non-zero element.

Table 1 describes the main variables used for the land price model and provides some useful descriptive statistics. The average farmland rent is about 200 euro per ha, even though there is large variation across regions in the EU. The largest value of production per ha accrues to farms producing wines and grapes followed by vegetables and flowers, fruits and olives. The average value of the SPS/SAPS payment per ha is about 490 euro. This variable exhibits the highest coefficient of variation[3], suggesting sizeable differences between countries and regions in Europe. The figure related to the contribution of family labour is unsurprisingly high, 73% of the total number of hours are worked by family members, on average. Finally, more than a half of the available UAA in the regions is rented and there is relatively little variation in this between regions in Europe.

3. RESULTS

Econometric results from different panel data models are summarized in

Table 2. The baseline model is a standard fixed-effects panel data model and estimated coefficient are reported in the second column of the table. Among all productions, vegetables and flowers only exhibit a positive and significant effect on farmland prices. The effect of other productions is largely insignificant, with the notable exception of cereals production, whose effect is negative and significant.

Estimates clearly indicate a positive and significant incidence of EU payments, providing support to the capitalisation hypothesis. According to the results a 1% increase in government support translates into a 0.22% increase in the farmland price. On the contrary, the coefficient on ECP is not significantly different from zero.

Focusing on the other control variables, there is evidence that lower farmland rents are paid in regions where the average farm size is higher, other things being equal. Similarly, higher rents are paid in regions where farmers rely more on a managerial approach to farming, perhaps based on the use of more family than hired labour for agricultural production. The coefficient associated to fixed assets per ha is, in fact, statistically insignificant. Concerning the possibility that a higher demand for rented land (hence a higher rent paid) is due to the necessity of manure spreading, results suggest that a higher density of animal units does not increase the average farmland rents in a statistically significant manner. Finally, rents are higher in regions where the supply of land for rent is scarce, as an increase in the share of rented to total UAA contributes to the decline in farmland rents.

Turning to the spatial models' estimates, results are presented first for the SAR model, hence assuming that the spatial spillovers in prices, due to spatial contagion or spatial competition, have an impact on the formation of farmland rents at the regional level. SEM model results, confining spatial relations to unobservable components only, follow in the next column. Finally, SDM estimates are presented. As the model requires the estimation of a second set of parameters related to the spatial lags of covariates, these estimates are also reported.

Comparing estimates of the parameters in the θ vector across spatial models and with the baseline FE panel data model, it is possible to note a substantial degree of consistency, at least in the case of EU payments and model controls. Nonetheless, there are minor changes in the significance of the coefficients in the case of production values. The estimated coefficient is negative and, in absolute value, larger in spatial models in the case of cereals production, and is positive and significant in all models but the SDM in the case

[3] Actually ECP show an higher coefficient of variation but the value of the variable is in fact negligible for the majority of regions in the sample.

of vegetables and flowers. There is new evidence related to the production of fruits and wines and grapes, whose coefficients are negative and marginally significant in a few cases.

Table 2: FE and Spatial Panel Model Estimates (Maximum Likelihood)

	FE	**SAR**	**SEM**	**SDM**	
	θ	θ	θ	θ	φ
X-Cereals	-0.097**	-0.106***	-0.146***	-0.164***	0.549
	(0.046)	(0.038)	(0.042)	(0.039)	(0.373)
X-Energy Crops	-0.010	-0.010	-0.011	-0.016	0.056
	(0.013)	(0.010)	(0.011)	(0.011)	(0.079)
X-Veg and Flow	0.049*	0.049**	0.045**	0.035	-0.206
	(0.029)	(0.023)	(0.023)	(0.023)	(0.445)
X-Fruits	-0.022	-0.022	-0.022	-0.034**	-0.528
	(0.020)	(0.016)	(0.015)	(0.016)	(0.331)
X-Wines Grapes	-0.033	-0.034	-0.040*	-0.047**	0.047
	(0.030)	(0.024)	(0.024)	(0.024)	(0.333)
X-Olives	-0.046	-0.047	-0.045	-0.024	0.302
	(0.051)	(0.041)	(0.041)	(0.041)	(0.705)
X-Forage	-0.009	-0.011	-0.019	-0.031**	-0.046
	(0.019)	(0.016)	(0.016)	(0.016)	(0.234)
X-Other Crops	-0.039*	-0.039**	-0.042**	-0.046***	-0.207
	(0.021)	(0.016)	(0.016)	(0.016)	(0.275)
SAP	0.225***	0.224***	0.224***	0.229***	-1.175***
	(0.030)	(0.024)	(0.025)	(0.024)	(0.317)
ECP	0.002	0.001	-0.002	-0.002	0.322***
	(0.010)	(0.008)	(0.008)	(0.008)	(0.123)
Asize	-0.580***	-0.594***	-0.665***	-0.703***	3.466*
	(0.185)	(0.149)	(0.150)	(0.149)	(2.005)
FamLab	-0.442*	-0.448**	-0.469**	-0.525***	2.208
	(0.232)	(0.185)	(0.185)	(0.182)	(2.081)
FixAss	0.053	0.041	-0.007	-0.018	3.004***
	(0.097)	(0.078)	(0.081)	(0.079)	(0.917)
AnimalD	-0.116	-0.114*	-0.106*	-0.123*	-2.135**
	(0.083)	(0.066)	(0.066)	(0.065)	(1.029)
RentProp	-1.140**	-1.170***	-1.297***	-1.400***	-0.586
	(0.481)	(0.386)	(0.385)	(0.395)	(6.309)
ρ		0.324		-0.571	
		(0.265)		(0.423)	
λ			0.643***		
			(0.173)		

Notes to table : Standard Errors in parentheses. ***, ** and * indicate significance at 1%, 5% and 10% respectively.

Focusing on the issue of capitalisation more closely, there is comprehensive evidence that payments are capitalised into land rents. The extent of capitalization estimated in this paper is also sizeable as the figure of 0.22% indicated by the FE panel data model's estimates is, by and large, confirmed by all spatial panel models. However, the coefficient for ECP remains statistically insignificant.

The result for the effect of average farm size on farmland rents is also qualitatively confirmed by the spatial models, although the new coefficient estimates are larger, in absolute values, compared to the non-spatial case. Similarly, the effect related to the supply of farmland for rent is estimated positive, confirming what found previously in simple panel model. Finally, a weakly significant evidence of a relation between animal density and farmland rents appeared in two of the spatial models, namely the SAR and the SEM. In contrast to expectations, however, such relation is negative.

Although all spatial models have provided similar results in terms of both size and significance of the estimated coefficients, the SEM is the only in which the spatial effect is in fact significant. Accordingly, both the hypothesis of spatial price contagion and omitted spatially correlated variables can be excluded. In contrast, spatially heterogeneity is the most likely cause of spatial correlation in residuals. Furthermore, the fact that the linear model and the SEM produce very similar estimates of parameters in the θ vector should not be interpreted as evidence that spatial panel methods applied to the rental price equation are not necessary in the case of EU regions. On the contrary, the coefficient related to spatial error autocorrelation is highly significant on the one hand and, on the other hand, the issue of spatial heterogeneity evidenced in SEM should probably be explored more closely. In this respect, the evidence presented in this paper should be considered preliminary since the effect of heterogeneity will be addressed more carefully studying how the incidence of agricultural payments varies across the EU territories.

4. CONCLUSION

Much of the empirical literature on the capitalisation of agricultural subsidies in farmland rents in Europe is based on micro-evidence, usually related to a single country or region in Europe. Evidence of capitalisation put forward by these studies varies according to the geographical area of the study, the time horizon considered and the methodological approach of the study. Consequently, there is lack of consistent and easily comparable empirical evidence for the whole Europe.

The present paper contributes to this stream of literature by expanding the geographical scope of the empirical analysis to all countries in the group of EU25. In addition, the capitalisation hypothesis is empirically assessed relying on regional rather than farm-level data. Following the introduction of decoupled support, the level of payment per ha is expected to vary across different regions more than across different farms in the same region. In addition, decoupled support are in general related to the characteristics of the territory more than to those of the single farm and, accordingly, the territorial level is deemed more appropriate for the analysis of capitalisation. To deal with the econometric issues related to the use of information on contiguous areas, spatial panel econometric techniques are employed in this paper.

Evidence suggests that regional farmland rents are strictly related to the average amount of subsidies granted to farmers in the region. In Europe, an additional 1% increase in agricultural subsidies granted to farmers causes, on average, a 0.22% increase in farmland rents. This extra-rent is hence capitalised by land owners and transferred out of the agricultural sector. In addition to agricultural support, the level of farmland rents appears to be determined by other factors also. Most important is the average size of farms, as larger farms probably pay lower rents, alongside the managerial approach of farmers, as proxied by the ratio of family to total labour, and the scarcity of land for rent at the regional level.

5. REFERENCES

Breustedt, G. and Habermann, H. (2011). The Incidence of EU Per-Hectare Payments on Farmland Rental Rates: A Spatial Econometric Analysis of German Farm-Level Data. *Journal of Agricultural Economics* 62: 225–243.

Ciaian, P. and Kancs, d'Artis (2012). The Capitalization of Area Payments into Farmland Rents: Micro Evidence from the New EU Member States. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie* 60: 517–540.

Ciaian, P., Kancs, d'Artis and Michalek, J. (2011). *SPS Capitalization into Land Value : Generalized Propensity Score Evidence from the EU*. LICOS Discussion Paper.

Elhorst, J.P. (2010). Applied Spatial Econometrics: Raising the Bar. *Spatial Economic Analysis* 5: 9–28.

European Commission - EU FADN (2013). *EU farm economics 2012*. Brussels.

Guastella, G., Moro, D., Sckokai, P. and Veneziani, M. (2013). *The Capitalization of Area Payment into Land Rental Prices: Micro-evidence from Italy*. Second Congress of the Italian Association of Agricultural and Applied Economics (AIEAA).

Kilian, S., Anton, J., Roder, N. and Salhofer, K. (2008). *Impacts of 2003 CAP reform on land prices: from theory to empirical results*. 109th Seminar of the European Association of Agricultural Economists.

Kirwan, B.E. (2009) The Incidence of U.S. Agricultural Subsidies on Farmland Rental Rates. *Journal of Political Economy* 117: 138–164.

Lence, S.H. and Mishra, A.K. (2003). The Impacts of Different Farm Programs on Cash Rents. *American Journal of Agricultural Economics* 85: 753–761.

LeSage, J. and Pace, R.K. (2009). *Introduction to Spatial Econometrics*. Chapman & Hall.

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

Roberts, M.J., Kirwan, B. and Hopkins, J. (2003). The Incidence of Government Program Payments on Agricultural Land Rents: The Challenges of Identification. *American Journal of Agricultural Economics* 85: 762–769.

Swinnen, J., Ciaian, P. and Kancs, d' Artis (2008). *Study on the Functioning of Land Markets in the EU Member States under the Influence of Measures Applied under the Common Agricultural Policy*. Centre for European Policy Studies.