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The Value of Agricultural Areas: An Estimation Model of the Area to the Southeast of the City of Bari

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Abstract: The role of agricultural activities in countries with mature economies suggests, on the one hand, the traditional role of producing foodstuffs and dietary fibers; on the other, it speaks to the offering of landscape, cultural, recreational, and environmental services. The member states of the European Union have for some time derogated the control of agricultural processes to EU decision-making, within an overarching vision that recalls both roles of this primary activity. The COVID-19 pandemic and the Russia–Ukraine military crisis have heightened the urgency to protect national agricultural production and guarantee minimum levels of agricultural provisions. In Italy, this orientation clashes with practices of unauthorized construction, favored by policies of "building amnesties", and the pressure exercised on urban growth that, particularly in fringe areas, modifies the mercantile nature of agricultural lands. This paper examines the theme in operative terms, analyzing an urban fringe in the city of Bari. The use of multiple regression analysis, applied to the agricultural land market, evidenced how prices in these areas are clearly impacted by their potential transformation into buildable terrains, even when urban plans do not foresee this use.

Keywords: agricultural land market; urban fringe areas; multiple regression model

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1. Introduction

Agricultural terrains in urban fringe areas are naturally subject to the pressure exercised by urban growth, even when urban planning instruments do not specifically contemplate its transformation into building plots [1,2].

When urban and spatial planning is unable to provide projects and uses to protect the landscape-environment [3–5], for example greenbelts, urban parks or gardens, it is almost inevitable that the original vocation of agricultural terrains succumbs to the desires of the building industry.

Additionally, recognizing the role of activities that also offer landscape, cultural, recreational, environmental, and other services, as well as growing dietary fibers and foodstuffs, no longer appears to represent an obstacle to these improper transformations [6,7].

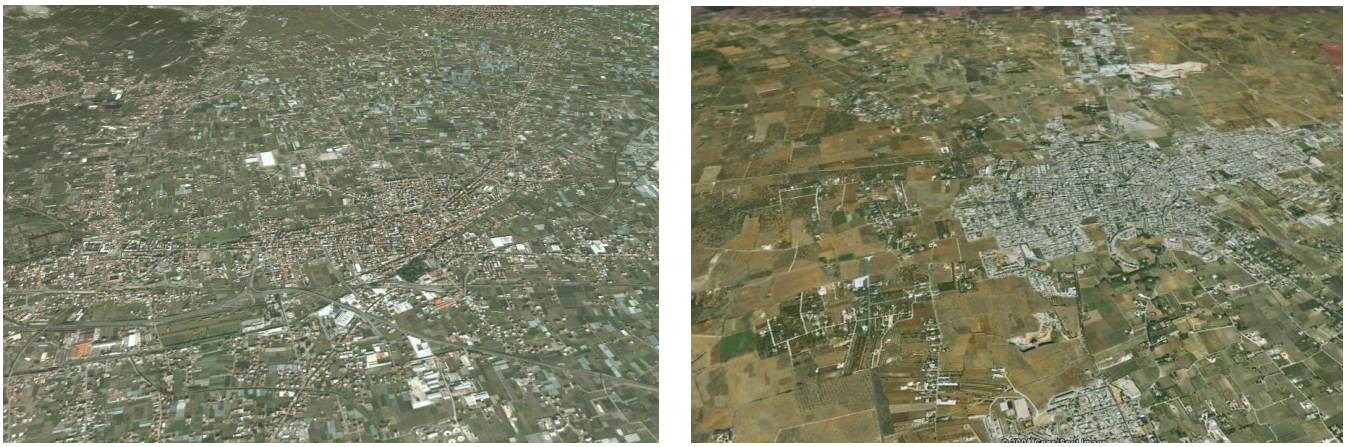
Hence, agricultural terrains around cities are the site of the most evident tensions between productive/non-productive functions [8] and the development of building activities. The territorial consequences lead to a progressive reduction in cultivated lands, to a substantial modification of the landscape at the margins of the city and to determination of a more intensive exploitation of terrains that continue to be used for agricultural purposes [9,10]. The agricultural land market in urban areas is often dominated by the effects of speculation.

It is probable that the reasons are to be found in a culture of urban planning little inclined to recognize the multifunctional role of agriculture, which makes it possible, among other things, to contain the social and ecological vulnerabilities of the city [11]. Similarly, urban and spatial planning regulations favor these subtractive processes [12].

These phenomena do not appear to be limited to countries with mature economies, where the primary sector makes an increasingly less important contribution to the gross national product, while it continues to interest developing nations [13]. In the latter, all the same, in particular where demographic growth requires more sources for the provisioning of food, there is a problem of how to promote the productive role of periurban agriculture serving the city [14].

With respect to the general topic of land consumption and, in particular, processes of subtracting agricultural terrains, Italy does not offer an exemplary tradition, given the lack to this day of an approach to urban and spatial planning that recognizes the productive and non-productive value of open lands and, consequentially, to graduate differentiated levels of protection.

One example is offered by the processes of sprawling settlement that characterize vast agricultural areas in diverse parts of Italy, as indicatively evidenced in the images that follow (Figure 1).



(**a**) (**b**)

Figure 1. Examples of sprawling settlement in Italy: (**a**) town of Scafati (SA); (**b**) town of Galatina (LE).

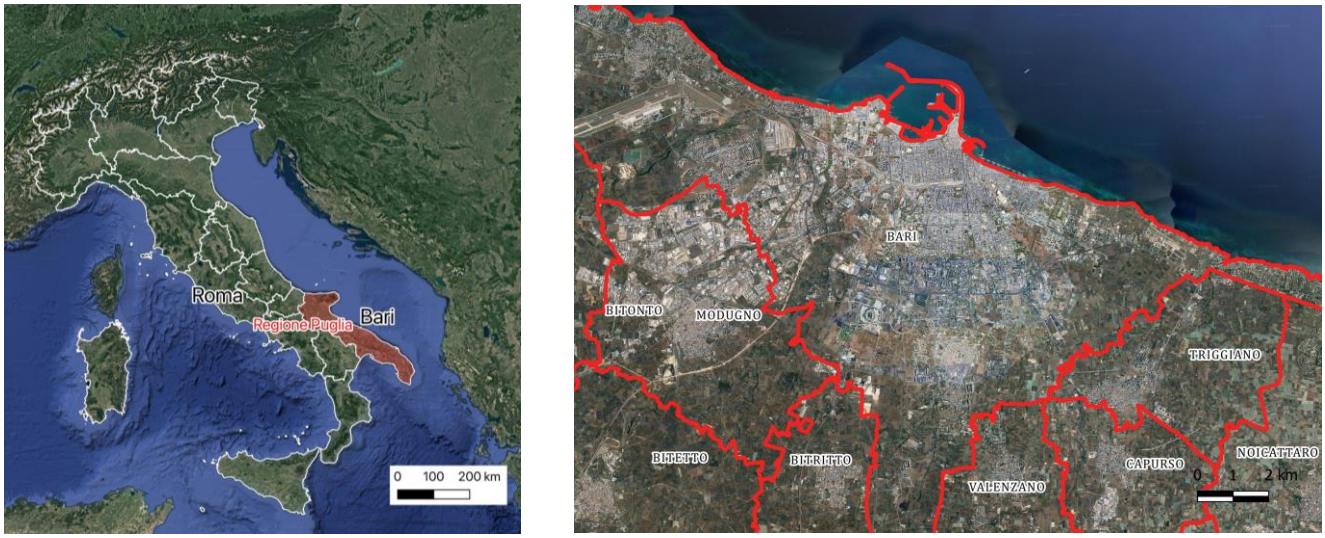
Nonetheless, in this paper we wish to circumscribe the analysis to the areas ringing urban centers, where the drive toward settlement is structured within the dynamics of the real estate market that recognizes, in fact, through rising prices, the diverse land use of these areas. In other words, the prices of agricultural terrains begin to rise without a specific reason linked to the primary activity.

A different case is presented by the phenomena of sprawling settlements in agricultural areas, where the (often illegal) behavior of individuals, leads individual owners of terrains to erect buildings that are damaging to the landscape and the environment, for purposes of leisure and without any connection to agricultural cultivation.

The paper analyzes the agricultural land market along a main axis in the city of Bari (Figure 2), affected for years, as in other urban centers, compared to an expansion of the settlement fabric (Figure 3), circumscribing the analysis to terrains adjacent to the most recent extensions to the southwest of the urban fabric.

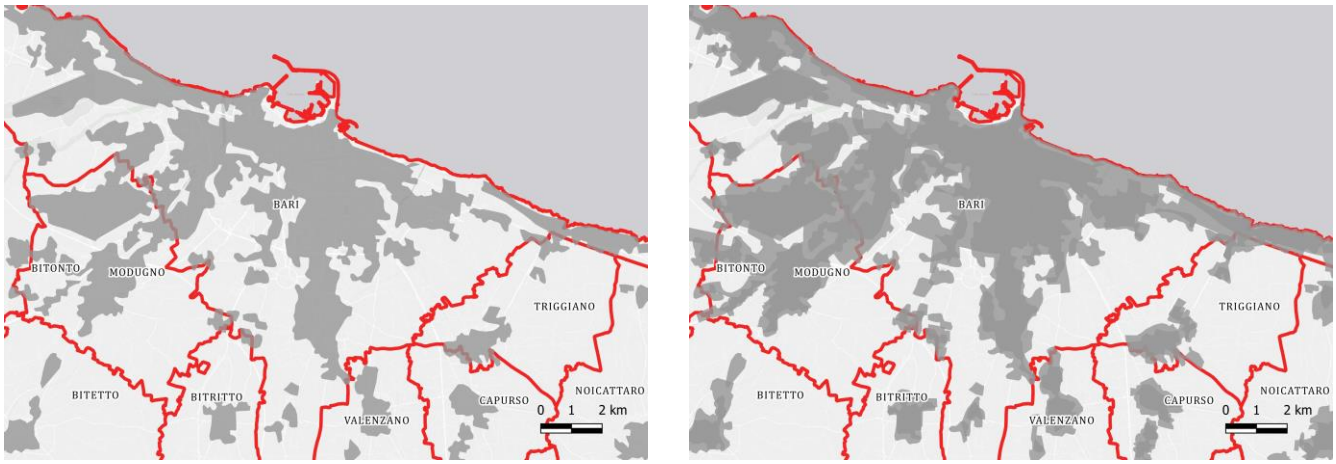
The aim of the study is to show how land on the urban fringe is under constant pressure from urban development, which alters its agricultural nature; the paper addresses this issue from an operational point of view, analyzing the formation of agricultural land prices in an urban fringe area of the city of Bari using a multiple regression model [15].

The model shows how the formation of agricultural land prices is strongly influenced by the intrinsic possibility of using the land for building purposes (even though the urban planning instrument does not provide for this) [12–15].



(**a**) (**b**)

Figure 2. Identification of the Metropolitan City of Bari. (**a**) General overview; (**b**) overview of the city of Bari and Triggiano.



(**a**) (**b**)

Figure 3. Expansion of the urban fabric in the Metropolitan City of Bari. (**a**) Urban development, 1990; (**b**) urban development, 2018. Calculations by the authors, using QGis and Shape Corine Land Cover.

2. Materials and Methods

2.1. The Linear Regression Model

The linear regression equation is formulated as follows:

$$\hat{Y} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots . \beta_n X_n + \varepsilon \quad (1)$$

where X_n represent the characteristics identified, while β_n represent the non-standardized coefficients through which the model attributes a value—increase or decrease—as a function of the statistical unit identified.

The results obtained by the product of the coefficients and the respective variables describe the level of enjoyment, in economic terms, of the characteristics analyzed [16].

2.1.1. Construction of the Database

A total of 148 deeds, 26 in the city of Bari and 122 in the city of Triggiano, have been registered for the purchase and sale of land between 2015 and 2019.

The area under study is located between the outskirts of Bari and the municipality of Triggiano. It is an area of about 3000 hectares, bounded to the north-east by the SS 16, to the west by the SS 100, to the north by the city of Bari and to the south by the municipality of Triggiano.

In the past, the olive grove was the most important agricultural crop. Nowadays, in addition to olive groves, there are table grapes under glass and arable land (Figure 4).

(**a**) (**b**)

Figure 4. Agricultural fabric of the Metropolitan City of Bari (**a**) Vineyards; (**b**) Olive groves.

The configuration of an agricultural enclave between two urban centers could make it possible to hypothesize its destination as an agricultural park, characterizing this territory not only from a productive point of view, but also from functions related to outdoor activities, slow mobility and leisure.

This configuration—which would have allowed two urban communities to benefit from easily accessible leisure services—competed with the transformations linked to the property market, starting with the industrial activities which, at the end of the 1990s, began to compromise the integrity of the agricultural area of this territory, according to the ribbon construction scheme (Figure 5).

(**a**) (**b**)

Figure 5. Expansion of the urban fabric of the Metropolitan City of Bari. (**a**) Northern part of the study area. On the right, the state road n. 100. On the left, two settlement structures intended for trade and production activities. (**b**) Northern zone of the study area. Plant of collective interest adjacent to the state road n.16.

It is no coincidence that, as we shall see, the market for agricultural land in the area today rewards the building potential associated with the size of the land and direct access to the main road network.

To create the database, public deeds kept in the offices of the Property Registry of the Province of Bari were consulted; the research looked only at acts of sale, excluding any other typology of land ownership transfer (donations, successions, expropriations). The database was populated with the following information:

- Registration number;
- Registration date;
- Notary public;
- Seller typology and quantity;
- Buyer typology and quantity;
- Municipality;
- Location;
- Cadastral map;
- Cadastral parcel;
- Cadastral cultivation quality;
- Lot area;
- Land income;
- Sale price;
- Land Use;
- Characterizing elements: access, rights of way, possession of title, etc.

2.1.2. Considerations of the Sample

The investigation included terrains with different land uses. Table 1 provides a summary of the documents examined.

Table 1. The table presents a subdivision in clusters of the survey data.

Land Use	n. Cases	%	Average Price (EUR /sqm)
Agricultural Zone	108	73.0%	2.73
Conservation Area	7	4.7%	1.18
Urban Parkland	7	4.7%	5.70
Equipment/Services	3	2.0%	9.86
Urban Zones	14	9.5%	57.73
Urban Settlements D	5	3.4%	31.70
Urban Settlements B	3	2.0%	495.58
Unplanned	1	0.7%	1.93

For the structuring of the database, in addition to discarding acts of sale for terrains with different land uses than agricultural use, we also eliminated all acts for sales with a quota of ownership less than 100%.

This operation reduced the number of observations (Appendix A) considered in the model to 50 (Figure 6).

Collected data was processed using the geographic information system (GIS) [17] utilizing open source "QGis" software to manage the information gathered [18] and produce an objective representation of the areas identified; through "virtual" surveying and the querying of Corine cover land maps [19], the database was implemented by adding the typology of cultivations effectively practiced on the selected terrains (Appendix A, Dataset).

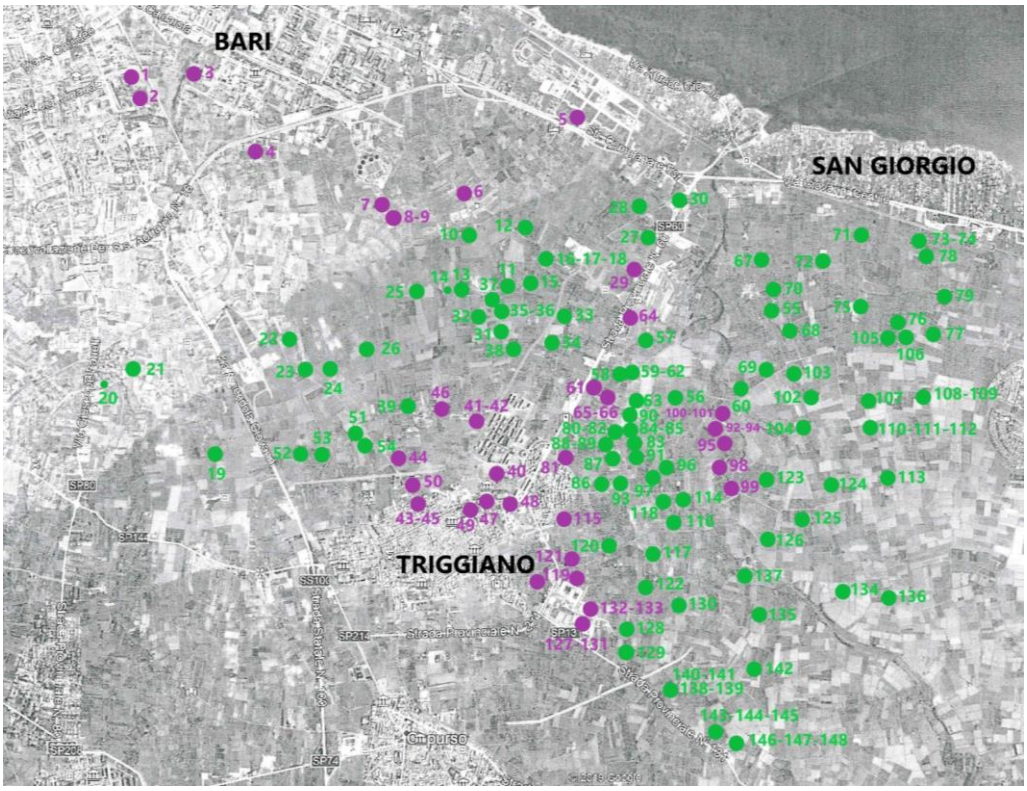


Figure 6. Identification of the surveyed properties: the magenta elements highlight the terrains considered in the analysis, while the green indicates those not considered.

2.2. Identification of Variables

In entirely general terms, the market value of an agricultural terrain depends substantially on a series of factors [20]: fertility, layout and exposure, presence or not of plantings, environmental quality of the area, presence of farm buildings, presence of watercourses or wells, distance from the city center, presence of restrictions or passive rights of way.

For the case study, it is necessary to make some preliminary general considerations, linked above all to the particular conformation of the territory; in the town of Triggiano, situated to the southwest of the Metropolitan City of Bari, there is a prevalently hobbyist use of cultivable lands associated with partial phenomena of abandonment, above all in proximity to inhabited areas, with terrains that were once cultivated as vineyards and olive groves now uncultivated.

A discrete vivacity of the land value market can be found instead in the area to the north, particularly in the subcoastal strip of municipal land, with a diffuse presence of olive groves and vineyards, prevalently double cordon plantings for table grapes.

That said, to develop the multi-parametric multiple regression model, we considered seven characteristics capable of influencing land prices:

1. Surface (Sur);
2. Year of sale (YS);
3. Topsoil (TS);
4. Possibility of building in rural area (PoBuRA);
5. Soil defects (SD);
6. Access to the main roads (AMR);
7. Distance from the town (DT).

Characteristics such as fertility, as well as the effects of artificial water and site slopes, were not considered in the model because they are common to all terrains.

2.3. Structuring of Variables

The variables analyzed were structured as follows:

- The surface variable (Sur): these variable expresses land area in square meters;
- The year of sale variable (YS): this variable defines the year of stipulation of the contract of sale, to consider temporal variations in pricing;
- The topsoil variable (TS): this variable identifies the different cultivations practiced; given the identification of a substantial difference only between arable land and all other typologies of cultivation (vineyards, olive groves, orchards, etc.), this variable was defined on a dichotomic scale: arable/pasture = 0 and olive grove/vineyard/orchard = 1;
- The possibility of building in rural area variable (PoBuRA): this variable uses a dichotomic scale (0 = absence; 1 = presence) to express the possibility of building homes on agricultural land. To better comprehend the significance of this variable, it is worth specifying that, according to Italian legislation, in agricultural areas (indicated in Municipal Master Plans—Piani Regolatori Generali Comunali-PRGC—with the code "E") it is possible to build homes with a maximum floor area ratio of 0.03 m3/sqm. This ratio refers to a minimum plot size, specified in each PRG. Precisely in relation to this latter aspect (specific to each municipality), it was noted that in the city of Bari the minimum area necessary in an agricultural area (Primary Activity A) is 5000 sqm, while in the town of Triggiano this number is 10,000 sqm (zones E2 and E3), or 50,000 sqm (zone E1). This means that it is easier to build in agricultural areas in Bari than in Triggiano (Table 2).

Table 2. Definition of the minimum lot size and relative Floor Area Ratio—FAR (Indice di Fabbricabilità Fondiaria—IFF) in agricultural areas in Bari and Triggiano.

Land Use	**Triggiano**			**Bari**	
	E1	E2	E3	Zones for Type A Primary Activities	Zones for Type B Primary Activities
Indice di Fabbricabilità Fondiaria—IFF (m^3/sqm)	0.03	0.03	0.03	0.03	0.01
Min. Plot Size (sqm)	50,000	10,000	10,000	5000	20,000

- The soil defects variable (SD): this variable uses a dichotomic scale (0 = absence; 1 = presence) to express the presence or not on the site of elements that affect land value (rocky terrain, outcropping rock, watercourses, etc.). These elements were identified through "virtual" site surveys;
- The access to the main roads variable (AMR): this variable uses a dichotomic scale (0 = absence; 1 = presence) to express the proximity to points of access to the site from principal road networks; this condition was verified for terrains situated less than 300 m from principal roads (provincial, state, paved municipal);
- The distance from the town variable (DT): this variable uses an ordinal scale to express the radial distance in meters, measured from the center of the terrain to the perimeter of the nearest inhabited area. The distance is the lesser of those between the two centers of reference (Bari and Triggiano).

3. Results

The 50 observations of price were used to develop an evaluative multiple linear regression model:

$$\hat{Y} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 \quad (2)$$

where X_1 = surface; X_2 = year of sale; X_3 = topsoil; X_4 = possibility of building in rural areas; X_5 = soil defects; X_6 = access to the main roads; X_7 = distance from the town.

All data were processed and modelled using SPSS Statistics; the results, summarized in the following tables, demonstrate the importance of the different variables (Table 3).

Table 3. Summary of the model [b].

Model	R	R-Squared	R-Squared Adapted	Std. Estimation Error	Durbin-Watson
1	0.866 [a]	0.749	0.708	0.36222	1.833

[a] Predictors: (constant), distance, surface, year, agriculture, accesso SP, elements, buildable; [b] Dependent variable: price per square meter.

The analysis of variance (ANOVA) (Table 4) demonstrates how the statistical significance of the regression model, less than 0.05, provides an overall indication that the model has a significant capacity to statistically forecast the resulting variable.

Table 4. ANOVA [a].

Model		Sum of the Squares	gl	Root Mean Square	F	Sign
1	Regression	16,472	7	2353	17,935	0.000 [b]
	Residual	5510	42	0.131		
	Total	21,982	49			

[a] Dependent variable: price per square meter; [b] Predictors: (constant), distance, surface, year, agriculture, accesso SP, elements, buildable.

The table of coefficients (Table 5) lists the values of the marginal prices implicit of all the characteristics/variables considered.

Table 5. Table of coefficients [a].

Model		Non Standardized Coefficients		Standardized Coefficients	t	Sign.
		B	Standard Error	Beta		
1	(Constant)	525.8032	95.074		5.530	0.000
	Sur	−0.000105	0.000	−0.614	−5.371	0.000
	YS	−0.258998	0.047	−0.446	−5.498	0.000
	TS	−0.159976	0.125	−0.103	−1.284	0.206
	PoBuRA	1.165973	0.239	0.528	4.869	0.000
	SD	−0.902504	0.167	−0.472	−5.407	0.000
	AMR	0.731430	0.152	0.404	4.821	0.000
	DT	−0.000146	0.000	−0.141	−1.765	0.085

[a] Dependent variable: price per square meter.

4. Discussion

The analyses and their relative results clearly demonstrate how the variables "possibility of building in rural area" and "access to the main roads" are rather significant.

For example, a terrain in the city of Bari measuring slightly more than 5000 sqm (thus buildable according to local planning regulations), situated approximately 1 km from the city center, free of defects and trees, easily accessible from the main road network, can reach a value of up to EUR 4.11/sqm.

A similar terrain, though unbuildable, and measuring just under 5000 sqm, is instead valued at EUR 2.95/sqm (−28.34%).

This difference is even greater, with a value of EUR 2.22/sqm (−46.13%) when the same piece of unbuildable land is situated more than 300 m from the main road network.

These two elements demonstrate how the agricultural land market is strongly influenced by the above-mentioned factors, evidencing how a non-agricultural use affects pricing.

A second element to be noted, albeit less influential on the formation of the final price, is the variable "topsoil"; the negative sign of its coefficient suggests a lesser appreciation of terrains cultivated as vineyards, olive groves, orchards, etc. In this context, "free" soils to be cultivated are more sought after, perhaps precisely with a view toward their future exploitation for non-agricultural uses (the presence of plantings may, in fact, represent an additional cost for anyone wishing to build).

Finally, it should be noted that the distance between the city of Bari and Triggiano is only 7 km; in this context, the accessibility of one of the two centers does not depend on their distance, but only on the accessibility of the main roads connecting them.

In fact, the value of the variable distance from the town (DT) is very low (−0.000140), while the value of the variable access to the main roads (AMR) is +0.7314. This element suggests that the greater proximity to inhabited centers is not particularly significant, as this characteristic is largely "absorbed" by the access to main roads (AMR) variable.

5. Conclusions

The agricultural territory ringing urban centers is subject to numerous factors that threaten their stability.

The analysis presented evidenced the significance of two variables, more than others: the possibility to build permitted by national legislation for rural areas allowing the construction of farmhouses, and the ease of access from main road networks.

This represents an evident problem for the survival of these spaces because their proximity to the built city over time produces a fully urban situation, anticipated by the higher value owners and market operators are willing to recognize sooner.

The resulting spatial configuration is that of an "urbanized countryside" located along the main roads leading in and out of the city, which preannounces a complete and definitive urban transformation. The imaginable scenario is thus one of a space in transition, destined to increase the amount of impermeable soil.

The forecasts are not comforting. Often, interests that come together around urban transformations are accompanied by a structural system characterized by processes of de-ruralization and abandonment, which may also include the lack of a general change in the entrepreneurial sector, as well as the fragmentation and pulverization of businesses, with the result being that the building market can insinuate itself within the dynamics of the land market, upsetting its premises and logics.

It is therefore up to political decision makers [21] to support similar phenomena, or to intervene to invert this trend, recognizing the formal and functional identity of agricultural space and its service to anthropic activities [22]: production, urban hygiene, and "spatial", where agrarian vegetation becomes a cultural testament and element of a strong identity for places, as well as resource for the landscape and recreational activities [23,24].

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A Dataset

Table A1. Dataset of the 50 analyzed observations.

ID [a]	Price (EUR/sm) [b]	Surface (Sur) (sm) [c]	Year of Sale (YS) [d]	Topsoil (TS) [e]	Possibility of Building in Rural Area (PoBuRA) [f]	Soil Defects (SD) [g]	Access to the Main Roads (AMR) [h]	Distance from the Town (DT) (m) [i]
13	2.99	8.418	2019	1	1	0	0	1.440
16	3.33	1.800	2016	0	0	0	0	1.800
18	2.22	900	2016	0	0	1	0	1.800
19	1.82	1.920	2016	0	0	1	0	1.900
21	3.26	6.142	2018	1	1	0	0	1.300
23	2.56	4.685	2019	0	0	0	0	1.450
24	3.36	1.784	2017	0	0	0	0	1.650
26	2.41	2.075	2019	1	0	0	0	1.800
28	2.01	23.877	2017	0	1	0	0	770
31	1.99	1.508	2018	0	0	1	0	750
34	2.15	2.935	2018	1	0	0	0	950
35	2.57	7.789	2016	1	0	0	0	800
36	2.61	7.664	2016	1	0	0	0	800
37	2.44	7.375	2016	1	0	0	0	800
51	2.43	1.646	2019	1	0	0	0	500
54	2.48	2.823	2015	1	0	1	0	500
57	2.99	568	2017	1	0	0	0	1.500
58	1.79	558	2019	1	0	1	0	1.000
63	2.52	2.582	2018	1	0	0	0	750
69	2.38	10.068	2019	1	1	0	0	2.000
72	0.83	6.370	2019	1	0	0	0	500
76	3.30	3.792	2016	1	0	0	0	1.800
80	2.77	2.887	2018	1	0	0	0	680
84	2.39	2.935	2019	1	0	0	0	700
85	3.13	3.200	2018	1	0	0	0	700
86	2.81	1.067	2018	1	0	0	0	270
91	2.67	10.100	2019	1	1	0	0	800
93	2.10	1.523	2019	1	0	1	0	450
103	3.49	1.431	2016	1	0	0	0	2.000
104	1.92	6.499	2017	1	0	0	0	2.500
105	1.88	3.189	2019	1	0	0	0	1.800
107	2.01	4.975	2018	1	0	0	0	2.400
111	1.74	5.735	2019	0	0	0	0	2.400
113	1.72	6.992	2019	1	0	0	0	3.100
117	2.92	3.425	2019	1	0	0	0	900
118	2.66	640	2018	0	0	0	0	850
122	2.00	2.000	2019	1	0	0	0	900
123	2.42	1.654	2017	1	0	0	0	1.900
124	2.13	3.994	2017	1	0	0	0	2.500
125	1.96	6.114	2019	0	0	0	0	2.000
128	1.45	2.750	2019	1	0	1	0	500
129	4.16	1.202	2017	0	0	0	1	500
137	2.69	7.425	2017	1	0	0	0	1.800
139	2.81	1.425	2018	1	0	0	1	1.200
140	3.49	1.905	2018	0	0	0	1	1.200
141	3.53	950	2018	1	0	0	1	1.200
143	3.62	968	2017	1	0	0	1	1.600
144	3.27	459	2017	1	0	0	1	1.600
146	3.51	3.053	2018	1	0	0	1	2.000
148	3.51	2.643	2018	1	0	0	1	2.000

[a] Identifier of the analyzed observation; [b] Price (EUR/sm); [c] Surface (Sur) (sm); [d] Year of Sale (YS); [e] Topsoil (TS); [f] Possibility of Building in Rural Area (PoBuRA); [g] Soil Defects (SD); [h] Access to the Main Roads (AMR); [i] Distance from the Town (DT) (m).

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