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Analysis of the initial steps of the Market Comparison Approach (MCA) for its application to agricultural land: parameters of the market segment and real estate data

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Abstract. In the current Italian real estate market, estimates of the market value of rural properties are carried out by appraisers mainly using the single-parameter comparison procedure and, less frequently, the income capitalization method. To overcome problems of appraiser subjectivity and other issues related to these methods, and to gradually comply with real estate appraisal standards, this research paper aims to develop and validate a scientifically rigorous method. This article carries out a first attempt to apply the mixed approach based on the integration of Market Comparison Approach (MCA) and General Assessment System (GAS) to agricultural land, currently used only in the field of urban real estate appraisal. The study focuses on the first steps of this valuation procedure: choice of the parameters which characterise the market segment and identification of the land characteristics to be included in the procedure. These two steps are preparatory to the following phase concerning the estimate of marginal prices, which represents the core of the whole valuation procedure.

Keywords: valuation standards, market-oriented method, land values, land prices, real estate appraisal.
JEL codes: C81, O18, Q1, R3.

1. INTRODUCTION

The 17 Sustainable development goals set by the European Union with Agenda 2030 include goal 2, which aims to end hunger, achieve food security, and promote sustainable agriculture that helps maintain the planet's ecosystem and contrasts the growing phenomenon of soil degradation and desertification; additionally, it aims to assure secure and equal access to land for all.

Until recently, the agricultural sector has seen little interest from those responsible for property appraisals. This is because the land market has a

marginal economic importance compared to urban real estate, which is more closely linked to the financial and investment sectors.

The land market is characterized by a particular good, soil, which has a limited and extremely rigid supply that has been exacerbated by its drastic consumption during the last few decades due to the land transition from agricultural to non-agricultural uses, and finally by land abandonment and movement of investments elsewhere.

However, it seems that a reversal in this trend may be underway, shown by increasing interest from analysts stimulated by greater public interest towards environmental sustainability and land consumption (Munafò, 2021).

An analysis of the land market requires transparent data collected with scientific rigor. However, up until now, precise information is still lacking on agricultural land trading activities (Festa et al., 2021).

Thus, there seems to be an unmet need on one side to have easily available sales databases and on the other to be equipped with a valuation tool complying with real estate appraisal standards in order to provide reliable estimates.

Today in Italy, the unreliability of land appraisal results is mainly due to the fact that information is obtained in a market that is scarcely active and rather opaque, making it difficult to implement market-oriented estimates and almost impossible to conduct large-scale valuations (e.g. Mass Appraisals). To overcome these obstacles, estimates are often based on the personal knowledge of the appraiser rather than on recorded and traceable data, thus becoming true "expertise" (Ciuna et al., 2014; Ciuna et al., 2015; Simonotti, 2003).

Up until now, the scientific community has concentrated its attention on urban real estate markets, and has refined tools and methodologies both for the measurement and data collection phase as well as for the valuation phase itself.

Thus, the introduction of these more advanced market-oriented procedures into the agricultural land market sector should be favoured, where the most used method in professional practice is still the single parameter comparative procedure.

The whole valuation discipline, especially that belonging to the Italian school (Brizi, 1946; Medici, 1972; Michieli, 1993), in dealing with the monoparametric appraisal procedure, makes a distinction between comparative estimates based on technical (or physical) parameters and those ones based on economic parameters.

Within the first category, the parameter that is most commonly cited in the literature and used in professional practice is the surface, a parameter that is easy to quantify because it can be detected with a very high degree of precision, depending on the measurement tool adopted.

Among those ones with economic parameters (gross saleable production, net product, landlord income, rent) the rent is the element most taken into consideration both by the literature and by the category of real estate appraisers in the field of agricultural land.

Within the first category, the estimates can be easily applied only when the goods have a high degree of homogeneity ("deep analogy" condition). Therefore, according to the appraisal theory, this parameter is difficult to use with land properties as the market value of this category of assets is attributable to a large variety of intrinsic and extrinsic characteristics and is not exclusively correlated to their surface area. The use of this parameter is therefore possible only if there is a high degree of homogeneity between the land being valued and the similar used for comparison, a situation which rarely occurs in the actual market.

In the case of economic parameters, the rent is applicable only following the occurrence of the two conditions illustrated below. The first one is that it must be determined by the effective interaction between land market demand and supply (pursuant to article 45 of Law no. 203 of May, 3rd, 1982) and the second condition is that land management of the specific market segment must ordinarily be rent-based.

This appraisal procedure may be strongly influenced by discretionary decisions made by the appraiser, who has the delicate task of identifying comparable properties that are similar in everything except the parameter chosen as the discriminant under a condition of "deep analogy" (Simonotti, 2002).

The absence of such a condition leads to a sample selection that is not consistent with the methodological assumptions of the valuation procedure. The distortion of the resulting appraisal valuation can be attributed to a lack of consideration of certain characteristics that significantly contribute to the market price but are operationally difficult to quantify, as well as to the low activity of the agricultural land market that does not easily allow for the identification of bought and sold properties that are only dissimilar from the one being appraised in a single characteristic.

Based on the situation discussed above, it seems evident that a procedure is needed that is multiparametric but also parsimonious, such as the Market Comparison Approach (MCA), which can make systematic adjustments of detected prices. These price corrections make it possible to: a) not have to identify comparable goods

that fit the "deep analogy" conditions; b) to decode otherwise omitted variables influencing market price into economic terms.

Currently, applications of MCA in the literature exclusively regard urban real estate markets (Simonotti et al., 2016; Simonotti, 2003; 2006; 2011; 2019) and to the authors' knowledge the only attempt to implement the MCA for agricultural land is that of Berloco (2012), who proposes using MCA as an instrument that can assure accurate and robust valuations of agricultural land, even in the presence of a land market that is notoriously stagnant and opaque.

First, Berloco (2012) emphasises the importance of carefully identifying the market segment to be studied due to the extreme complexity of agricultural holdings. The collection of property data comes next, which should be carried out by using ad hoc survey forms. In the absence of a set of universally shared agricultural land property characteristics, the Author presents a wide variety to stimulate a discussion with appraisal professionals to identify the current "best practices" that can be used as the foundations for agricultural property appraisal standards [1]. To this end, he proposes an illustrative case-study where an integrated MCA-General Assessment System (GAS) is applied to an agricultural property producing cereal and forage crops.

Besides, MCA and GAS in relation to agricultural land can be found in Italian Property Valuation Standard (Tecnoborsa, 2005; 2018) and in Simonotti (2011). The latter proposes three examples of application of the MCA and the GAS for educational purposes; the former, aims to provide professionals with the guidelines for the appraisal of agricultural assets and to indicate their operative field. Therefore, the Code mentions MCA and GAS, among others, in the more general context of the Market Approach Method for the evaluation of agricultural land.

In the light of the above, there is the actual risk that professional estimates are carried out on the basis of real estate characteristics just described and not developed from the methodological point of view.

The GAS is a mathematical procedure based on comparison. By starting with two or more properties with one or more characteristics that are usually qualitative, this process makes it possible to determine the marginal prices of said characteristics and the value of the subject through matrix calculus techniques (Simonotti, 2011). It can be used both autonomously and in combination with the MCA when the marginal prices of qualitative characteristics need to be estimated. Since its resolution requires the use of matrix calculus, its main limitation is that the number of comparables must be equal to the number of qualitative characteristics involved plus one.

A didactic example of the application of this method to agricultural land can be traced in a quite old study by Simonotti (1985), where the author deals with it from a theoretical point of view while making in the closing part of the paper a mere exemplification concerning an agricultural piece of land.

However, no further developments have followed this pioneering study in investigating appraisal methodologies for agricultural properties.

The objective of the present study is to obtain estimates that are rigorous in terms of both property data collection and valuation analysis, even under the condition of a scarcely active market[2].

This study discusses the following first two steps of the research that has been carried out so far:

1. Choice of parameters to implement the segmentation of the agricultural land market (market segmentation data collection form);
2. Identification of the characteristics to be included in the procedure determining the relative marginal prices (property data collection form).

2. CHOICE OF PARAMETERS TO IMPLEMENT THE SEGMENTATION OF THE AGRICULTURAL LAND MARKET (*MARKET SEGMENTATION DATA COLLECTION FORM*)

Like the urban real estate market, the agricultural land market is also divided into segments that can be identified through a process of segmentation.

The parameters that characterize a segment show both how each segment differs from the others and also identifies unifying properties with common technical and economic parameters (Simonotti, 2011).

Furthermore, as defined by Simonotti (2011), the market segment is the basic unit of economic and estimative analysis for the real estate market that cannot be further divided.

In Simonotti (2011), as regards the definition of the market segment, some parameters are already reported

[1] To the best of our knowledge, the second edition of Tecnoborsa (2005) already included a chapter exclusively addressing agricultural properties in its third edition of the *Codice delle Valutazioni Immobiliari* (Real Estate Valuation Code).

[2] Recently Festa et al. (2021) and Povellato (2022) reported data on bought and sold surface areas. Using ISTAT calculations based on annual surveys of notary activities, they estimated the approximate annual percentage of agricultural and forest land that is bought and sold in Italy to be about 1% of the total agriculture and forest surface area.

such as: Description; Location; Type of contract; Destination; Real Estate Typology; Size; Characteristics of supply and demand; Market form; Price level.

In Italian Property Valuation Standard (Tecnoborsa, 2018), there is just a list of parameters (location; form of contract; agricultural production destination; type of land investments and other fixed endowments; size; characteristics of supply and demand; market regime; price level) which define the market segment of an agricultural company (page 234).

In this regard, a new market segment survey form has been developed to carry out this first phase. It is based on the already tested and widely used survey form for urban real estate valuation proposed by Simonotti (2011) and reported in Tecnoborsa (2018), within which the parameters that characterize a given market segment are contained. For these parameters to be translated into economic-estimative indicators, they must be measured and recorded, as suggested by Simonotti (2011).

Below, potential parameters that characterize rural property market segments are discussed.

The *type of contract* indicates a sale, rental, or other relationship (donation, exchange, "rent to buy", etc.).

Location refers to the geographic and economic position (presence of infrastructure, public services, etc.) of an immovable property, taking into consideration the *General Regulatory Plan* (Piano Regolatore Generale, PRG, in Italian), which is an urban planning instrument that classifies land areas based on their construction potential and eventual planning and protection restrictions.

Current use indicates whether the land making up a certain segment is used for agricultural production or for other uses[3]. The type of use (agricultural or not agricultural) serves as a discriminant to determine if additional parameters characterizing the market segment apply. Indeed, if the current use of a property is "agricultural", then the following additional parameters should be considered:

- The *altitude range* indicating the altitude, in terms of meters above sea level (MASL) of the considered area. For this purpose, a classification into "agricultural regions" is used, i.e., portions of land made up of "groups of municipalities according to rules of homogeneous territorial continuity in relation to certain natural and agricultural characteristics and, subsequently, aggregated by altimetric zone"[4] (ISTAT, 1958). According to this classification, the following altimetric zones will be identified for the practical definition of the market segment: internal mountains and coastal mountains; internal hills and coastal hills; lowlands.
- The *climate data* relating to average annual temperature and precipitation values and their distribution are essential as they guide crop choices. Furthermore, living in the era of climate change, these values can be subject to varying fluctuations over the short term. Thus, satellite-based remote sensing tools such as the Climatic Research Unit Gridded Time Series v. 4.06 (CRU TS) (Harris et al., 2020) can be helpful since they provide a continuous monitoring of data made available through open access platforms such as Google Earth;
- The *size class* refers to the order of magnitude, expressed in hectares (ha), of the rural property that characterizes a given segment for a certain type of contract. The various size classes could go hand in hand with the Utilized Agricultural Area (UAA) (or *Superficie Agricola Utilizzata*, SAU, in Italian) classes adopted by ISTAT (2012) for data collection for the General Agriculture Census. In this way, appraisers could have a reference point to compare with his or her own knowledge of the market. Following this reasoning, the dimensional classes could be ≤ 0.99 ha, from 1.00 to 1.99 ha, from 2.00 to 4.99 ha, from 5.00 to 9.99 ha, from 10.00 to 19.99 ha, from 20.00 to 49.99 ha and ≥ 50.00 ha;
- *characteristics* refer to all the rural characteristics to be considered within the procedure that potentially contribute to the formation of each given segment and therefore positively or negatively influence the market;
- *supply and demand agents* describe the kinds of figures operating in the market and the motivations that drive them to act. The principal actors within the rural land market can be classified as physical or legal persons. The first group generally include those involved in the agricultural sector as professional farmers, direct cultivators, and field workers or non-agricultural workers for whom farming is a hobby and not an income source. The physical persons category also includes private individuals who operate in the rural land market for investment purposes. The legal persons category includes corpora-

[3] Given the complexity of the subject, this first exploration only considers cases where the land is used for purely agricultural purposes (including the uncultivated land at the service of the productive agricultural area, called tare) and momentarily excludes land used for other purposes.

[4] Translated into English by authors. Original text: "gruppi di comuni secondo regole di continuità territoriale omogenee in relazione a determinate caratteristiche naturali ed agrarie e, successivamente, aggregati per zona altimetrica".

tions, cooperatives, public entities, and the Church;
- the *market form* is established based on the degree of competition between supply and demand for a property belonging to a given segment. The rural land market can be defined as "imperfect" because of the varying nature and behaviour of the agents that locally influence the supply and demand of land, and the relative high transaction cost involved. This is proven by the fact that there are actually many different markets for land, both in terms of time and space as well as in relation to its alternative uses. In this sense, the Italian rural land market takes on a bilateral oligopoly (Antonietti, 1976; Magri, 1985, Bazzani, 1987; Grillenzoni and Grittani, 1994; Schimmenti et al., 2013);
- the *market ratios*, which are mainly used for the calculation of marginal prices/rents of characteristics per surface area in the context of the urban real estate market. In this moment, it is not possible to say which agricultural land characteristics are actually connected, nor to describe the possible ways of determining their value. The eventual detection of these relationships will depend on how the calculation of the marginal prices of certain characteristics will be developed;
- the *indicative price* regards the sales price, the rent, etc. The trend of increasing, decreasing or steady prices and the number of sales in a given time frame (market cycles) characterize individual market segments;
- the *attachments* are generally satellite images or urban planning documents (*Piano Regolatore Generale*, PRG), that refer to the geographic location of the identified market segment.

In Figure 1 a scheme of market segmentation parameters is reported.

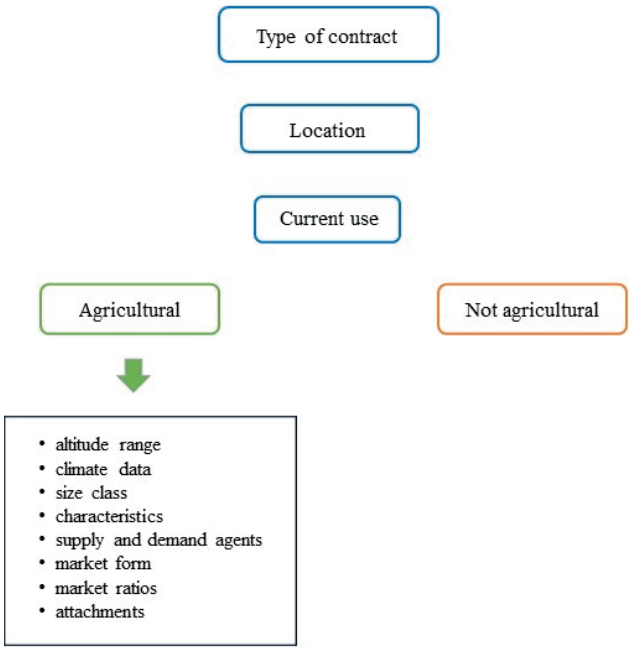

Figure 1. Parameters for the identification of agricultural land market segments.

3. IDENTIFICATION OF THE CHARACTERISTICS NEEDED FOR MARGINAL PRICES DETERMINATION

The fundamental contribution made by this line of research is the determination of marginal prices for all the characteristics that potentially influence the value of agricultural land, including those that are intrinsic and extrinsic, qualitative and quantitative.

Thus, first it is necessary to identify all these characteristics, analyse their advantages and disadvantages, eventual correlations or interactions with other characteristics and choose the most functional ways to express them, establishing nomenclature, measurement scales and economic criteria. For qualitative characteristics, the marginal price is estimated using the GAS.

Already Grillenzoni and Grittani (1994, p. 412) and Gallerani et al. (2011, p. 28) in their textbooks and, more recently, Tecnoborsa (2018, p. 235) provide a list of the main characteristics which are most likely to affect the market price of a land asset.

The characteristics listed and described in this study take the cue from the relevant white and grey literature on the topic.

The first characteristic, of extrinsic nature, is the *date*, which refers to the moment in which the sales contract is stipulated for comparable properties. The estimate of its marginal price is for the purpose of the adjustment of the comparables' prices to the moment of appraisal. A discrete cardinal scale is used, with months as the measurement unit (Simonotti, 2011). The marginal price can be calculated in a similar way to urban real estate estimates, i.e., through the monthly change rate of the considered market segments (Simonotti, 2011) or for a similar market segment (Tecnoborsa, 2018; Simonotti, 2019). This variation rate is finally multiplied by the comparable market price.

However, despite there being an analogy with the urban real estate market in terms of the formula to be applied for calculating the marginal price, it may be necessary to change the time frame considered for the selection of comparables given the different level of the rural land market's activity compared to that of urban real estate.

The *surface area* is an intrinsic characteristic, its measurement scale is cardinal and refers to the Utilized Agricultural Area (UAA) and Uncultivated Land Area (Tare). According to the definition of the Italian *Network of Agricultural Accounting Information* (Rete di Informazione Contabile Agricola, RICA, in Italian), the UAA represents the surface area used for agricultural production and thus occupied by agricultural crops. According to RICA, in Italian *tare* are those land areas that are not directly used for production but are in any case necessary for farming, such as areas occupied by buildings, country roads, or any other non-agricultural use. The urban real estate method for calculating marginal prices was also thought to be the best choice in this case. Thus, the UAA is the main surface area, and the *tare* may be considered as the secondary surfaces. The marginal price would then be the lowest[5] of the average prices calculated by the ratio between the total price of the comparable properties and the *commercial surface area*[6] (Equation 1). The market ratio of tare refers to the ratio between the marginal prices of tare and UAA and its value is likely to be obtained directly through official and unofficial market sources (i.e., estate agents, consultants, ecc.) or by means of data inferred from notarial deeds.

$$\bar{p} = \frac{P}{UAA + TARE * \pi} \quad (1)$$

In (1) $\bar{p}$ is the average price (€/m^2 or €/ha); P is the market price paid for comparable land (€); UAA is the utilized agricultural area (ha or m^2); $TARE$ is the unproductive land according to the definition cited above (ha or m^2); π is the market ratio of the uncultivated surface area.

Regarding the $TARE$, the marginal price (p_{TARE}) can be determined as the product of the UAA's marginal price (p_{TARE}) and the relative market ratio (π_{TARE}) (Equation 2).

$$p_{TARE} = p_{UAA} \times \pi_{TARE} \quad (2)$$

The *crop type* indicates the crop (herbaceous or orchard) present in the subject and in the comparables with reference to the moment of valuation for the former and at the time of sale for comparables. For herbaceous crops[7] no other details are necessary. For orchard crops, the tree variety should be recorded, as well as the planting distance (between the rows and within the rows) to know the planting density (i.e., the number of trees per hectare), pruning shape (i.e., the form used to manage the vegetative growth of a tree for both technical and economic ends), the age of the orchard to identify what stage of the production cycle the orchard in question is in: planting and establishment, growth and maturity, peak production, decline (Gallerani et al., 2011; pages 67-68-74-75). This intrinsic characteristic due to its nature is to be expressed in a nominal scale, by distinguishing as a first step among herbaceous crops and orchards and if necessary, by describing the cultivated plant species and varieties.

Regarding the economic criteria, the cost value and the capitalization value are believed to be the best choices to determine the marginal prices of the crop types, especially in the case of tree orchards.

The first of the two economic criteria mentioned above – the cost value – can always be used to estimate the value of the topsoil of a tree crop land. Regardless of the specific context, it is always possible to proceed with the preparation of a metric estimate (Computo Metrico Estimativo in Italian, CME) - current or referring to a certain year (by consulting the Regional Agricultural Price Lists or carrying out any analyses of unit prices) - based on technical nature (use of factors and means of production) and economic nature (average unit prices by type of intervention), in order to arrive at the total cost of planting a specialized topsoil. In this way, the planting cost would correspond to the marginal price for the transition from the value of bare land (e.g. arable land) to that of land containing a given tree crop plantation. In summary, it would be the amount of money necessary for the transition from the market value of arable land to that of tree crop land.

The second economic criterion that is proposed here is the capitalization value, applicable to the estimate of equal in age tree crop lands that are renewed on themselves at the end of the economic cycle of the crop in progress. The mechanism by which the quantification of the marginal price for the type of crop is reached is the determination of the difference between the estimated value in an intermediate year (V_m) of the economic cycle and that of bare land (V_0). However, this criterion is excessively complicated having in mind the objective of using it in a "thrifty" estimating procedure, as it would be necessary to carry out a double estimate by

[5] As for the MCA used for urban real estate appraisal, the choice to use the lower of the average unit prices of comparable properties is due to the difficulty in determining the relationship between the average price and the marginal price trend. There may not be enough real estate transactions to create a curve of the average and marginal prices based on the total market prices to compare to the traded areas.

[6] The term "commercial", taken from the urban real estate sector, simply means that the different weight of productive and unproductive areas is directly considered in terms of economic value - at least for agricultural production.

[7] Herbaceous crops can be cereals, leguminous plants, vegetable crops, forage crops, etc.

capitalization, first applied to the bare land, then to the land considered already planted with trees, for the sole purpose of gathering the variation in the total price of a land property after the change in land use from arable to orchard or vice versa.

The *exposition* represents the capacity of the land to receive sunlight, in relation to its orientation in respect to the four cardinal points and the potential presence of mountains, or to be influenced by negative phenomena that exclude the possibility of cultivation, such as exposure to wind (EXEO, 2023). The angle of incidence of sun rays on the earth's surface influences the microclimate in terms of humidity and temperature. Obviously, the best definition of exposition depends on the cultivated crop. Furthermore, since this is an intrinsic qualitative characteristic, its measurement scale could be ordinal – with points attributed in terms of preferences (1 poor, 2 medium, 3 excellent) – or dichotomous – i.e., in relation to the type of crop grown on the subject, the comparable and whether the same subject receives an optimal sun exposition (presence = 1/ absence = 0). In both cases the relative marginal price could be determined with the GAS.

The *land improvements* regard investments made to construct immovable goods that aim to improve the land's productivity and attractiveness. These improvements entail both an increase of income as well as the value of the property where they are built since they become an integral part of the land's capital (Medici, 1972; Michieli, 1993). The following is included in the category of land improvements:

- the rural buildings that contribute to farming, such as the farmer's home, barns to shelter animals, to store machinery and equipment and agricultural products;
- hydraulic improvements are interventions to regulate excess water on farmland caused by precipitation and/or runoff phenomena. Excess water inflows/outflows can severely damage crops, causing water stagnation on flat lads (killing plants via root asphyxiation, nutrient leaching, soil structure destruction, etc.) and of erosion on sloping lands (topsoil removal, i.e. the soil layer with the highest level of biological activity and of organic substances, causing a consequent reduction of the soil's infiltration and thus water retention capacity). Furthermore, the construction of drainage infrastructure, channels, terracing, etc. can help mitigate these phenomena, which would permanently compromise the fertility of agricultural soil;
- the farm's wells, artificial lakes and water supply from irrigation consortia as sources of irrigation water;
- irrigation systems, which transform a farm from a dry system to an irrigated one. In this way, the farmer can establish the times and methods of irrigation/ other interventions to better satisfy the water needs of crops;
- internal roads within the farm facilitate the movement of people and agricultural machinery without affecting the area where crops are grown (i.e., the UAA);
- fencing provides security for the farmer, who needs to protect his or her land from possible damage caused by the intrusion of animals or people.

This characteristic is cardinal and its unit of measurement depends on the nature of the land improvement (linear, square or cubic metre) since the characteristic is manifold.

The most appropriate economic criterion for the marginal price of land improvements is the cost value, depreciated according to the age, state of maintenance and economic life of the built structure involved.

The *layout* represents the shape of the land parcel. This parameter is important because it can determine whether production limits or advantages are present in terms of the agricultural surface area suitable for farming. If the parcel is rectangular or square, it can be defined as regular; instead, if its geometric shape diverges from the above-mentioned ones, it is defined as irregular (EXEO, 2023). Thus, this intrinsic characteristic lends itself to being expressed as a dichotomous variable in terms of absence/presence of regularity and the relative marginal price is estimated through the GAS.

The *degree of consolidation and fragmentation* tells us if the cadastral units that make up the entire real estate property are connected or split into two or more parts. The more fragmented (i.e., the number of parts) the property is, the more difficult it is for the landowner to manage it. It is an extrinsic qualitative characteristic which can be expressed on an ordinal scale according to the number of parts the property is composed of, and its marginal price can be quantified using the GAS.

The presence of *planning and protection restrictions* on the property, identifiable through the urban zoning certification *(*known as Certificato di Destinazione Urbanistica, CDU, in Italian), which entail a depreciating factor on the property. From a legal point of view, these can be grouped into three large categories: building restrictions; building codes and land use regulations.

The first are enforced by laws governing the entire category of properties that are recognized as worthy of protection because they possess public good qualities. These include hydrological restrictions, forest restrictions and environmental restrictions. Building codes are

enforced on a property so that it does not compromise the ability of another property to serve public interests. These include access and buffer requirements (regarding roads, cemeteries, public land, railroads, electric lines, aqueducts, methane pipelines, airports, public maritime property, public waters, etc.). Finally, land use regulations include the limits imposed by the territory governance plan (Piano di Governo del Territorio, PGT, an Italian regional planning instrument), which governs land transformations, building density, urban attractiveness and even the use-destinations of private properties involved in expropriations.

Regardless of restriction type, they all partially or entirely limit an owner's potential to develop land. The more restrictions exist on a property, the less attractive it will be to the market. This extrinsic characteristic can be expressed by a dichotomous scale (presence/ absence of restriction) and its marginal price quantified using the GAS.

The *type of access to the property* is an intrinsic characteristic and indicates ease of access. In fact, a property can be accessed by public roads (such as highways, principal and secondary extra-urban roads and local roads in order of importance) or be interlocked, i.e. surrounded by other properties without the possibility of being accessed from a public road. By law, the owners of interlocked properties have easement rights, and the owners of neighbouring plots must grant them passage. However, clearly access through an easement is not the same as direct access from a public road. This is a qualitative characteristic measured through a dichotomous scale (0 = interlocked land; 1 = land with front-road access) and the procedure for identifying its marginal price is the GAS.

Furthermore, the *distance from the public road network* is important for all properties that are accessed through private inter-property roads, which is considered equal to the sometimes-winding route that must be taken to access these properties. These roads are often unpaved, and difficult or impossible to travel on with cars or farm vehicles. This extrinsic variable can be expressed on an ordinal scale according to the distance and the upkeep condition of the roads involved and the marginal price can be estimated with the GAS.

One of the most important characteristics of rural land, especially in market segments where the buyer is a farmer, direct grower or field worker, is *soil fertility*[8].

In fact, characteristics directly connected to land productivity are of particular interest to an agricultural buyer, who shows a willingness to pay during negotiations that is directly proportional to the property's expected profitability (Grillenzoni and Grittani, 1994; Grittani, 1994).

Fertility is perhaps the most relevant intrinsic characteristic of land, yet it is also the most complex and articulated because it is divided amongst three components: physical fertility, chemical fertility and biological fertility.

The first is related to soil structure and grain size. The second is connected to soil's cation exchange capacity, electrical conductivity and pH. Finally, biological fertility is linked to the presence of organic matter and to the activity of beneficial microorganisms in the surface layer of the soil, which in turn influence the other two previously mentioned components of fertility.

Thus, overall soil fertility is the product of these three components. In turn, each one is also influenced by various endogenous factors, including anthropic activity.

Thus, the overall valuation of fertility is quite complex and cannot be carried out in a synthetic way by professional appraisers without the support of the costly laboratory analyses necessary to measure the different indicators involved.

In addition, some intrinsic characteristics of soil (slope, rockiness, stoniness, etc.) influence soil fertility. A separate assessment of such characteristics could result in an over-estimation of the fertility marginal price due to their conjoint influence on a land property's market value.

A solution to the above problem might be to separately analyse the characteristics which mainly contribute to the overall level of soil fertility. Despite the existence of several intrinsic characteristics affecting soil fertility, at this very early stage of the research it seems appropriate to describe only those ones reported by Costantini (2006), based on the Land Capability Classification System[9].

Stoniness and *rockiness* characteristics influence soil properties and consequentially farm management. In general terms, areas with a strong presence of these factors are difficult to work mechanically, require frequent irrigation, and repeated fertilizing.

Stoniness indicates the presence of stones (classified as gravel, pebbles, stones, and boulders according to

[8] Here we report as an example one of the numerous definitions of soil fertility present in the field literature (Violante, 2013): "It defines the ability of the soil, used for agronomic purposes, to allow abundant plant production. More precisely, fertility is expressed by the maximum yield that can be obtained from a soil cultivated with the plant species most suitable for the climatic conditions of a specific environment. Therefore, the propensity to produce is not a function of the only characteristics of the soil but represents the productive potential of a complex pedoclimatic system".

[9] The Land Capability Classification System was established in 1961 in the United States of America by the Department of Agriculture's Soil Conservation Service.

their size) on and below the soil surface that can impede farming activities. The following classes regarding surface stoniness are proposed:

- not stony: absence or almost absence (up to 3% of the UAA) of stones on the surface, for which no intervention is necessary;
- slightly stony: when up to 15% of the UAA is covered with stones;
- moderately stony: when up to 50% of the UAA is covered with stones;
- very stony: presence of stones for over 50% of the UAA.

Thus, the measurement scale is ordinal and the economic criteria to be used is the cost value. The marginal price can be determined based on the cost of the stone clearing necessary for a property to move up one category.

Rockiness indicates the presence of bedrock near the soil surface, or of rocky outcrops above the surface. The following classes indicate the different percentage frequencies of rockiness present in an area:

- non-rocky: absence or near absence (up to 2% of UAA) of rocks;
- slightly rocky: when up to 10% of UAA is covered by rocks;
- moderately rocky: when up to 25% of UAA is covered by rocks;
- very rocky: when up to 50% of UAA is covered by rocks;
- extremely rocky: presence of rocks for over 50% of UAA.

Unlike stoniness, rockiness indicates actual layers of rocks on the ground that are difficult if not impossible to remove. For this reason, it is appropriate to consider it as a surface subtracted from agricultural production and therefore to be included in the unproductive surface area present on the land. Thus, this characteristic is included in the MCA as a non-productive area and its marginal price is calculated by referring to the Equation 2 described at the beginning of this section.

Slope, intended as the relationship between the difference in elevation and the distance between two known points, can significantly affect agricultural productivity and management costs.

The steeper the slope, the more difficult farming will be. Furthermore, slope directly affects soil fertility due to erosion. Erosion is a naturally occurring phenomenon where soil surface particles are detached and transported by precipitation, which can significantly reduce soil fertility. The rate of erosion is positively correlated with the slope: the greater the slope, the more intense the erosion will be, with consequent negative repercussions for the soil productivity.

The following four distinct slope classes are proposed:

- flat: up to 13%;
- gentle slope: up to 20%;
- moderate slope: up to 35%;
- steep slope: up to 60%.

Land with a grade of over 60% and up to 90% is defined as excessively steep, and a slope over 90% is defined as precipitous. Such high slope values preclude any kind of cultivation and so land or portions of land with these features can be classified as unproductive areas. Thus, for *slope,* an ordinal measurement scale is used.

However, like fertility, slope is a complex characteristic due to the various collateral effects it causes, such as impeding mechanized farming operations, and causing hydrogeological instability, i.e., landslide risk. For these reasons, an economic criterion to calculate the marginal price of slope is not easily definable and it will be identified in a further development of the study.

Praedial servitudes, are easement rights where one property (the servient tenement) must bear a property burden favouring another property (the dominant tenement) belonging to a different owner (Art. 1027 c.c.).

According to the Italian Civil Code, they can be instated voluntarily with an *inter vivos* act (with a contract) or a *mortis causa* act (with a will). The acts must be put in writing by law otherwise they are null and void.

The legislation automatically provides for a small number of easements (right of way easements, aqueduct easements, power line easements, irrigation easements) in the absence of explicit agreements between parties, which can be established coactively, through a judicial ruling or through an administrative act from the public administration.

In both cases (with or without a contract), the property owner of the dominant tenement must pay an indemnity in favour of the owner of the servient tenement, which is indispensable for the holder of the servitude to start exercising his or her right.

A property bearing a servitude burden is less attractive to the market than one that is free of encumbrances, as for all economic burdens.

Servitude burdens on properties are usually indicated in notary deeds of sale, even if the description is rarely precise enough to allow an appraiser to assess its importance in economic terms. In the map sheets the presence of servitudes could be found.

A dichotomic scale is used to express this extrinsic characteristic (0 = presence, 1 = absence), while the quantification of the marginal price is based on the monetary sum (the indemnity) due the owner of the servient tenement to compensate for the burden imposed

on the property. If this should be impossible to determine, even though it remains a dichotomous characteristic, its marginal price should be calculated with the aid of the GAS.

Usufruct is a real right to enjoy another owner's property, which is regulated by the Italian Civil Code (art. 978-1020).

The two legal subjects involved in the institution of usufruct are:

- the legal owner loses property rights, while remaining formally the owner of the asset;
- the usufructuary holds the rights to enjoy the "fruits" of the property, i.e., to benefit from the property and use it as if he or she were the owner, with the exception that the usufructuary cannot change its economic destination.

Usufructuary rights can last up to a maximum of 30 years for legal persons and for the natural life of physical persons.

The presence of usufruct is transcribed in both the cadastral register and in the deed of sale, specifying the parties involved (usufructuary and legal owner).

The same right can also be transferred. Rural properties with the burden of total or partial usufruct are less attractive to the market since the buyer cannot use the asset until the usufruct expires (potentially until the death of the usufructuary).

As for the characteristics preceding it, the usufruct is an extrinsic one, is measured with a dichotomic scale (0 = presence, 1 = absence) and the economic criterion used to quantify its marginal price is the discounting of the future income annuities that have still to be gained by the usufructuary for the residual period of the usufruct.

In case of a "life-long" usufruct contract, the number of residual years can be quantified through the statistical data produced by ISTAT and freely accessible from the ISTAT website. They provide the life expectancy of an individual in a certain territorial area by age and gender. These data correspond to the second quartile of a statistical sample, in other words to the median of the distribution curve.

The annual income of an usufructuary can be approximately traced back to the Land Benefit, which represents the reward due to the landowner, that is the price paid for the use of real estate capital. The average annual income of the land owner can be obtained following two methodological procedures. The first one is based on the annual farm balance by which Land Benefit is quantified by subtracting all the farming cost items (various expenses, wages, salaries, taxes, interests on agricultural capital and maintenance, insurance and depreciation quotas) from the Saleable Gross Product (SGP).

Alternatively, the adjustment for the presence of a life-long usufruct right might take place by applying the coefficients of the usufruct right used by law for tax purposes. These coefficients allow to derive the value of bare ownership (that is, the property subject to usufruct) by subtracting the monetary value of the usufruct right, as obtained above, from the observed sale price of land.

One of the most important financial characteristics to be included in the collection of agricultural land real estate data is the presence of an *ongoing loan or mortgage*, which constitutes an additional financial burden in its sale.

This situation is always described in particular detail in the notary deed, thus appraisers should not have any difficulties quantifying this important monetary sum.

The economic criterion used to assess the marginal price of this extrinsic characteristic is the discounting, i.e., accumulating all the remaining future loan or mortgage payments to the present moment of appraisal by applying a commercial interest rate. In other terms, the economic criterion to be adopted is to discount all the remaining loan instalments at the time of the valuation and then to subtract their present value from the estimated land market value.

In this case, the marginal price will differ from comparable to comparable, depending on single instalment amounts, the number of remaining payments and the applied interest rate.

Regarding *property tax*[10], in Italy, the Unified Municipal Tax (Imposta Municipale Unica, IMU) is applied to all real estates, and therefore in this specific study on agricultural properties. Nevertheless, to date the latter are exempted[11] when they are situated in minor islands (Law No. 448/2001) or in mountain or hill areas (Legislative Decree No. 504/1992). The characteristic is extrinsic and can be expressed through a dichotomic scale (1-present; 0-absent). Its marginal price has a negative sign and is calculated by the discounted present value of the unlimited annual tax fees saved by the landowner in case of IMU exemption.

Entitlements connected to European grants for farmers must also be considered. These entitlements represent the right to obtain monetary aid to cultivate a given area

[10] As to tax benefits, the new 2023 Italian finance law (L. 197/2022) states that registration and mortgage taxes for professional farmers and direct cultivators holding small farm and mountain properties are to be paid at a fixed rate (200 euros) and a cadastral tax equivalent to 1% of the land's sale price. Agricultural cooperatives that directly manage land receive the same benefits. Although tax benefits might affect land purchase propensity by the above-listed categories, they have not been included among the characteristics since they are not directly linked to the value of land capital but to the typologies of buyers.

[11] Stability Law 2016 – Law No. 208/2015.

of land. In addition to receiving these incentives, a farmer can obtain entitlements by buying them. Since they are an object of transfer, it would be possible to retrace the price paid for them using notarial deeds and to use it to appropriately adjust the purchase price of the land upwards or downwards.

The National Strategic Plan of the Common Agricultural Policy (CAP) has stated that entitlements will be abolished starting from 2028 and that in the meanwhile their values will be gradually lowered. Therefore, they are not considered in the present study.

EU income support represents the amount of money granted to farmers through the CAP. These economic supports are allocated in relation to the crops and to the cultivation area. The scale of measurement of this extrinsic characteristic is cardinal. The marginal price can be calculated by discounting the future grants based on the of National Strategic Plan period (2023-2027).

Distance to population centres or product processing/commercialization centres is an important characteristic that strongly influences a property's attractiveness to market agents. The traveling time from the closest population centre and/or processing/commercialization centre of the farm's products can, in fact, significantly influence a property owner's management costs. Furthermore, a potential buyer usually pays just as much attention to the property's location compared to population and processing/commercialization centres as to other aspects.

A cardinal scale in kilometres seems the best way to measure this extrinsic characteristic. The economic criterion for the quantification of the marginal price is that of the cost value. The marginal price is linked to the unit cost of the fuel necessary to cover a kilometre of distance between the reference population centre and the rural property. Assuming an average fuel consumption and a given standard fuel price, the marginal price is obtained by multiplying the two factors. Due to the nature of the characteristic, its marginal price is negative since there is a proportionally inverse relationship between market value and distance.

For the sake of clarity, we are going to describe all the steps from the determination of the marginal price to the quantification of the price delta related to the characteristic within the evaluation table.

The marginal price is obtained by multiplying the kilometre consumption by the unit price of the fuel (petrol or diesel) and is expressed in €/Km. In order to obtain the price adjustment, the round-trip distance travelled daily between the land property and the nearest inhabited centre (subject minus the comparable one) is firstly multiplied by 365 (in order to pass from daily to annual distance) and then the result is to be divided by an adequate commercial rate to capitalize the annual figure.

Alternatively, its marginal price could be calculated as the relationship between the opportunity cost and the possible income the property owner waives by traveling to and from the centre. As per the previous calculations, appropriate adjustments need to be made in the valuation table and the obtained result needs to be capitalized to a single moment in time with a given commercial rate.

The main information concerning the characteristics dealt with in this section are summarized in table 1, reported below.

4. DISCUSSION AND FIRST REMARKS

This paper has described an initial attempt to utilize the mixed approach MCA and GAS for the agricultural land assessment, dealing in particular with the choice of the market segment parameters and with the identification of the relevant land characteristics. Therefore, it serves an exploratory purpose, providing an initial overview of the potential for further methodological developments.

Such a research need arises since in the literature there are just documents reporting a list of land characteristics (Tecnoborsa, 2018) and some illustrative efforts for educational/professional goals (Simonotti, 2011) or for a scientific purpose (Berloco, 2012).

It is believed that this line of investigation could produce a breakthrough in terms of both scientific research and professional practice. Not only would it provide a more transparent and objective method for appraising land through the development of a modified MCA, but it would standardize parameters and features of real estate, create a database of land prices, as well as a database of the marginal price of land features.

Should this research continue to be developed, it would contribute to increasing the knowledge of freelance appraisers and to diversifying appraisal methodologies, with market-oriented methods currently limited to just the single parameter procedure. Thus, appraisers could have a practical land appraisal tool based on scientific principles and not on subjective judgements.

This would significantly help appraisers to overcome the known difficulties they encounter when valuing land, which are principally caused by the land market's low level of activity and its opacity. These drawbacks strongly impact on the search of sales deeds and on the identification of comparables characterized by an adequate level of homogeneity.

Table 1. Characteristics analysed for the inclusion in the MCA procedure.

Characteristics	Nature (intrinsic or extrinsic)	Type (quantitative or qualitative)	Measurement scale (dichotomic, cardinal, ordinal, nominal)	Economic criterion or procedure
Date of sale	Extrinsic	Quantitative	Cardinal	-
Surface area	Intrinsic	Quantitative	Cardinal	Market value
Tare	Intrinsic	Quantitative	Cardinal	Market value
Crop type	Intrinsic	Qualitative	Nominal	Cost and capitalization value
Exposition	Intrinsic	Qualitative	Ordinal or dichotomic	GAS
Land improvements	Intrinsic	Quantitative	Cardinal	Cost value
Layout	Intrinsic	Qualitative	Dichotomic	GAS
Degree of consolidation and fragmentation	Extrinsic	Qualitative	Ordinal	GAS
Planning and protection restrictions	Extrinsic	Qualitative	Dichotomic	GAS
Type of access to the property	Extrinsic	Qualitative	Dichotomic	GAS
Distance from the public road network	Extrinsic	Quantitative	Cardinal	GAS
Stoniness	Intrinsic	Quantitative	Ordinal	Cost value
Rockiness	Intrinsic	Quantitative	Ordinal	Cost value
Slope	Intrinsic	Quantitative	Ordinal	Not defined
Praedial servitudes	Extrinsic	Qualitative	Dichotomic	Benefit calculated in compliance with the normative in force
Usufruct	Extrinsic	Qualitative	Dichotomic	Discounting
Ongoing loan or mortgage	Extrinsic	Quantitative	Dichotomic	Discounting
Property Tax	Extrinsic	Quantitative	Dichotomic	Discounting
Entitlements	Extrinsic	Quantitative	-	Not applicable
EU income support	Extrinsic	Quantitative	Cardinal	Discounting
Distance to population centres or product processing/ commercialization centres	Extrinsic	Quantitative	Cardinal	Capitalization of a cost value

The greatest limit to the practical application of the MCA lies in the nature of agricultural land characteristics, which are generally more qualitative and less technical than those of urban real estate. This makes them harder to standardize and measure, entailing fewer possibilities to use the MCA.

In fact, as seen above, nominal or dichotomic scales are advisable for a great part of the variables involved in rural land appraisal. Consequentially, marginal prices need to be estimated through the GAS. Since it is based on mathematical and matrix calculations, its use requires a number of comparables equal to the number of qualitative characteristics involved, plus one. For example, in the case of six qualitative characteristics (a plausible hypothesis, at least in this initial analysis of the characteristics involved), at least seven comparables are needed to use the GAS. This number would cause the MCA-GAS to no longer be a parsimonious method, and thus it would lose its advantage over single parameter and multiparameter methods based on Multiple Regression Analysis.

As this paper shows, the same progress has not been made for all the characteristics analysed. While for some of them it has been possible to hypothesize ways of estimating their marginal price, for others their complexity and the multiple interactions that a single characteristic can have with other ones casts doubts on their ability to be used in the approach at all.

Indeed, given the experimental nature of this investigation, an alternative method for calculating the marginal price could be found for one or more of the characteristics for which the adoption of GAS is currently suggested.

Nevertheless, the results of this research project could be practically useful for those operating in land real estate and credit (notaries, judges, professional appraisers, those involved in real estate court disputes, real estate agents, credit institutions, etc.), as well as for the academic community.

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