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Exploring drivers of farmland value and growth in Italy and Germany at regional level

The recent renewed growing attractiveness of investments in farmland for agricultural and non-agricultural reasons have raised new attention by European Union on factors able to influence the farmland value and on the enhancement of agricultural policies for supporting the development of European regions. Despite its importance, there is a very limited number of studies focusing on European context and a little concordance between the drivers affecting the farmland value and growth. Attempting to reduce the gap, this study investigates the determinants of farmland prices from 2000 to 2010 by exploring and comparing Italy and Germany that are interesting because of their similarity with respect to the outlined dichotomy between urbanized and farming counties/provinces. The comparison across models allows to discuss the cross-cutting and country-specific drivers affecting farmland value and the implication of these findings on agricultural policies recommendations.

1. Introduction

Farmland is one of the main production factors as well as the principal component of the fixed assets, accounting for roughly 80% of the value of total assets in US (USDA, 2005) and for 82% in Europe (EU Farm Economics Overview, 2009). As a result, farmland price has been recently considered to be key determinants of the financial health of a region (Borchers *et al.*, 2014). In this light, many studies attempted to define the agricultural and non-agricultural determinants of farmland price and its growth. A consistent number of these studies specifically focused on US land market. However, large differences exist between US and European background. Cavailhès and Thomas (2013) suggest that the analysis of farmland value in European countries, which are characterized by high population density, limited rural area and regulated land markets, is substantially different from large and sparsely populated countries, where rural landscapes cover a large proportion of the country, such as US and Canada. Comparatively few papers have explored the European land market (Ciaian *et al.*, 2010). This is likely due to the scarce consistency of the European data and a lack of structured data sources (Choumert & Phélinas, 2015).

Despite of these concerns the farmland prices is increased considerably in the last decades across European Regions due to the growing attractiveness of investments in agricultural land. The reasons are multiple. First, the continuous development of infrastructures and the increasing of urban sprawl have led to a larger

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request of land for real estate purpose (Livanis *et al.*, 2006; Cavailhès & Thomas, 2013). Second, the boom of bioenergy production and the highly-subsidized bioenergy cropping (Stokes & Cox, 2014) have further increased the demand of farmland. Third, the recent global crisis has reduced the profitability of other financial assets, leading to a (re)discovery of the agricultural sector, also by non-agricultural investors (Hüttel *et al.*, 2013; Baker *et al.*, 2014).

In addition, since agricultural land prices tend often to significantly vary across countries because of geographical, climate, political and market differences, lots of European studies were typically characterized to be focused on a single country or even more restricted areas. The final result has been to produce a number of case studies highlighting conflicting findings which have made hard to identify the real determinants of farmland value in Europe and define common agricultural policies at EU level.

In this light, we attempt to contribute to literature gap by exploring the factors affecting the level and the growth of farmland value in two significant European countries in terms of extent and relevance of agricultural activities. Specifically, a comparison analysis between Italy and Germany is developed in order to identify cross-cutting and country-specific determinants of farmland value in 2010 and in a 10-year window from 2000 to 2010. The modelling focuses on the farmland price value and growth as influenced by the level and the change over time of a number of explorable agricultural and non-agricultural factors. The lack of centralized European dataset as well as the attempt to make comparable two different countries lead to test a reductive number of variables if compared to literature and US background. Furthermore, following the reasons of Patton and McErlean (2003), spatial lag models are implemented in order to address the dichotomy between developed and rural regions which could support the presence of spatial effect on farmland value in these two countries.

Finally, a spatial lag model is implemented to test the relevant factors differently affecting the land price in the two countries. Even though linear hedonic modelling is the most widely adopted in this type of literature, the focus on geographic units (counties and provinces) and their distribution across more and less developed and urbanized areas drives the supposition about the spatial influence. Patton and McErlean (2003) confirms this supposition by studying the spatial effects within the agricultural land market in Northern Ireland. Recently, Kostov (2009) has discussed the spatial dependence issue in agricultural land prices arises because of the spatial fixity of land. In addition, if price of a land parcel might depend on the price of neighbouring parcels, this spatial link could be also stronger focusing on average value at county/province level. Results of Moran's I test further validate this potential assumption.

The findings suggest that land productivity, land fertility and land availability as well as agricultural holding size and urbanization factors affect the level and growth of farmland prices in different ways. On the one hand, productivity and fertility are critical in Italy but they influence farmland value more than growth in Germany. Livestock pressure, land availability and average holding size show contrasting findings depending on country. On the other hand, population density is mainly critical in Western Germany, the overall relationship between building and agricultural land prices is confirmed, and the number of permits is a better predictor in Germany than Italy.

The paper is structured as follows. The first section summarizes the literature reviews and collect the main studies exploring the agricultural and non-agricultural drivers of farmland value. The second section defines the contextual background exploring similarities and differences between Italian and German land market. The third section focuses on the operationalization and modelling of data. Finally, findings and political implications are discussed.

2. Previous studies and theoretical framework

Although several different approaches have been implemented to explore and analyse the farmland values (Polelli and Corsi, 2008), scholars have mainly implemented studies based on hedonic price method and Present Value Model (PVM).

The hedonic price method has become the standard empirical approach for modelling the determinants of agricultural land values (Delbecq *et al.*, 2014) and characteristics affecting farmland value have been studied by several authors (e.g. Huang *et al.*, 2006; Sills & Caviglia-Harris, 2009; Troncoso *et al.*, 2010; Feichtinger & Salhofer, 2013; Sklenicka *et al.*, 2013; Awasthi, 2014; Czyzewski & Trojanek, 2016). Farmland value is affected by many agronomical, economics, demographic and spatial factors (Huang *et al.*, 2006) and (Sklenicka *et al.*, 2013). Different classification systems of farmland value determinants have been adopted in literature and a large number of explanatory variables have been taken into account. Feichtinger and Salhofer (2013) define internal agricultural variables and external non-agricultural variables. Huang *et al.* (2006) classified productivity, neighbourhood, location, and environmental characteristics.

Several agricultural determinants are widely used in a number of studies. Sklenicka *et al.* (2013) discuss land size and land productivity as significant factors affecting farmland prices in Czech Republic. Nilsson & Johansson (2013) analyze farmland value in Sweden by focusing on land fertility, average size of farms, availability of land. A positive relation between soil quality and productivity of crops is typically suggested (Devadoss & Manchu, 2007; Nilsson & Johansson, 2013; Huang *et al.*, 2006). Increasing in crop productivity is also potentially related to recent boom in world demand for grain and for corn in ethanol production (Stokes & Cox, 2014). The livestock production in general and swine production in particular are further expected to affect proximate property values (Mela *et al.*, 2012; Drescher & MCNamara, 2000, Pirani *et al.*, 2016). According Ma & Swinton (2012), the cultivated land area as percentage of parcel for crops and pasture area as percentage of parcel for livestock are directly related to the tillable area on the land parcel.

Many authors support also the significance of non-agricultural factors in addition to agricultural ones. Delbecq *et al.* (2014) show the different impact of agricultural and urban productivity on the value of agricultural lands as depending on the rural or peri-urban location. Dirgasova *et al.* (2017) dispute the significance of relative more than absolute farmland size and proximity to district cities by referring to Slovakia market. The positive relationship between farmland price and proximity to capital cities is also claimed by Naydenov (2009) in Bulgaria. Hilal *et al.* (2016) focus on location (distance to regional capital, to closest urban center, to retail and public services) and productivity by exploring data provided by the French department of Côte-d'Or between 1992 and 2008. The proximity of land to urbanized areas is further expected to positively influence the value of land because of amenities and services as grocery stores, gas stations and educational facilities the cities offer (Stewart & Libby, 1998) and savings in transportation costs for farmers. The impact of environmental amenities is also supported by Uematsu *et al.* (2013) and Wasson *et al.* (2013). Similarly, Nilsson & Johansson (2013) explore the access to urban and rural amenities. Cavailhès and Thomas (2013) further argue farmland prices in Belgium increase with population density and growth, with the proximity to the center of urban areas and with per-capita income of the commune. Population growth is also assessed because of the effect on conversion rate of farmland to residential and commercial use (Forster, 2006, Pirani *et al.*, 2016). Competing potential land uses play a critical role in influencing the farmland price (Livanis *et al.*, 2006). Wen and Goodman (2013), Davis and Heathcote (2007) and Devadoss and Manchu (2007) dispute the positive relationship between land price and housing price. Hüttel *et al.* (2016) highlight price differentials potentially exist between farmer and non-farmer buyers because of different expected revenues from using the land. Temesgen and Dupraz (2014) perform an empirical analysis of farmland prices based on farmland sale market in the Bretagne Region of France by exploring farmers' competition and bargaining power of buyers.

Although in the last years it is less used, traditionally a relevant group of authors applied PVM for analysing agricultural land values. The PVM relates its current price to the infinite streams of future returns that holding the asset allows to earn, considering the returns to land the main driver of farmland price (Ay and Latruffe, 2013). The model developed by Just and Miranowski's (1993) first provided a comprehensive framework including all determinants that were suggested by the literature at their time of analysis.

Even in the PV approach different papers analysed the influence of several variable on farmland price and in particular different kinds of policy have been studied, including agricultural policies (Roberts *et al.*, 2003, Kirwan, 2009, Latruffe and Le Mouël, 2009; Feichtinger and Salhofer, 2011; Ciaian *et al.*, 2012b, Casini et al, 2015), land-use regulations (Jaeger *et al.*, 2012), land institutional and transaction regulations (Latruffe and Le Mouël, 2006, Latruffe and Davidova, 2007, Ciaian *et al.*, 2012a) in different context (e.g. France, former European communist countries, Greece).

Moreover, according to PVM urban influence on farmland price has been analysed by Plantinga *et al.* (2002), Livanis *et al.* (2006), Géniaux *et al.* (2011), Wu *et al.*, 2011, and Salois *et al.* (2012). Many authors define also the significance of factors concerning non-market goods. Specially many of them developed PVM focused on the role of water as a public good (Boisvert *et al.*, 1997, Horsch and Lewis, 2009). Others studied the influence of biological conservation (Naidoo *et al.*, 2006, Bode *et al.*, 2008) and suitable habitats for biodiversity (Lawley and Towe, 2013). Finally, a discussed paper on the effects of climate change on farmland price implementing PVM was published by Mendelsohn *et al.* (1994) and commented by several authors.

To sum up, even though a lot of factors have been adopted in order to explain the agricultural and non-agricultural determinants of the farmland value and growth, the most suitable factors at European level are likely related, on the one hand, to size and productivity of farming area, and on the other hand, to location and urbanization features.

3. Research design and methodology

3.1 Contextual background

Most of the previous studies focuses on single countries. This study attempts to extend the understanding of topic by analysing and comparing two European countries. The main reason is to achieve more robust findings at European level and identify cross-cutting and country-specific determinants of farmland value and growth. Extending the sample to other regions, even though desirable, was made problematic because of the lack of structured databases and comparable data.

Italy and Germany are specifically selected because, according the European agricultural census provided by EUROSTAT in 2000 and 2010, they are two of the most relevant European countries in term of utilised agricultural area and output value of agricultural industry at producer prices. In addition, they are also characterized by a similar dichotomic regional structure where strongly urbanized and industrial regions (Northern Italy and Western Germany) are compared to agriculture-based regions (Southern Italy and Eastern Germany).

However, despite of similarities, it needs to keep in mind that exists a historically different distribution of the categories of land use, mainly due to topographical differences and climatic conditions. Germany is characterized by a higher concentration level and a larger average holdings' size (Hüttel *et al.*, 2014). Italian farmland is more fragmented (Povellato, 1997; Gioia and Mari, 2012, Mela *et al.*, 2012). The difference in average size of farm (55.80 hectares in Germany against 11.13 hectares in Italy in 2010) mainly depends on the total number of holdings and the amount of utilised agricultural area. For instance, in 2010, there were 298,860 holdings for 16,926,200 hectares in Germany, and 1,590,802 holdings for 12,689,928 hectares in Italy. Likewise, if the German holdings with more than 100 hectares (11.3%) account for 55.1% of utilised agricultural area, in Italy they represent 1% of holding and just 26.2% of utilised agricultural area. Some differences concern also the farmland production. Whilst Italy has a stronger vocation for permanent crops, its amount is almost null in Germany. Differently, the share of arable land is higher in Germany than Italy. Moreover, they are opposite with respect to the national level of Gross Domestic Product (GDP) per capita and Agricultural Gross Value Added (AGVA) per hectare. Germany registers a higher GDP but lower AGVA than Italy.

Finally, the last difference regards the evolution of farmland prices over the time. The price in both Eastern and Western Germany is stable from 1993 to 2007 and then it increases fast reaching in 2014 a price 2.8 times bigger than in 1993. In contrast, in Italy the price increases more lowly but constantly from 1993 to 2014. Since the first 90s, the value of land has started to grow in the whole country, but with two different rates, especially after the EUR was introduced. If the northern part of the Peninsula seems to be affected by a consolidated and positive growth, the South has shown a stagnant situation across the considered period.

3.2 Data and variables

The lack of structured database organized at European or national level has been already underlined. As consequence, data were required to be collected from different sources. German farmland values were directly collected from each Statistic Institution of the Federal States, while data about influencing factors were provided by DESTATIS (Statistiches Bundesamt). Differently, the Italian database merges data from ISTAT (Italian Statistic Institute), Revenue Agency (Osservatorio del Mercato Immobiliare) and INEA (Istituto Nazionale di Economia Agraria). In despite of attempt to make comparable the two datasets, some differences were preserved.

Cross-sectional data were collected at NUTS-3 level (counties for Germany and provinces for Italy) in order to assess the determinants of farmland value in 2010 and growth from 2000 to 2010. Two different depending variables are defined in order to analyse the impact of agricultural and non-agricultural factors respectively on the level and the growth of farmland value. In the first model setting, the level of farmland value in 2010 (*LVAL_2010*) is regressed with respect to the value of exploratory variables as measured in 2000. It is operationalized by the log of the average per hectare price of agricultural land at county/province level. Several studies empirically adopted the logarithmic transformation of land price for a more robust modelling (Sklenicka *et al.*, 2013; Uematsu *et al.*, 2013; Czyzewski & Trojanek, 2016). Nilsson and Johansson (2013) specifically used the log of average price per hectare as measured at municipal level. In addition, Hüttel *et al.* (2013) argue a log-linear model is to be preferred to simple linear model or log-log model. In the second model setting, the farmland value growth (*LVAL_growth*) is adopted and it is defined as the variation rate from 2000 to 2010. In addition to other regressors, the farmland value as referred to 2000 (*LVAL_2000*) is also introduced as control variable potentially explaining the farmland value growth.

A number of exploratory variables, classified in agricultural and non-agricultural factors, are operationalized as follows.

It is widely recognized that the price of agricultural land strongly depends on the quality and structure of site characteristics. Productivity represents potential profits obtainable from land and it is often used as proxy of land quality (Mela *et al.*, 2012). Since productivity is primarily related to the income generating capacity of the land, including crop productivity, government payments, credit policies and technological change (Tsoodle *et al.*, 2006), it is here operationalized as the agriculture gross value added per hectare (*GVAAGRI_HA*) which is the value of goods and services produced by agricultural sector standardized per hectare at local level.

Across the agricultural determinants, the amount of land represents one of the principal factor in the creation of a market because a limited bid can influence the breakeven-point and consequently the price definition process. For this reason, the quantity of utilized agricultural area in each district (*UAA_TOT*) has been taken as factor describing the availability of agricultural land. Similarly, the land value is expected to increase alongside the farm size (Levia and Page, 2000). In this light, the average size of agricultural holdings at local level (*HOLD_AV*) is used to address the effects of scale economies in the agricultural sector (Nilsson & Johansson, 2013).

The differences in the price of agricultural land also reflect regional variations in natural prerequisites such as soil quality and climate conditions. Since Devadoss & Manchu (2007), Nilsson & Johansson (2013) and Huang *et al.* (2006) suggest a positive relation between soil quality, land fertility and productivity of crops, hundreds of kilos per hectare of wheat (*WHEAT_HA*) has been taken as yeld of agricultural land. Moreover, the share of permanent crop on total amount of agricultural area (*PERM_CROP*) are computed as indicators of weight of permanent crops, that are able to generate higher revenue per unit (acre) basis as compared to temporary crops. Similarly, livestock production in general and swine production in particular are expected to affect property values (Mela, *et al.*, 2012; Drescher & MCNamara, 2000). Hüttel *et al.* (2013) underline a positive relationship between the livestock density and the regional demand for land. Thus, the livestock pressure (*LSU_HA*) is introduced as the number of livestock unit per hectare of utilised agricultural area. Productivity of crops and livestock production are both introduced in order to control for eventual differences in the structure of agricultural sector, since Italy is characterized by a more crop-based agriculture whilst Germany is traditionally more livestock-oriented.

Population density (*POP_DEN*) is adopted as measure of residential development, access to amenities and urbanization level of the area where the farmland is located (Stewart & Libby, 1998; Maddison, 2009; Nilsson & Johansson, 2013; Cavailhès & Thomas, 2013). Specifically, it is operationalized as logarithm of number of inhabitants per km^2. In addition, gross domestic product (GDP) and gross value added per capita are collected since per capita income has consistently been shown to be a critical factor in explaining the urban sprawl (Guiling *et al.*, 2009). Mela *et al.* (2012), Huang *et al.* (2006) and Maddison (2009) provides evidences of positive influence of per capita GDP on farmland price. However, because of their high correlation with population density, they are not introduced in the model for avoiding collinearity issues.

Since urban proximity can also increase agricultural returns in addition to increasing the option value from future urban conversion (Livanis *et al.*, 2006) and a significant relationship seems to exist among the dynamics of house prices and land prices (Devadoss & Manchu, 2007; Wen & Goodman, 2013), the number of residential and non-residential building permits (*PERM_BUILD*) have been taken as a proxy of potential conversion rate related to the urban sprawl and the relative speculative demand for land. In addition, the average price per square meter of residential buildings in Italy and the price per square meter of building lands in Germany (*PR_BUILD*) have been adopted as indicator of the future potential value of land.

3.3 Descriptive statistics

Logarithmic distributions of farmland prices are very similar across countries and time (Figure 1). Table 1 provides descriptive statistics of the data for sale prices at county/province level. The German average price is lightly higher than Italian one in 2000 but they are inclined to converge in 2010. Minimum values are also very closed in 2000 even if they considerably diverge in 2010 (the German value grows more). Differently, the Italian maximum value is lower than German one in both 2000 and 2010 but it grows more. In other words, despite of the same average growth rate, Germany mainly registers a relevant increase of the minimum price level of lands while Italian prices grow more in the right tail (as suggested by the grey areas in Figure 1).

Furthermore, looking at average values, on the one hand, the German counties are more densely populated and are characterized by larger agricultural holdings. On the other hand, the Italian provinces have a larger utilized agricultural area, higher productivity and higher livestock pressure per hectare. Finally, the latter averagely register higher building prices and release a larger number of building permits.

The geographical representation of farmland value and growth rate (Figure 2) also shows higher values in the North (specifically concentrated in the North-

Figure 1. Density distribution of farmland value.

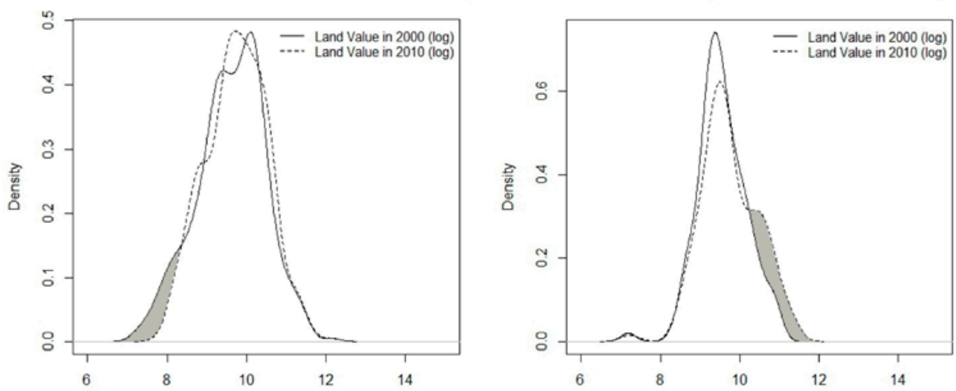
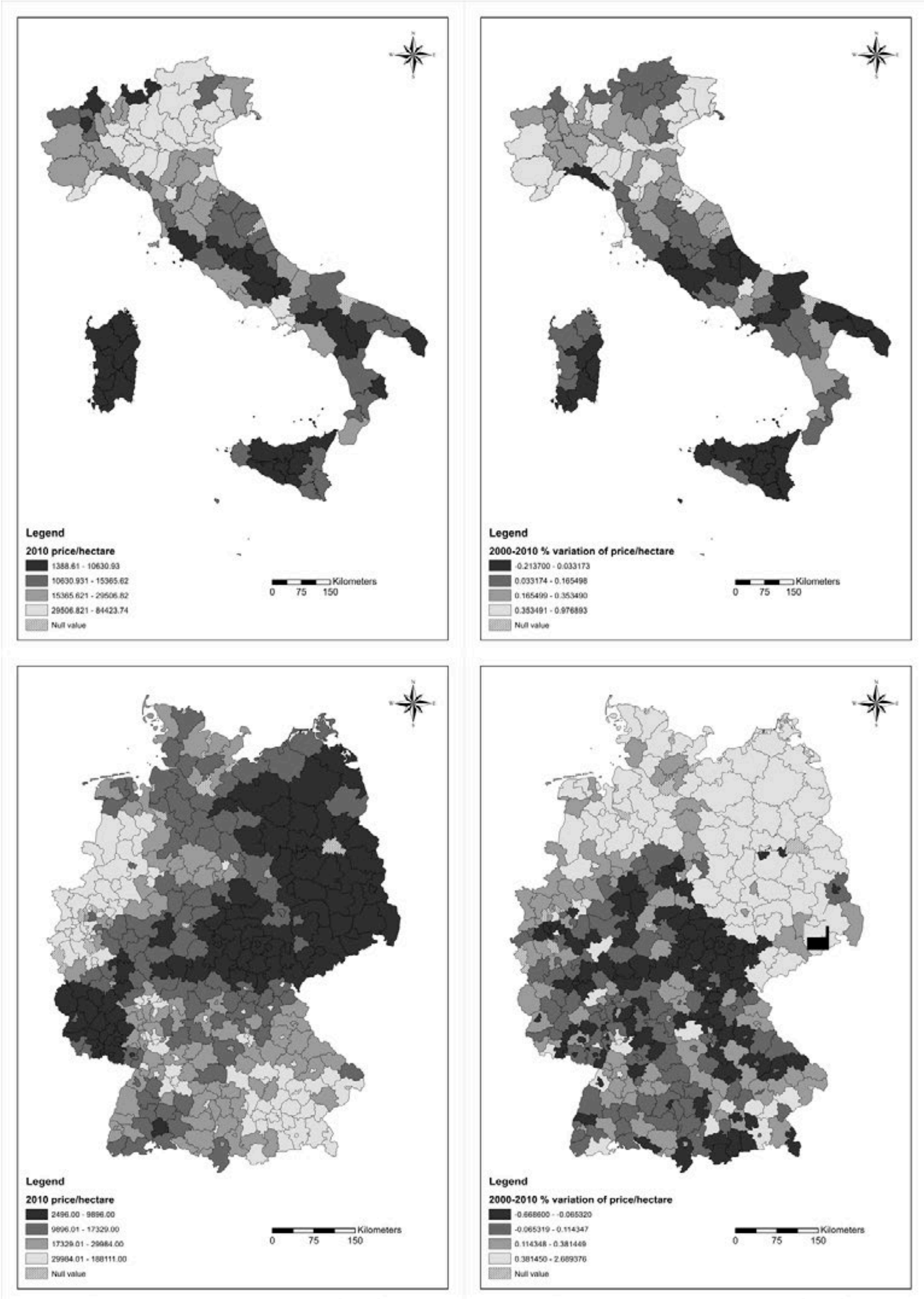


Table 1. Descriptive statistics (Italy and Germany).

	Variables	Germany					Italy				
		Nuts3	Min	Median	Mean	Max	Nuts3	Min	Median	Mean	Max
1.	*LVAL_2000 (log)*	402	7.20	9.66	9.61	12.14	107	7.19	9.50	9.56	10.90
2.	*LVAL_2010 (log)*	402	7.82	9.76	9.74	12.15	107	7.24	9.64	9.74	11.34
3.	*LVAL_growth*	402	-0.67	0.11	0.21	2.69	107	-0.21	0.17	0.21	0.98
4.	*GVAAGRI_HA*	402	231.40	1155.00	1697.90	53229.60	107	425.90	2365.50	2839.70	13103.60
5.	*PERM_CROP*	402	0.00	0.00	0.02	0.64	107	0.00	0.15	0.19	0.68
6.	*WHEAT_HA*	402	0.00	68.50	69.14	105.00	107	15.00	37.00	41.12	75.31
7.	*LSU_HA*	402	0.04	0.70	0.79	3.25	107	0.08	0.58	0.85	5.38
8.	*UAA_TOT*	402	231.00	34533.00	42775.00	376705.00	107	2199.00	114003.00	123423.00	500844.00
9.	*HOLD_AV*	402	6.23	28.79	55.41	301.79	107	0.82	6.17	7.43	31.58
10.	*POP_DENS*	402	42.69	202.40	522.83	3895.15	107	16.75	161.53	232.81	2612.17
11.	*PERM_BUILD*	402	38.00	495.00	576.90	4159.00	107	84.00	452.00	613.80	2455.00
12.	*PR_BUILD*	402	9.08	59.31	92.80	1086.41	107	376.10	1079.20	1143.90	2872.10

Figure 2. Spatial distribution of farmland value and growth.



east) more than in the South of Italy. Similarly, the growth rate of prices is also focused on the North but it is more heterogeneously distributed across provinces. The German counties appear more spatially depending. In the North of Germany, farmland prices decrease moving from West to East. Differently, in the South of Germany, the trend is opposite. Looking at growth rate, the increase of prices is more in the Northern and Eastern Germany.

3.4 Method

Several previous studies have argued the spatial dependence of farmland prices on neighbouring prices at parcel level (Maddison, 2009; Hüttel *et al.*, 2013). If it is very reasonable that neighbouring plots represent a reference for valuation because of similarities related to soil quality, climate, water access and other local sub-district features, adopting a municipal unit of analysis does not exclude spatial autocorrelation issues. Patton & McErlean (2003) highlighted in the North Ireland the existence of less favoured sub-markets, due to differences in agricultural production and to the effect of targeted government policy, able to influence the farmland prices in a given area. In the case of German farmland, Lehn & Bahrs (2018) claim that prices in one municipality can be influenced by realized prices in neighbouring areas. Guastella *et al.* (2017) in their study on land use efficiency in the municipalities of the Lombardy region in Italy explore the impact of the spatial lag of the farmland values at municipal level. In addition, we have already underlined that both Italy and Germany are characterized by a similar dichotomy structure which shows an outlined distinction between a more urbanized and developed area and a more rural and less favoured one. In this light, we expect a higher average farmland price in a given municipality when the farmland prices of neighbouring municipalities are higher regardless of specific agricultural or not-agricultural features. In other words, farmlands with similar characteristics in terms of land fertility and productivity as well as proximity to urban areas might show significant differences in prices due to their closeness to less favoured districts. Such a potential spatial dependence among observations cannot be ignored. Moran's I test on farmland value and growth confirms the potential relevance of spatial autocorrelation for both countries. Moran I statistics computed on the linear regression residuals reveal strongly more significant values for Germany than Italy.

In order to apply the appropriate model specification, spatial correlation need to be considered by implementing a spatial lag or spatial error model. The former introduces the spatially weighted average of the prices (spatially lagged dependent variable) as an additional explanatory variable. The latter a modelling of spatially autoregressive process of the disturbances. The findings of the specification test based on the Lagrange Multiplier (LM) suggest spatial lag is strongly to prefer to spatial error modelling.

Additionally, regional variables at NUTS2 level are included as location dummies to reduce the potential spatial correlation (Hüttel *et al.*, 2013)

The model finally used is given by the following formula:

$$y_i = \varrho \sum_j W_{ij}\, y_i + \sum_k x_{ik}\, \beta_k + \sum_c d_{ic}\, \delta_c + e_i \tag{1}$$

where y_i is the dependent variable (respectively the logarithmic transformation of farmland price and the growth rate) and i represent the observation at county/province level. W_{ij} denotes the row-standardized spatial weighting matrix[1] such that $S_j w_{i\text{-}j} y_i$ means the spatially-lagged dependent variable with $i^1 j$. Thus, r may be interpreted as the effect of the average prices of the neighboring districts. X_k represent the k explanatory variables and d_c denotes the c regional dummy-variables. b_k and d_c are the respective arrays of regressive parameters and e_i is the disturbance term.

Specifically, Table 4 and 5 respectively report the spatial lag models for Italian and German sample. Model 1, in both tables, measures the impact of explanatory variables as referred to 2000 on the average farmland price at local level in 2010. Model 2 assesses the influence of the same explanatory variables on the growth rate of farmland price from 2000 to 2010. Finally, model 3 computes the growth rate as dependent variable but introduces as determinants the change of explanatory variables from 2000 to 2010. *LVAL_2000* is introduced as explanatory variable of growth rate only in the model 3. In model 1 and 2 it produces collinearity disturbance due to strong correlation with other productivity and fertility terms, such as *GVAAGRI_HA* and *WHEAT_HA*. Table 2 and 3 shows correlation matrix[2] for Italy and Germany. Average and maximum Variance Inflation Factor (VIF) values are also reported per model in Table 4 and 5.

4. Results

The results of log linear spatial lag model for farmland value are shown in model 1 of Table 4 and 5. Model 2 and 3 respectively estimates the impact of explanatory variables and their change on the growth of farmland value. Model from 4 to 6 reproduce the previous models by reducing the sample to Western Germany and Centre-Northern Italy. Following results distinguish between agricultural and non-agricultural determinants of price and its growth, and compare German and Italian context.

On the one hand, the land productivity (*GVAAGRI* in all models of Table 4) in Italy positively affects both farmland value and growth. Similarly, it is positively

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1 The spatial weighted matrix is based on the Queen contiguity scheme as extrapolated by the coordinates of counties/provinces provided in the appropriated shapefiles. The *R*'s package *spdep* allows to build a neighbours list based on counties/provinces with contiguous boundaries, that is sharing a single boundary point, and then the corresponding row-standardized matrix.

2 Correlation matrix as referred to change of explanatory variables is not shown because of lower correlation level. It is also confirmed by the lower VIF values in model 3 with respect to model 1 and 2 of Table 4 and 5.

Table 2. Correlation matrix (Germany).

	Variables	1	2	3	4	5	6	7	8	9	10	11	12
1.	*LVAL_2000 (log)*	1											
2.	*LVAL_2010 (log)*	0.91***	1										
3.	*LVAL_growth*	-0.50***	-0.11*	1									
4.	*GVAAGRI_HA*	0.44***	0.44***	-0.12*	1								
5.	*PERM_CROP*	0.09*	0.06	-0.07	0.21***	1							
6.	*WHEAT_HA*	0.30***	0.32***	-0.06	0.04	0.01	1						
7.	*LSU_HA*	0.16**	0.23***	0.06	-0.03	-0.27***	0.09†	1					
8.	*UAA_TOT*	-0.42***	-0.26***	0.49***	-0.17***	-0.16**	0.04	0.11*	1				
9.	*HOLD_AV*	-0.61***	-0.55***	0.40***	-0.16**	-0.17***	-0.20***	-0.34***	0.52***	1			
10.	*POP_DENS*	0.47***	0.47***	-0.12*	0.25***	0.08	0.14**	-0.15**	-0.48***	-0.23***	1		
11.	*PERM_BUILD*	0.00	0.13*	0.24***	-0.02	-0.06	0.18***	0.18***	0.36***	0.00	0.01	1	
12.	*PR_BUILD*	0.56***	0.55***	-0.18***	0.15**	0.11*	0.00	-0.11*	-0.34***	-0.3***	0.55***	0.16**	1

Note: significance levels are '***' p<0.001; '**' p<0.01; '*' p<0.05; '†' p<0.1.

Table 3. Correlation matrix (Italy).

Variables	1	2	3	4	5	6	7	8	9	10	11	12
1. *LVAL_2000 (log)*	1											
2. *LVAL_2010 (log)*	0.97***	1										
3. *LVAL_growth*	0.47***	0.65***	1									
4. *GVAAGRI_HA*	0.58***	0.56***	0.29**	1								
5. *PERM_CROP*	0.08	0.00	-0.24*	0.32***	1							
6. *WHEAT_HA*	0.56***	0.62***	0.56***	0.12	-0.44***	1						
7. *LSU_HA*	0.44***	0.47***	0.35***	0.14	-0.35***	0.55***	1					
8. *UAA_TOT*	-0.06	-0.10	-0.21*	-0.37***	-0.05	-0.03	-0.01	1				
9. *HOLD_AV*	-0.11	-0.04	0.19*	-0.26**	-0.62***	0.38***	0.41***	0.06	1			
10. *POP_DENS*	0.38***	0.34***	0.04	0.54***	0.19†	0.14	0.09	-0.24*	-0.08	1		
11. *PERM_BUILD*	0.36***	0.35***	0.15	-0.01	0.02	0.29**	0.25**	0.35***	-0.06	0.14	1	
12. *PR_BUILD*	0.30**	0.31**	0.21*	0.19*	-0.25**	0.19*	0.01	-0.03	0.05	0.20*	0.11	1

Note: significance levels are '***' $p<0.001$; '**' $p<0.01$; '*' $p<0.05$; '†' $p<0.1$.

Table 4. Spatial lag models for Italian context.

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Dependent variable	*LVAL_ HA2010*	*LVAL_ growth*	*LVAL_ growth*	*LVAL_ HA2010*	*LVAL_ growth*	*LVAL_ growth*
Intercept	8.555 (0.918)***	0.076 (0.050)	0.086 (0.048) †	8.691 (1.040)***	0.172 (0.052)***	0.089 (0.045) †
Rho (weighted average of neighbor prices)	0.096 (0.099)	0.090 (0.126)	0.072 (0.122)	0.096 (0.109)	0.081 (0.140)	0.051 (0.136)
LVAL_HA2000			0.047 (0.021)*			0.054 (0.023)*
GVAAGRI_HA	0.251 (0.052)***	0.060 (0.025)*	0.046 (0.017)*	0.250 (0.057)***	0.062 (0.028)*	0.052 (0.021)*
UAA_TOT	0.041 (0.041)	-0.036 (0.020) †	0.018 (0.018)	0.040 (0.046)	-0.035 (0.022)	0.021 (0.023)
HOLD_AV	-0.072 (0.050)	0.007 (0.023)	-0.047 (0.022)*	-0.050 (0.054)	0.006 (0.026)	-0.054 (0.024)*
PERM_CROP	0.101 (0.055) †	-0.015 (0.026)	0.023 (0.019)	0.115 (0.062) †	-0.015 (0.030)	0.033 (0.022)
WHEAT_HA	0.194 (0.061)**	0.057 (0.030)*	-0.045 (0.016)**	0.190 (0.066)**	0.058 (0.032) †	-0.044 (0.019)*
LSU_HA	0.168 (0.046)***	0.006 (0.021)	0.005 (0.017)	0.171 (0.050)***	0.005 (0.023)	0.004 (0.024)
POP.DENS	0.001 (0.042)	-0.052 (0.020)*	-0.012 (0.016)	-0.004 (0.045)	-0.052 (0.022)*	-0.074 (0.059)
PERM_BUILD	0.076 (0.042) †	0.031 (0.020)	-0.025 (0.016)	0.076 (0.045) †	0.030 (0.022)	-0.023 (0.018)
PR_BUILD	0.076 (0.041) †	0.005 (0.020)	-0.015 (0.017)	0.103 (0.048)*	0.006 (0.023)	-0.014 (0.019)
Location dummies						
South	0.127 (0.124)	0.094 (0.059)	0.017 (0.064)			
Center	0.275 (0.145) †	0.149 (0.070)*	0.104 (0.066)	0.125 (0.137)	0.054 (0.067)	0.100 (0.063)
North-East	0.578 (0.198)**	0.162 (0.090) †	0.194 (0.087)*	0.429 (0.187)*	0.068 (0.088)	0.195 (0.074)**
North-West	0.227 (0.166)	0.162 (0.082)*	0.225 (0.076)**	0.076 (0.168)	0.069 (0.085)	0.220 (0.066)***
Statistics						
N	107	107	105	90	90	88
Log-Likelihood	-37.512	41.291	45.487	-36.455	28.080	33.230
AIC (AIC lm)	107.02 (105.86)	-50.583 (-52.186)	-56.974 (-58.688)	102.91 (101.63)	-26.160 (-27.901)	-34.461 (-36.343)
Average Vif	1.409	1.409	1.180	1.397	1.397	1.201
Max Vif	1.810	1.810	1.370	1.654	1.654	1.305

Note: in Model 3 predictors are computed as change in explanatory variables; Models 4, 5 and 6 adopt a limited subset of data excluding provinces of southern Italy and islands; VIF values are measured on pooling model; significance levels are '***' p<0.001; '**' p<0.01; '*' p<0.05; '†' p<0.1.

Table 5. Spatial lag models for German context.

	Model 1	Model 2	Model 3	Model 4 [a]	Model 5 [a]	Model 6 [a]
Dependent variable	*LVAL_ HA2010*	*LVAL_ growth*	*LVAL_ growth*	*LVAL_ HA2010*	*LVAL_ growth*	*LVAL_ growth*
Intercept	4.711 (0.421)***	0.679 (0.131)***	0.480 (0.114)***	5.289 (0.531)***	0.134 (0.108)*	0.164 (0.026)**
Rho (weighted average of neighbor prices)	0.444 (0.046)***	0.163 (0.065)*	0.219 (0.063)***	0.480 (0.052)***	0.215 (0.074)**	0.252 (0.072)***
LVAL_HA2000			-0.156 (0.028)***			-0.158 (0.026)***
GVAAGRI_HA	0.261 (0.055)***	0.056 (0.052)	0.012 (0.019)	0.268 (0.059)***	0.039 (0.045)	0.018 (0.020)
UAA_TOT	-0.027 (0.029)	0.079 (0.027)**	0.037 (0.018) †	-0.099 (0.053) †	0.098 (0.040)*	0.027 (0.032)
HOLD_AV	0.176 (0.047)***	0.055 (0.043)	-0.004 (0.021)	0.300 (0.186)	0.016 (0.140)	-0.025 (0.023)
PERM_CROP	0.019 (0.021)	0.020 (0.020)	-0.021 (0.015)	0.026 (0.025)	0.009 (0.019)	-0.021 (0.013) †
WHEAT_HA	0.103 (0.024)***	-0.013 (0.023)	0.026 (0.018)	0.089 (0.029)**	-0.007 (0.022)	0.003 (0.019)
LSU_HA	0.034 (0.022)	0.071 (0.021)***	-0.011 (0.016)	0.058 (0.027)*	0.058 (0.021)**	0.036 (0.022)
POP.DENS	0.0203 (0.032)***	0.036 (0.030)	0.017 (0.022)	0.183 (0.036)***	0.024 (0.027)	0.068 (0.025)**
PERM_BUILD	0.071 (0.025)*	-0.012 (0.023)	0.040 (0.020)*	0.083 (0.032) †	-0.038 (0.024)	0.044 (0.018)*
PR_BUILD	0.061 (0.025)*	-0.011 (0.024)	0.018 (0.019)	0.057 (0.027) †	0.008 (0.020)	0.001 (0.067)
Location dummies						
BW	0.890 (0.158)***	-0.052 (0.149)***	-0.314 (0.132)*			
BY	1.215 (0.156)***	-0.607 (0.145)***	-0.332 (0.127)**	0.306 (0.067)***	-0.092 (0.050) †	-0.060 (0.053)
HE	0.807 (0.156)***	-0.573 (0.156)***	-0.428 (0.133)**	-0.085 (0.088)**	-0.071 (0.066)	-0.111 (0.069)
MV	0.223 (0.152)***	0.128 (0.144)	0.231 (0.150)			
NI	0.826 (0.150)***	-0.3332 (0.140)*	-0.129 (0.112)	-0.101 (0.106)	0.191 (0.081)*	0.173 (0.063)**

	Model 1	Model 2	Model 3	Model 4 [a]	Model 5 [a]	Model 6 [a]
NW	0.859 (0.161)***	-0.584 (0.153)***	-0.288 (0.129)*	-0.054 (0.091)	-0.035 (0.069)	0.027 (0.060)
RP	0.579	-0.664	-0.584	-0.307	-0.126	-0.251
	(0.148)***	(0.150)***	(0.126)***	(0.088)	(0.064)*	(0.066)***
SH	0.698	-0.247	-0.070	-0.161	0.259	0.192
	(0.188)***	(0.175)	(0.133)	(0.155)	(0.120)*	(0.094)*
SL	0.636	-0.529	-0.529	-0.272	-0.001	-0.167
	(0.182)***	(0.181)**	(0.159)***	(0.163)	(0.0118)	(0.114)
SN	0.204	0.002	-0.064			
	(0.130)	(0.124)	(0.133)			
ST	0.077	-0.240	-0.121			
	(0.124)	(0.118)*	(0.121)			
TH	0.088	-0.987	-0.819			
	(0.114)	(0.127)***	(0.130)***			
Statistics						
N	384	384	378	308	308	304
Log-Likelihood	-115.510	-86.502	-75.965	-103.955	-9.627	-0.598
AIC (AIC lm)	279.010 (356.91)	221.000 (225.000)	201.930 (210.810)	245.910 (314.090)	57.254 (62.806)	41.197 (50.343)
Average Vif	1.588	1.588	1.278	1.572	1.572	1.197
Max Vif	2.846	2.846	1.835	1.974	1.979	1.389

Note: a) Models 4, 5 and 6 adopt a limited subset of data excluding counties of Eastern Germany; VIF values are measured on pooling model; significance levels are '***' p<0.001; '**' p<0.01; '*' p<0.05; '†' p<0.1.

related to the German farmland price level even though it does not impact on its growth rate (*GVAAGRI* is significant only in models 1 and 4 of Table 5). On the other hand, the level of farmland fertility, measured as productivity of crops (*WHETA_HA*), specifically influences the farmland price in both countries. However, if a growth of fertility is inversely related to growth of price in Italy, no effect on growth rate is shown for German sample. No relevance has the share of permanent crops (*PERM_CROP*), while the effect of livestock pressure (*LSU_HA*) is different. It drives the farmland value in Italy, the farmland value growth in Germany, and both value and growth in Western Germany. No linkage seems exist between growth of livestock pressure and growth of price (in model 3 and 6 of Table 4 and 5).

As previously introduced in the section concerning the descriptive statistics, high-value farmlands are inclined to grow more in Italy. The opposite effect is registered in Germany. *LVAL_2000*, in fact, is positive and significant in both model

3 and 6 of Table 4, while it is negative and significant in the respective models of Table 5.

Looking at local availability of lands (*UAA_TOT*) and average size of agricultural holdings (*HOLD_AV*), the findings change across countries. In Italy, the former is not a significant driver neither of farmland value neither of its growth, the latter has no effect on value but it negatively affects the growth rate. This confirms the lack and scarce relevance of large agricultural holding in the country. It is different in Germany, where the higher the availability of land, the higher is the growth of farmland prices. In other words, the value of farmland grows faster in counties with largely utilized agricultural areas, above all in Eastern Germany. This finding, in fact, is less significant when such counties are excluded by the analysis (model 4-6 in Table 5). Similarly, the size of agricultural holding is critical in Western Germany where the size positively affects the level more than the growth of farmland prices.

Finally, the potential effects of urbanization are measured by looking at population density, building land value and number of building permits. The findings firstly suggest a low positive relationship exists between building and agricultural land prices. However, no effect on growth is identifiable. Secondly, building permits affect the farmland value but change in the number is a good predictor of value growth only in the German context. Population density is insignificant determinant of Italian farmland value but positively affects the price level of agricultural lands in Germany. Moreover, population density predicts the growth of farmland prices in both countries but with contrasting findings. On the one hand, the Italian farmland value is inclined to decrease in higher populated and urbanized areas. On the other hand, the population change rather than density positively affects the growth of prices only in Western Germany.

5. Discussion and conclusion

This study points to explore the cross-cutting and country-specific drivers affecting farmland value and growth by focusing on comparison between two European countries, Italy and Germany.

The comparative analysis suggests a number of cross-cutting determinants of farmland price. However, they specifically characterize level rather than growth. In this light, the main cross-cutting determinants of the farmland price level are land productivity, land fertility, building price and permits. Some country-specific drivers of farmland price level are also livestock pressure for Italy and holding size and population density for Germany. Differently, no common determinants are to be referred to farmland price growth. This explicitly depends on country-specific factors. Italian growth is positively affected by land productivity and fertility, and negatively depends on average size of agricultural holdings and population density. In contrast, German growth is mainly influenced by availability of land, livestock pressure and building permits. These concerns suggest that farmland price growth more than level can be strongly influenced by local agricultural policies and that the implications of local decision makers should be adequately discussed and assessed (also involving specialists of the field) at European level.

In addition, the ambiguous effect of the average regional price level on its growth and the lack of significant spatial dependency in the Italian context need to be underlined. Concerning the former issue, the previous farmland value negatively affects the growth of prices in Germany. In other words, the price of low-value lands increases faster than high-value lands. This suggests that the change in German farmland prices leads to a higher concentration around an average national value. Therefore, the higher growth rates of Eastern Germany may reflect the results of local policies to stimulate the agricultural development of Eastern Germany and reduce the gap with the more productive and consolidate structure of agricultural industry in Western Germany. Differently, Italy appears to be mainly characterized by a more homogeneous growth of farmland prices, even though they are inclined to increase above all in the North-east (Povellato, 1997; Gioia and Mari, 2012). . This is likely due to the massive growth of wine cultivation as supported by national incentives, increasing demand and large export opportunities. Secondly, the weighted average of neighbor prices is a critical factor in Germany rather than Italy. Despite the significant of Moran test as referred to the distribution of farmland value in both countries, regression modelling highlights spatial parameter is significant only for farmland prices of German counties. In Italy, value and growth of farmland prices do not depends on spatial contextualization but rather on regional more than national capacity to support the local development of agricultural industry (Schimmenti *et al.*, 2013). Differently, the spatial cohesion of German farmland prices is likely the result of a broader agricultural national planning.

The comparison between the farmland markets of the two countries can be read as a face-off between two agricultural of agricultural systems, the Middle European and the Mediterranean, which represent two different forms of agricultural system. The first more oriented to industrial agriculture and the latter to typical products. Farmland market is the result of the evolution of agriculture as a function of the territorial, climate, historical background in the common framework of European agricultural policy regulation.

Some limitations of the study need to be further explicated. First, the spatial limitation of the study to two European countries may influence the potential extending of findings. Different regional backgrounds may lead different results. In this light, the building of extended data warehouse involving a large number of EU regions is desirable in order to achieve more robust and widely acceptable findings. Second, the quality and the scale of data on farmland value in European countries are a strong limitation in the quality of the output of this paper and any other work on this issue. In fact, data at macro-regional, regional and district level don't take into account the geographical and geomorphological differences and the specific productive context including crops and livestock local specialization. Moreover, the lack of data makes difficult to test all potential determinants. Modelling may be further improved by looking at other factors such as climate conditions, water availability, agricultural amenities or local policies. Finally, the analysis explores the average effect of agricultural and non-agricultural drivers on farmland value at county/province level. It may be interesting to control at parcel level by analyzing land transactions.

References

Awasthi, M. K. (2014). Socioeconomic determinants of farmland value in India. *Land use policy*, *39*, 78-83.

Ay J. S. and Latruffe L. (2013) The Empirical Content of the Present Value Model: A survey of the instrumental uses of farmland prices, *Factor Markets Working Papers, No. 53,* June 2013

Baker, T. G., Boehlje, M. D., & Langemeier, M. R. (2014). Farmland: is it currently priced as an attractive investment? *American Journal of Agricultural Economics*, *96*(5), 1321-1333.

Sustainability2018,10, 123; doi:10.3390/su10010123www.mdpi.com/journal/sustainability

Bode, M., Wilson, K., Brooks, T., Turner, W., Mittermeier, R., McBride, M., Underwood, E. and H. Possingham (2008) Cost-effective global conservation spending is robust to taxonomic group, *Proceedings of the National Academy of Sciences, Vol. 105, No. 17*.

Boisvert, R., Schmit, T. and A. Regmi (1997) Spatial, productivity, and environmental determinants of farmland values, *American Journal of Agricultural Economics, Vol. 79, No. 5*, pp. 1657-1664.

Borchers, A., Ifft, J., & Kuethe, T. (2014). Linking the price of agricultural land to use values and amenities. *American Journal of Agricultural Economics*, *96*(5), 1307-1320.

Casini, L., Marone, E., Scozzafava, G. (2015) Analisi del rapporto tra valori fondiari e aiuto pubblico: possibili effetti sui cambiamenti di uso del suolo, AESTIMUM 66, Giugno 2015: 63-78

Cavailhès, J., & Thomas, I. (2013). Are agricultural and developable land prices governed by the same spatial rules? The case of Belgium. *Canadian Journal of Agricultural Economics/Revue canadienne d'agroeconomie*, *61*(3), 439-463.

Choumert, J., & Phélinas, P. (2015). Determinants of agricultural land values in Argentina. *Ecological Economics*, *110*, 134-140.

Ciaian, P., Kancs, D. A., & Swinnen, J. F. (2010). EU land markets and the Common Agricultural Policy. Centre for European Policy Studies Brussels, CEPS Paperbacks.

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

Ciaian, P., Kancs, d'A., Swinnen, J., Van Herck, K. and L. Vranken (2012b) Institutional factors affecting agricultural land markets, *Factor Markets project Comparative Analysis of Factor Markets for Agriculture across the Member States* 245123-FP7- KBBE-2009-3, Working Paper No. 16.

Czyzewski, B. and Trojanek, R. (2016). Drivers of Agricultural Land Prices in Terms of Different Functions of Rural Areas in Poland. *Problems of Agricultural Economics*, 2.

Davis, M. A., & Heathcote, J. (2007). The price and quantity of residential land in the United States. *Journal of Monetary Economics*, *54*(8), 2595-2620.

Delbecq, B. A., Kuethe, T. H., & Borchers, A. M. (2014). Identifying the extent of the urban fringe and its impact on agricultural land values. *Land Economics*, *90*(4), 587-600.

Devadoss, S., & Manchu, V. (2007). A comprehensive analysis of farmland value determination: a county-level analysis. *Applied Economics*, *39*(18), 2323-2330.

Dirgasová, K., Bandlerová, A., & Lazíková, J. (2017). Factors affecting the price of agricultural land in Slovakia. *Journal of Central European Agriculture*, *18*(2), 291-304.

Drescher, K., & McNamara, K. T. (2000). Analysis of German agricultural land prices. *Land ownership, land markets and their influence on the efficiency of agricultural production in Central and Eastern Europe.*, 210-228.

Feichtinger, P. and Salhofer K. (2011) The valuation of agricultural land and the influence of government payments", *FP7 Factor Markets project, Factor Markets project Comparative Analysis of Factor Markets for Agriculture across the Member State*s 245123-FP7-KBBE-2009-3, Working Paper no. 10.

Feichtinger, P., & Salhofer, K. (2013). What Do We Know about the Influence of Agricultural Support on Agricultural Land Prices? *Journal of International Agricultural Trade and Development*, *62*(2), 71-85.

Forster, D. L. (2006). An overview of US farm real estate markets. *The Ohio State University Department of Agricultural, Environmental and Development Economics AEDE-WP-0042-06*.

Géniaux, G., Ay, J.-S. and Napoléone C. (2011) A spatial hedonic approach on land use change anticipations, *Journal of Regional Science, Vol. 51, No. 5*, 967-986.

Gioia M. and Mari F. (2012). Il valore della terra. Un contributo alla conoscenza del mercato italiano dei terreni agricoli attraverso i dati della RICA. INEA, collana RICA, Quaderni, Roma

Guastella, G., Pareglio, S., & Sckokai, P. (2017). A spatial econometric analysis of land use efficiency in large and small municipalities. *Land Use Policy*, *63*, 288-297.

Guiling, P., Brorsen, W. B. & Doye, D., 2009. Effect of Urban Proximity on Agricultural Land Values. *Land Economics,* 85(2), pp. 252-264.

Hilal, M., Martin, E., & Piguet, V. (2016). Prediction of the purchase cost of agricultural land: The example of Côte-d'Or, France. *Land Use Policy*, *52*, 464-476.

Horsch, E. and Lewis D. (2009) The effects of aquatic invasive spe*cies on property values: Evidence from a quasi-experiment, Land* Economics, Vol. 85, No. 3, pp. 391-409.

Huang, H., Miller, G. Y., Sherrick, B. J., & Gomez, M. I. (2006). Factors influencing Illinois farmland values. *American journal of agricultural economics*, *88*(2), 458-470.

Hüttel, S., Jetzinger, S. & Odening, M., (2014). Forced Sales and Farmland Prices. *Land Economics,* pp. 395 - 410.

Hüttel, S., Odening, M., Kataria, K. & Balmann, A., (2013). Price Formation on Land Market Auctions in East Germany - An Empirical Analysis. *German Journal of Agricultural Economics,* 62(2).

Hüttel, S., Wildermann, L., & Croonenbroeck, C. (2016). How do institutional market players matter in farmland pricing? *Land Use Policy*, *59*, 154-167.

Jaeger, W., Plantinga, A. and Grout C. (2012) How has Oregon's land use planning system affected property values?, *Land Use Policy, Vol. 62,* pp. 62-72.

Just, R. and J. Miranowski (1993), "Understanding farmland price changes", *American Journal of Agricultural Economics, Vol. 75, No. 1*, pp. 156-168.

Kirwan, B. (2009) The incidence of US agricultural subsidies on farmland rental rates, *Journal of Political Economy, Vol. 117,* No. 1, pp. 138-164.

Kostov, P. (2009). A spatial quantile regression hedonic model of agricultural land prices. *Spatial Economic Analysis*, 4(1), 53-72.

Latruffe, L. and Davidova S. (2007) Common Agricultural Policy direct payments and distributional conflicts over rented land within corporate farms in the New Member States, *Land Use Policy, Vol. 24, No. 2,* pp. 451-457.

Latruffe, L. and Le Mouël C. (2006) Description of Agricultural Land Market Functioning in Partner Countries, *EU FP7 IDEMA project*, Deliverable No. 9.

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

Lawley, C., and Towe C. (2014) Capitalized Costs of Habitat Conservation Easements, *American Journal of Agricultural Economics 96 (3)*: 657–72

Lehn, F., & Bahrs, E. (2018). Analysis of factors influencing standard farmland values with regard to stronger interventions in the German farmland market. *Land Use Policy*, *73*, 138-146.

Levia Jr, D. F., & Page, D. R. (2000). The use of cluster analysis in distinguishing farmland prone to residential development: a case study of Sterling, Massachusetts. *Environmental Management*, *25*(5), 541-548.

Livanis, G., Moss, C. B., Breneman, V. E., & Nehring, R. F. (2006). Urban sprawl and farmland prices. *American Journal of Agricultural Economics*, *88*(4), 915-929.

Ma, S., & Swinton, S. M. (2012). Hedonic valuation of farmland using sale prices versus appraised values. *Land Economics*, *88*(1), 1-15.
Maddison, D. (2000). A hedonic analysis of agricultural land prices in England and Wales. *European Review of Agricultural Economics*, *27*(4), 519-532.
Maddison, D. (2009). A Spatio-temporal Model of Farmland Values. *Journal of Agricultural Economics*, *60*(1), 171-189.
Mela, G., Longhitano, D., & Povellato, A. (2012). The evolution of land values in Italy. Does the influence of agricultural prices really matter? European Association of Agricultural Economists, *Dublin, Ireland*.
Mendelsohn, R., Nordhaus W. and Shaw D. (1994) The impact of global warming on agriculture: A Ricardian analysis, *The American Economic Review, Vol. 84*, No. 4, pp. 753-771.
Naidoo, R., Balmford, A., Ferraro, P., Polasky, S., Ricketts, T. and Rouget M. (2006) Integrating economic costs into conservation planning, *Trends in Ecology and Evolution, Vol. 21, No. 12*, pp. 681-687.
Naydenov, I. (2009). Factors Influencing Farmland Prices in Bulgaria, Master Thesis, Maastricht University
Nilsson, P., & Johansson, S. (2013). Location determinants of agricultural land prices. *Jahrbuch für Regionalwissenschaft*, *33*(1), 1-21.
Patton, M., & McErlean, S. (2003). Spatial effects within the agricultural land market in Northern Ireland. *Journal of Agricultural Economics*, *54*(1), 35-54.
Pirani, A., Gaviglio, A., Demartini, E., Gelati, M., & Cavicchioli, D. A study on farmland rental values determinants. Potentialities of micro data with an application of hedonic prices method. *Aestimum*, (69), 131-151.
Plantinga, A., Lubozski, R. and Stavins R. (2002) The effects of potential land development on agricultural land prices, *Journal of Urban Economics, Vol. 52*, pp. 561-581.
Polelli, M.; Corsi, S. (2008) Nuovi modelli interpretativi delle dinamiche del mercato fondiario. In2008 XXXVII Incontro di Studio del CESET; Firenze University Press: Firenze, Italy, 2008.
Povellato A. (a cura di) (1997). Il mercato fondiario in Italia. Istituto Nazionale di Economia Agraria, Roma.
Roberts, M., 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, Vol. 85, No. 3*, pp. 762-769.
Salois, M., Moss C. and Erickson K. (2012). Farm income, population and farmland prices: a relative information approach, *European Review of Agricultural Economics, Vol. 39, No. 2*, pp. 289-307.
Schimmenti, E., Asciuto, A., Mandanici, S. (2013) Andamento dei valori fondiari in Italia ed in Sicilia AESTIMUM 62, Giugno 2013: 89-110
Sills, E. O., & Caviglia-Harris, J. L. (2009). Evolution of the Amazonian frontier: Land values in Rondônia, Brazil. *Land Use Policy*, *26*(1), 55-67.
Sklenicka, P., Molnarova, K., Pixova, K. C., & Salek, M. E. (2013). Factors affecting farmland prices in the Czech Republic. *Land Use Policy*, *30*(1), 130-136.
Stewart, P. A., & Libby, L. W. (1998). Determinants of farmland value: the case of DeKalb County, Illinois. *Review of Agricultural Economics*, *20*(1), 80-95.
Stokes, J., & Cox, A. (2014). The speculative value of farm real estate. *Journal of Real Estate Research*, *36*(2), 169-186.
Temesgen, C., & Dupraz, P. (2014). The role of farmers' competition on farmland price in local markets: Bretagne region of France. In *AAEA Annual Meeting, Minneapolis, MN*.
Troncoso, J. L., Aguirre, M., Manriquez, P., Labarra, V., & Ormazábal, Y. (2010). The influence of physical attributes on the price of land: the case of the province of Talca, Chile. *Ciencia e investigación agraria*, *37*(3), 105-112.
Tsoodle, L. J., Golden, B. B., & Featherstone, A. M. (2006). Factors influencing Kansas agricultural farm land values. *Land Economics*, *82*(1), 124-139.
Uematsu, H., Khanal, A. R., & Mishra, A. K. (2013). The impact of natural amenity on farmland values: A quantile regression approach. *Land Use Policy*, *33*, 151-160.

Wasson, J. R., McLeod, D. M., Bastian, C. T., & Rashford, B. S. (2013). The effects of environmental amenities on agricultural land values. *Land Economics*, *89*(3), 466-478.

Wen, H., & Goodman, A. C. (2013). Relationship between urban land price and housing price: Evidence from 21 provincial capitals in China. *Habitat International*, 40, 9-17.

Wu, J., Fisher, M. and Pascual U. (2011) Urbanization and the viability of local agricultural economies, *Land Economics, Vol. 87 No. 1*, pp. 109-125.