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Serres National Cadaster: An Intestate Succession Preliminary Case Study

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Abstract

In the famous "anti-Commons" theory, resources are underused when multiple owners are endowed with the right to exclude other potential users, in contrast to the "Commons" theory that identifies resource over-exploitation. In this crucial preliminary study, "Intestate Succession" (i.e. "Succession without Will") is under investigation, thus evaluating whether the number of land cotenants (heirs, in "Intestate Succession") affects significantly (or not) land market values, by taking into account certain significant economic variables, representing the whole population official and primary data, officially available from the municipal Serres Farmlands. Applying advanced GLM, we perform ANCOVA analysis, considering as dependent variable the market land value. We find that, controlling for the objective land value (IRS land value), location, irrigation, farmer identity, and land segmentation-fragmentation all affect significantly the market land value variable. Significantly, the number of heirs does not seem to be a significant factor yet in the context of the "anti-Commons" theory.

Keywords: intestate succession; commons vs. anti-Commons theories; national cadastre; GLM; ANCOVA.

JEL classification: C13; O18; R11; Q15.

1. INTRODUCTION

The spatial anti-commons theory (Heller, 1998), stresses that "each owner receives a core bundle of rights, but in too small a space for the most efficient use". The anti-commons theory (Buchanan and Yong, 2000) examines how the increasingly patchwork-like distribution of rural land parcels can be expected to affect farm productivity. In this anti-commons theory resources are underused when multiple owners are endowed with the right to exclude other potential users. The Spatial anti-commons theory, in parallel, stresses that an owner is unable to maximize the benefits of his core bundle of rights, because a space is too small to implement them.

We may argue that land fragmentation (i.e. segmentation, or fractionation in fact) stemming from the right to property division has generated a spatial anti-commons case.

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The commons theory (Hardin, 1968) says that use rights are shared by a group of people, ultimately leading myopic individuals to exploit a resource. In an anti-commons case, multiple owners are endowed with exclusion rights to a resource, such that no one has effective rights to use. The commons theory, on the contrary, results in resource overuse, while the anti-commons theory is prone to under use.

In the spatial anti-commons, deadweight loss is generated because units that would maximize value cannot be employed as a whole. Resources go idle. Spatial anti-commons in land exist when bundles of rights are applied to physical parcels that are too small to generate the maximum potential benefits that could occur, if the parcels were combined! Each land use requires a minimum parcel size upon which the economic benefits stream can be realized. In the spatial anti-commons, property rights either fail to select for a primary land use that best suits the qualities of the land itself, or subdivide the land intro parcels that are too small for efficient application of the use! In the modern economy, all of the spatial rights and responsibilities pertaining to a parcel of land are associated with a single owner.

Land fragmentation results in a checkerboard-like distribution of numerous small, isolated lots allocated to dissimilar land uses! It may be that small, segregated lots associated with land fragmentation frequently fall below the minimum area requirement for efficient agricultural use; therefore, land fragmentation potentially presents a spatial anti-commons case. Agricultural land is susceptible to the spatial anti-commons tragedy, because it is often allocated to uses that are not best suited to the land characteristics, or subdivide into parcels too small to maximize agricultural yield and, thus, agricultural land value(s). Because agriculture is an intensive use of a non-renewable recourse, the size and geographical distribution of inputs inherently affects the efficiency of production.

So, according to Buchanan and Yong (2000) “An anti-commons problem arises when there exist multiple rights to exclude”. On the other side, the economic problem of the Commons (Hardin, 1968) exists where a resource is over-exploited because many have privilege to use a resource, but no one has a right to exclude! Thus, the problem of the anti-commons is characterized by under-use of the resource. Buchanan and Yoon go on to demonstrate that an inverse relationship between (land) resource value and the number of individuals with the right to exclude exists.

Most important also, when we have numerous cotenants (“heirs”, in our preliminary research case), the costs of legal partition of the land, may be such that necessary court costs exceed the expected benefits of land partition. For example, in cases where high numbers of heirs face significant legal costs in order to legally partition their common property, legal partition may not occur. In such cases, non-cooperation amongst cotenants (“heirs”, in our preliminary case study here), with each exercising an exclusion right of the land use, may preclude the best uses of the land.

Under these theoretical conditions, our crucial preliminary case study here, that is “Intestate Succession” (i.e. “Succession without Will”) is under investigation, in order to evaluate whether the number of land cotenants (“heirs”, in “Intestate Succession”) affects significantly (or not) land market values, by taking into account certain significant (and, in fact, all available) economic variables (Deaton, 2007). These economic – agricultural land and market values represent the whole population official and primary data from the municipal Serres farmlands. Our empirical research first investigates all possible statistical relationships between economic and technical variables, by means of descriptive statistics. In the next step, applying advanced statistical techniques and more specifically the GLM

Univariate procedure, we perform an analysis of covariance (ANCOVA), considering as dependent variable the market land value.

Our research focus area is the Serres municipality farmlands, with the Serres County (Perfecture) area being 3790 km^2, with the municipal (study) are being 601.75 km^2 and a population size of 76,817 people. The official data come from for the Serres regional Cadastre Office, representing all available farmland related values of all the intestate successions cases (not sales) that are officially recorded from 2007 up to 2015.

This preliminary and original research paper, that is, to the best of our knowledge, the first of its kind in the Greek State to investigate the economic problem of the "Intestate Succession", is divided into the following sections: Section 2 develops the basic fundamental theories involved. Section 3 presents a basic introductory reference on the Greek Intestate laws and Regulations. Next section (4) presents the statistical analysis and main results obtained. The 5th section follows with the most significant conclusions and proposed research directions.

2. THE BASIC THEORIES INVOLVED

When a person dies without will, the laws of "Intestate Succession" apply through the legal transfer of land, in the form of tenancy in common. We apply the term "Heir property" to refer to the real resource – the land – that is held in the form of tenancy in common, as a result of the (Greek) laws of intestate succession. Focusing on intestate succession, in the Greek economic environment for the first time, to the best of our research knowledge, results in part from the fact that less wealthy farmers are likely to die without a (valid) will (Deaton, 2007; American Association for Retired Persons Research Group, 2000); and, in part due to the obvious economic necessity for the application of the official regional Cadastre data for significant regional economic reconstruction and strategic planning purposes, after seven economic depression and severe national crisis years.

Our economic reasoning, in this paper, stems from the fundamental link between the long established national laws of intestate succession and heir property, summarized in the following section of the paper, and the theory of the anti-Commons (vs. the theory of the Commons), in order to evaluate the economic consequences of heir property; where, the empirical evidence comes from the current officially approved research that is conducted, in the form of a preliminary case study thus far, in the Serres municipal farmlands, with all applied data being codified officially at the city of Serres regional Cadastre Office. Serres region stands as an economically important municipality with a significantly developed primary sector, within the main agricultural fields of Central Macedonia, in Norther Greece. In fact, economic concern about the relationship between co-ownership, inheritance, and poverty levels, especially in the primary sector, appears quite relevant to other major regions of the western world, the United States and Canada (Deaton, 2007; Mitchell, 2001; Shoemaker, 2003).

Significant economic theories provide the scientific framework for examining the economic relationships that may exist when a large number of cotenants each has a legal right to exclude certain economic activities on a shared – in fact, inherited – parcel of (agricultural) land. The fundamental economic model that is developed is that of Buchanan and Yong (2000), termed as the "Anti-Commons" problem – where, the "Tragedy of the Anti-Commons" (Heller, 1998) is characterized by under-use of the (land) resource, when there exist multiple legal rights to exclude. This case is in a direct contrast to "The Tragedy

of the Commons" (Hardin, 1968), where the real resource investigated – the land – is over-exploited because many co-tenants, have privilege to exploit the resource, but no one has a right to exclude the others. Thus seen, the Pareto inefficient outcome in the case of the "Tragedy of the Anti-Commons" results in an inverse relationship between the resource rent (agricultural market land value, here) and the number of individuals (co-tenants, - heirs-, in intestate succession, here) with the (legal) right to exclude (Buchanan and Yong, 2000).

Buchanan and Yong (2000), refining Heller (1998) "Spatial Anti-Commons" characterization and analysis of the "Anti-Commons Theory", developed the graphical – mathematical model of the "Tragedy of the Anti-Commons", thus explaining the symmetric relationship between this and the "Tragedy of the Commons" (Hardin, 1968). Following then Buchanan and Yoon, an anti-commons condition exists when multiple co-owners (Heirs, in Intestate Succession) each exercise the legal right to exclude the use of a jointly owned resource, such that the tragedy of the anti-commons results in a diminishing resource rent (agricultural land market value, in our case evidence in Serres Farmlands) because the resource is under used (in direct contrast with the tragedy of the commons, where the resource rent is again diminishing, because of overuse).

The theory of the anti-commons assumes that the owners of the common resource (cultivated agricultural land, in our case study of the Serres regional Cadastre farmlands data) do not cooperate, although this assumption of non-cooperation among tenants in common (i.e. "heirs", next) needs much further empirical verification. This assumption, in fact, allows for the Pareto Inferior (Nash) equilibrium condition (Deaton, 2007; Dagan and Heller, 2001; Buchanan and Yong, 2000). Considering more the non-cooperation issue, along with Coase (1960) transaction costs theory involved, one might argue that a possibly high number of heirs (in our intestate succession case study here) face significant transaction costs to legally partition their inherited property (agricultural land). These cases need be analyzed further, in order to understand why legal partition may not occur in cases of intestate succession that essentially represent lower property values and, in fact, lower land resource values for persons dying without a will.

The spatial anti-commons theory (Heller, 1998), stresses that "each owner receives a core bundle of rights, but in too small a space for the most efficient use". The anti-commons theory examines how the increasingly patchwork-like distribution of rural land parcels can be expected to affect farm productivity. In this anti-commons theory resources are underused when multiple owners are endowed with the right to exclude other potential users. The Spatial anti-commons theory, in parallel, stresses that an owner is unable to maximize the benefits of his core bundle of rights, because a space is too small to implement them. We may argue then that land fragmentation stemming from the right to property division has generated a spatial anti-commons case. The commons theory (Hardin, 1968), on the other side, says that use rights are shared by a group of people, ultimately leading myopic individuals to exploit a resource. In an anti-commons case, multiple owners are endowed with exclusion rights to a resource, such that no one haw effective rights to use. Therefore, the commons theory results in resource overuse, while the anti-commons theory is prone to under use.

In the spatial anti-commons, deadweight loss is generated because units that would maximize value cannot be employed as a whole. Resources go idle. A spatial anti-commons in land exists when bundles of rights are applied to physical parcels that are too small to generate the maximum potential benefits that could occur if the parcels were combined. Each land use requires a minimum parcel size upon which the economic benefits stream can

be realized. In the spatial anti-commons, property rights either fail to select for a primary land use that best suits the qualities of the land itself, or subdivide the land intro parcels that are too small for efficient application of the use! In the modern economy, all of the spatial rights and responsibilities pertaining to a parcel of land are associated with a single owner.

Land fragmentation results in a checkerboard-like distribution of numerous small, isolated lots possibly allocated to dissimilar land uses. It may be that small, segregated lots associated with land fragmentation frequently fall below the minimum area requirement for efficient agricultural use; therefore, land fragmentation potentially presents a spatial anti-commons case. Agricultural land is susceptible to the spatial anti-commons tragedy because it is often allocated to uses that are not best suited to the land characteristics, or subdivide into parcels too small to maximize agricultural yield. Because agriculture is an intensive use of a non-renewable recourse, the size and geographical distribution of inputs inherently affects the efficiency of production (Krugman, 1991). Land fragmentation (i.e.: "segmentation", or "fractionation") increases the relevant transaction costs associated with the efficient expansion of agricultural operations that satisfies increase in production yields by acquiring more land units through economies of scale (Marsden *et al.*, 2002). Therefore, resolving the tragedy of the spatial anti-commons, by limiting fragmentation, while controlling for the intestate succession negative side effects, will definitely increase the economic and agricultural benefits of the valuable rural farmlands. A survey of American property law (Heller, 1999) reveals that property law responds to excessive fragmentation with the use of a variety of rules and doctrines such as the rule against perpetuity, zoning and subdivision restrictions, property taxes and registration fees, etc.

These crucial issues involved, in a country facing six years of severe economic recession and three sequential referendums, require a scientific and economically sound measurement of the degree of the prevalence of heir property in lower income rural regions, in order to better evaluate these properties, with respect to the number of cotenants and the other relevant economic and demographic characteristics available, all facts that characterize the problematic regional economic development constraints.

3. A BRIEF INTRODUCTION TO GREEK INTESTACY LAWS AND REGULATIONS

Under the term "Inheritance Law" we mean the legal set of laws that govern inheritance; that is, the legal transmission of hereditary rights and obligations, after one's death, to one or more legal entities called heirs. The fortune of the deceased, as a whole, is called Heritage. In the absence of a will, succession is in fact governed by Greek inheritance law where the criteria of parentage, marriage and nationality designate the heirs.

The Inheritance Law belongs to the Civil Law and the provisions contained in articles 1710 – 2035 of the Civil Law discuss the mode of succession. Certain provisions of the inheritance law are still scattered in other Civil Law sectors, such as the Property and Family Law.

The general principles governing the law of succession are:

a) Principle of immediacy: The heir automatically acquires hereditary right of succession property.

b) Principle of universality: The succession property in one transaction, death, devolves to the heir and merges with his/hers personal property.

Succession Categories:

a) succession by law
b) succession of wills

The Succession by law is categorized as:

a) intestate succession
b) forced succession

In the succession of wills, the covenant redactor (testator) reflects his/her determination regarding the fate of his property after his death. This action is thus called testamentary provision. After the death of the testator, the covenant should be published before the competent court, or consular authority, to make known its contents.

The intestate succession holds, pursuant to Article 1710, the 2nd par. of the Civil Law, when there is no will or when the succession of wills is canceled totally or partially.

The forced succession holds, in accordance with Articles 1825 of the Civil law et seq., in the case that some people associated with close family relationship with the deceased are forced heirs, according to provision of law and against the wishes of the deceased.

3.1 The Intestacy: A brief historical development of the institution of intestacy

In ancient times, the institution of private property was recognized in Athens with the legislation of Solon and Crete with the law of Gortyna; whereas, In Roman law it seems to represent the three stages of the evolution of the institution of ownership: the "the generational omokyriotita", "the family omokyriotita" and "the individual ownership" (Pantazopoulos, 1974, p. 168). In Roman Law, the heirs of "pater familias" called the sui, are the descendants of the deceased at death that were under his absolute power. When there were no sui, the closest relatives of male children (male side) were called, the "agnati proximi", which were linked to the deceased under the family shared sovereignty.

The Byzantine Emperor Justinian reforming the Inheritance Law and under "The Laws <Young - 118 and -127>" imposed the system of generation based on blood relatives. "The Laws <Young of Justinian>" and especially the 118, were the ones in force in Greece after its nineteenth century National Independence (The National Independence – The Greek Revolution as of 1821). The Justinian Laws were followed by the 2310 Law from 1920, which was based on the German and Swiss Codes and reformed the intestate succession. On February 23, 1946, the "Civil Code Laws" were implemented which were the codification of the provisions of civil law and the intestate succession that established the system of generations called "The Classes". Generation is a group of persons consisting of the parent and the persons originating by him.

3.2 The reasons for the introduction of intestacy and fundamental rules involved

The existence of property and its parts are recognized and constitutionally guaranteed in Article 17 (paragraph 1) of the Constitution by introducing the protection of private property. By the term "ownership", as a condition of law, we mean the ownership which is the absolute right to use and exploit. The introduction of intestacy law sought in principle the protection of the family, whose constitutional protection enshrined in Article 21 (paragraph 1) of the Constitution. According to the "inheritance law" persons who compose the family of the deceased are considered as the most appropriate to manage the property.

Co-ownership in the Greek Law can be divided and sold in pieces, under certain legal rules and court approvals. Therefore, an anticommons problem cannot arise, since there are no multiple rights to exclude certain activities on a shared parcel of land. Unlike the "Anticommons Problem" (Buchanan and Yong, 2000), the "Tragedy of the Commons" (Hardin, 1968), might accrue, since the resource might be over-exploited because many co-tenants have legal privilege to use the common resource through consequent land fractionation (i.e. resulting segmentation or fragmentation, under legal approval demanding official court appeals), but no one has a right to exclude (without court decisions and arrangements). Thus, the Pareto inefficient outcome in the "Tragedy of the Anticommons" (Heller, 1998) that is characterized by the under-use of the resource does not hold, unless co-tenants have their own preferences in maintaining the shared parcel of land as an undivided resource under common use and exploitation or, similarly, under lack of common land exploitation interests that leads towards land abandonment!

Moreover, in the Greek intestacy law, the surviving spouse would receive only one fourth of the real property (or, 25 percent of the whole), and this as a divided unit property under inheritors' demands; with the two children (example) receiving a partial and potentially divisible interest in the remaining six eights (or, 75 percent of the whole).

The introduction of succession achieved the strengthening of private property rights and ensured the necessary stability and security in economic relations and transactions. In this way, the economic life improves, despite the death of a man, for the sake of society. The intestate succession (Civil Code 1813-1824) is, in Greece, the most common way of succession. The above provisions of the Act (Civil Code 1813-1824) stipulate the relatives of the deceased, who are called to the succession as legitimate heirs of the deceased. Criterion is the family relationship with the deceased, so the law has come to join relatives - heirs in classes. Only the closest of all relatives are in fact called in the intestacy process.

The intestate succession is governed by two rules: a) succession in classes, i.e. the closest class heir excludes everyone else (Article 1819 of the Civil Code). b), succession in roots, i.e. among many successors, the closest (of them) precludes the ultimate in the same order (Class). In place of the successor who does not live at the opening of the succession, the involved descendants participate through that linked kinship with the deceased (Civil Code, Article 1813). There are six classes of intestate heirs:

The First Class: Descendants of the deceased are the children, grandchildren, and the great grandchildren. The descendant of the nearest degree excludes all other descendants of a more remote degree. The surviving spouse is grouped in the first class and her portion is one fourth of the estate.

The Second Class: is composed of the deceased's parents, brothers and sisters, as well as the children and grandchildren of these brothers and sisters who have pre-deceased the deceased.

The Third Class: is composed of the grandparents of the deceased. If these grandparents do not survive, their children and grandchildren take their portion.

The Fourth Class: it is composed of the great grandparents of the deceased who inherit per capita irrespective of the line. The surviving spouse, concurring with the second, third or fourth class, receives one half of the estate.

If no relatives of the four classes exist, the spouse inherits all the estate in the Fifth Class.

In the Sixth Class, in the absence of any relatives, the heir is the State of the deceased's nationality.

4. RESULTS

Figure no. 1 presents the market land value per square meter, for the irrigated vs. the non-irrigated farmland properties, for all the intestate succession cases, within the Serres Municipal Farmlands. It is quite reasonable to verify that irrigated farmland properties are of higher market value (as it was, in fact, expected initially).

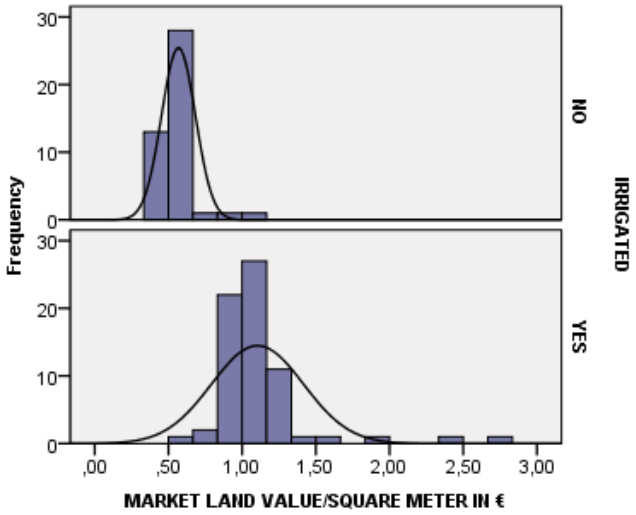

Figure no. 1 - Market Land Value/m^2 * Irrigated

As it is clear from Figure no. 2, the difference between the IRS (Official Internal Revenue Service Land Values) and the commercial market mean value per m^2 is greater in the case of irrigated farmlands.

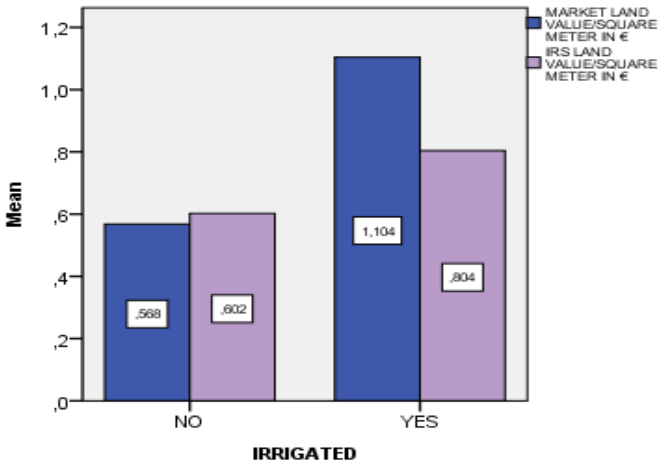

Figure no. 2 - Mean Market Land/m^2 and IRS Land Value/m^2 *Irrigated

The following Table no. 1 reveals that the mean market land value per square meter of the irrigated farmland properties of all the examined intestate succession cases, is almost double (1.104) that from the non-irrigated ones (0.568).

Table no. 1 – Group Statistics, mean market land value/m^2 and IRS value/m^2 *Irrigated

	Irrigated	N	Mean	Std. Deviation	Std. Error Mean
Market Land Value/m^2	No	44	.5680	.1149	.0173
	Yes	68	1.1040	.3124	.0379
IRS Land Value/m^2	No	44	.6019	.1657	.0250
	Yes	68	.8041	.1815	.0220

We use Independent-Samples T Test to compare the market land value/m^2 and the IRS value/m^2 of the two groups (irrigated and not irrigated farmland properties). This test, tests the significance of the difference between two sample means. The procedure produces two tests of the difference between the two groups. One test assumes that the variances of the two groups are equal. The Levene statistic tests the hypothesis of equal variances between the two groups. The significance value of the t-statistic in Table no. 2 being lower than 0.05 (sig.=0.000), provides evidence that there is a statistically significant difference between the two samples, and the hypothesis of equality of means between the irrigated and no irrigated land parcels is rejected for the market land value/m^2 as well as the IRS land value/m^2.

Table no. 2 – Independent samples test

		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	Df	Sig. (2-tailed)
Market Land Value/m^2	Equal variances assumed	5.182	.025	-10.899	110	.000
	Equal variances not assumed			-12.866	91.705	.000
IRS Land Value/m^2	Equal variances assumed	.190	.664	-5.956	110	.000
	Equal variances not assumed			-6.074	97.828	.000

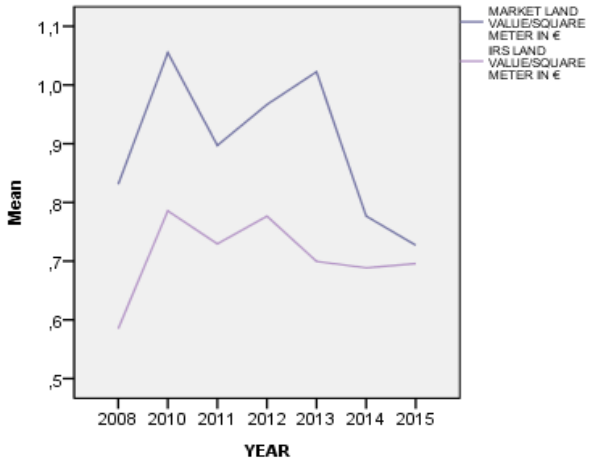

Figure no. 3 – Multiple line chart, mean market land value/m^2 and IRS land value/m^2

The multiple line chart depicted in Figure no. 3, presents the mean market land value and IRS land value per m^2, respectively, for the period under consideration. The market land average value is positioned above the respective IRS land value. However, the dramatic decline in market land average value resulted in a reduction of the gap between the two variables and their convergence over the recent years. It is of great interest that in the severe economic crisis year of 2015, the market land average value was lower than 2008.

Next Figure no. 4 shows that the farmers' total market land value is much greater that the corresponding of the citizens' farmland properties.

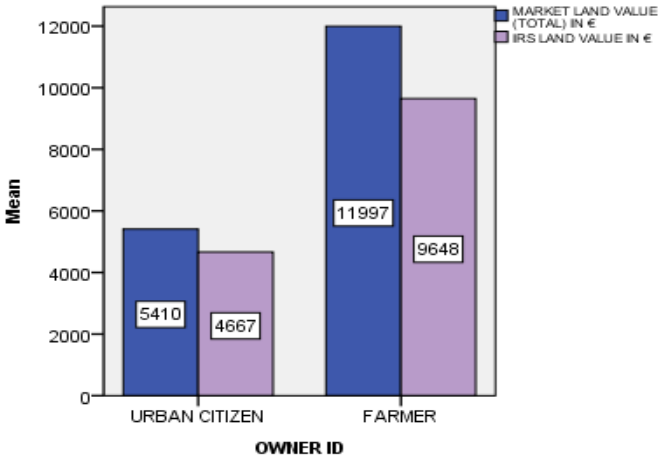

Figure no. 4 – Total market land value, and total IRS value* owner identity

To the contrary, Figure no. 5 makes clear that the per m^2 mean land values present only marginal differences between the two groups of owners (farmers and urban citizens), and the market and the IRS mean values don't seem to be dependent on owner's identity.

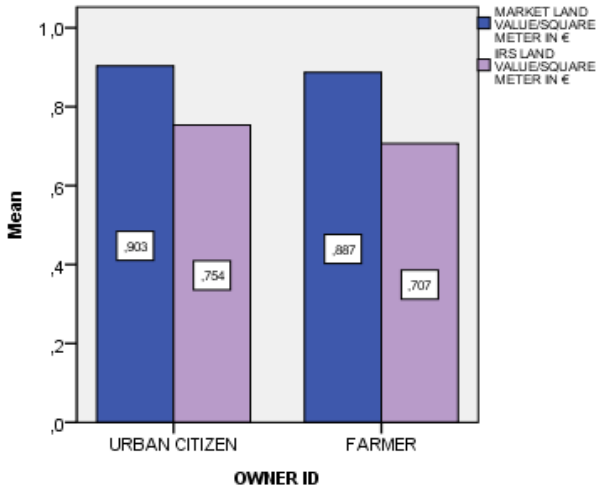

Figure no. 5 – Mean market land value/m^2, and IRS value/m^2* owner identity

Table no. 3 – Group Statistics, mean market land value/m^2 *owner identity

	Owner ID	N	Mean	Std. Deviation	Std. Error Mean
Market Land Value/m^2	Urban Citizen	43	.9033	.3912	.0597
	Farmer	69	.8873	.3504	.0422

The following Table no. 4 presents the results concerning the Independent Samples Test testing the hypothesis of equality of the means of the two groups. The sig value (0.822) being higher than 0.05 provides evidence that the owner identity does not consist a significant differentiating factor for the mean market land value/m^2.

Table no. 4 - Independent Samples Test

Market Land Value/m^2	Levene's Test for Equality of Variances		t-test for Equality of Means		
	F	Sig.	t	df	Sig. (2-tailed)
Equal variances assumed	.441	.508	.225	110	.822
Equal variances not assumed			.220	81.858	.827

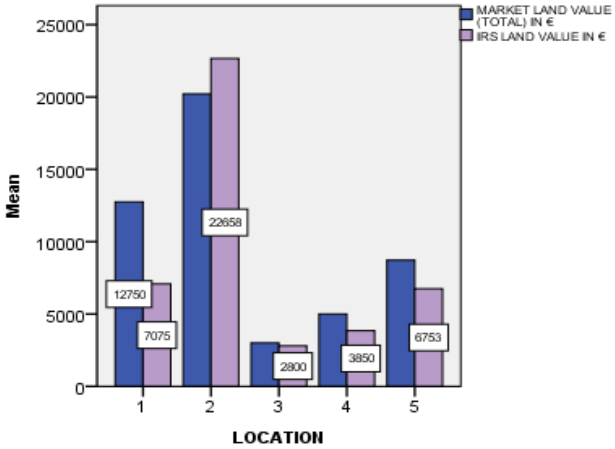

Figure no. 6 – Total mean market land value, and IRS value * location

Table no. 5 and Figure no. 6 describe the fact that the per m^2 mean market, as well as the IRS land values, appear significantly higher in location 1.

Table no. 5 – Group statistics, mean market land and IRS value/m^2 * location

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
						Lower Bound	Upper Bound
Market Land Value/m^2	1	4	1.6448	.7655	.3827	.4268	2.8629
	2	8	.7597	.2936	.1038	.5143	1.0052
	3	1	.5416	.	.	.	.
	4	5	.6251	.1267	.0567	.4678	.7825
	5	94	.8908	.3191	.0329	.8255	.9562
	Total	**112**	**.8934**	**.3649**	**.0345**	**.8251**	**.9617**

		N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean	
						Lower Bound	Upper Bound
IRS Land Value/m^2	1	4	1.1871	.2517	.1259	.7866	1.5877
	2	8	.8932	.2148	.0759	.7137	1.0728
	3	1	.5055	.	.	.	.
	4	5	.5222	.0436	.0195	.4680	.5763
	5	94	.7037	.1666	.0172	.6696	.7378
	Total	**112**	**.7246**	**.2009**	**.0190**	**.6870**	**.7622**

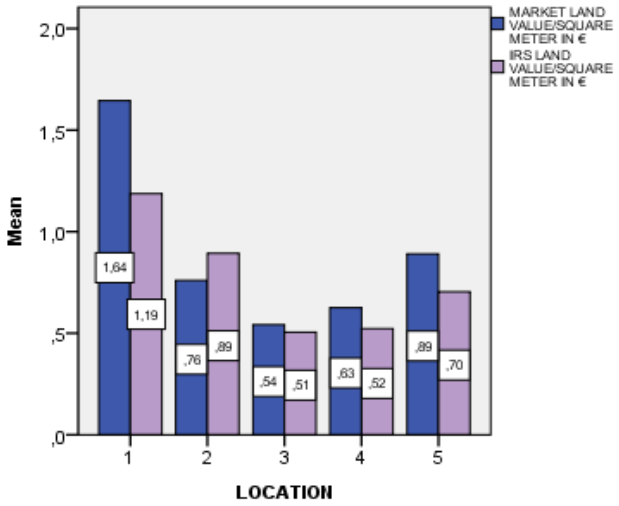

Figure no. 7 – Mean market land value/m^2 and IRS value/m^2 * location

In order to test whether the per m^2 mean market land and the corresponding IRS values are equal between farmland area locations, we apply the ANOVA procedure (Table no. 6). Table no. 6 indicates which variables contribute the most to our cluster solution. Variables with large *F* values provide the greatest separation between clusters. In both cases, the p-value being lower than 0.05, provides evidence that the several means are not equal. Our results make clear that location is indeed, as expected, a significant differentiating factor for the two per m^2 mean values (sig=0.000), for all the examined intestate succession cases.

Table no. 6 – ANOVA, mean market land and IRS value/m^2 * location

		Sum of Squares	df	Mean Square	F	Sig.
Market Land Value/m^2	Between Groups	2.886	4	.721	6.489	.000
IRS Land Value/m^2	Between Groups	1.377	4	.344	11.879	.000

As the hypothesis of equality of the variances of the two groups is accepted, we proceed applying the ANOVA procedure to test if the total market land value and IRS values depend on land segmentation due to intestate succession (# of heirs) (Table no. 7). The sig. value being higher than 0.05 provides evidence that the number of heirs does not consist a significant differentiating factor for the total market and IRS values.

Table no. 7 – ANOVA, total market land and IRS value * Land segmentation/heirs

		Sum of Squares	df	Mean Square	F	Sig.
Total IRS Land Value	Between Groups	373633202.17	9	41514800.24	.460	.898
Total Market Land Value	Between Groups	981309810.33	9	109034423.37	.783	.633

Similarly, per m^2 means (market land and IRS values) do not depend upon the number of heirs (Table no. 8). In both cases, the sig. value being higher than 0.05 (0.568 and 0.853 respectively), provide evidence that the mean market and IRS values and the number of heirs are independent each other.

Table no. 8 – ANOVA, mean market land and IRS value/m^2 * Land segmentation/heirs

		Sum of Squares	Df	Mean Square	F	Sig.
Market Land Value/m^2	Between Groups	1.037	9	.115	.855	.568
IRS Land Value/m^2	Between Groups	.199	9	.022	.526	.853

In contrast, land segmentation/fragmentation seems to affect significantly (sig.=0.00) total Market and IRS land values (Table no. 9).

Table no. 9 – ANOVA, total market land and IRS value * Land segmentation/ fragmentation

		Sum of Squares	Df	Mean Square	F	Sig.
Total IRS Land Value	Between Groups	7613614912.3	10	761361491.23	39.000	.000
Total Market Land Value	Between Groups	11393930112.5	10	1139393011.25	30.346	.000

However, the land fragmentation (segmentation, or fractionation) does not seem to affect significantly the per m^2 mean market and IRS land values (Table no. 10), as sig. values are higher than 0.05 (0.619 and 0.952 respectively).

Table no. 10 – ANOVA, mean market and IRS land value/m^2 * Land fragmentation

		Sum of Squares	Df	Mean Square	F	Sig.
Market Land Value/m^2	Between Groups	1.098	10	.110	.810	.619
IRS Land Value/m^2	Between Groups	.163	10	.016	.382	.952

Assessing, next the crucial issue of correlations, in order to trace out any possible links between the total market and IRS values, we estimate the Pearson correlation coefficient. The coefficient was found to be significantly positive revealing a strong positive relationship between these two variables (Table no. 11).

Table no. 11 – Correlation between total market and IRS land value

		Total Market Land Value	Total IRS Land Value
Total Market Land Value	Pearson Correlation	1	.932**
	Sig. (2-tailed)		.000
	N	112	112
Total IRS Land Value	Pearson Correlation	.932**	1
	Sig. (2-tailed)	.000	
	N	112	112

Note: **. Correlation is significant at the 0.01 level (2-tailed).

The positive and significant coefficient (0.621) reveals a positive but lower association between the per m^2 market and IRS values (Table no. 12).

Table no. 12 – Correlation between per m^2 market and IRS land values

		Market Land Value/m^2	IRS Land Value/m^2
Market Land Value/m^2	Pearson Correlation	1	.621**
	Sig. (2-tailed)		.000
	N	112	112
IRS Land Value/m^2	Pearson Correlation	.621**	1
	Sig. (2-tailed)	.000	
	N	112	112

Note: **. Correlation is significant at the 0.01 level (2-tailed).

In contrast and quite interestingly, the correlation coefficient between the total market land value in € and the land segmentation due to the intestate succession # of heirs (Table no. 13), is positive, suggesting, as it was expected, that a higher number of heirs coexists with higher land values. However, this link is not statistically significant (0.0621) as sig. > 0.05.

Table no. 13 – Correlation between total market land value and Land Segmentation - Heirs

		Total Market Land Value	Land Segmentation - Heirs
Total Market Land Value	Pearson Correlation	1	.061
	Sig. (2-tailed)		.522
	N	112	112
Land Segmentation - Heirs	Pearson Correlation	.061	1
	Sig. (2-tailed)	.522	
	N	112	112

Similar and important evidence is found about the estimated correlation coefficient concerning the relation between per m^2 market land value and number of heirs (Table no. 14). The respective coefficient is found to be negative and significant at the 0.1 level, pointing towards the anti-commons theory verification.

Table no. 14 – Correlation between per m^2 market land value and Land Segmentation - Heirs

		Market Land Value/m^2	Land Segmentation - Heirs
Market Land Value/m^2	Pearson Correlation	1	-.162
	Sig. (2-tailed)		.088
	N	112	112
Land Segmentation - Heirs	Pearson Correlation	-.162	1
	Sig. (2-tailed)	.088	
	N	112	112

In contrast, the significantly positive coefficient (0.834) reveals a strong relationship between total market value and land fragmentation (fractionation) (Table no. 15). This also important finding that questions the fundamental previous anti-commons tendency needs further detailed analysis, this being done in the form of the GLM procedure below.

Table no. 15 – Correlation between total market land value and Land Fragmentation

		Total Market Land Value	Land Segmentation - Fragmentation
Total Market Land Value	Pearson Correlation	1	.834**
	Sig. (2-tailed)		.000
	N	112	112
Land Segmentation - Fragmentation	Pearson Correlation	.834**	1
	Sig. (2-tailed)	.000	
	N	112	112

Note: **. Correlation is significant at the 0.01 level (2-tailed).

However, a non-significant positive relationship (0.021) is fount between land segmentation-fragmentation and per m^2 market land value (Table no. 16).

Table no. 16 – Correlation between market land value and Land Fragmentation

		Market Land Value/m^2	Land Segmentation - Fragmentation
Market Land Value/m^2	Pearson Correlation	1	.021
	Sig. (2-tailed)		.829
	N	112	112
Land Segmentation - Fragmentation	Pearson Correlation	.021	1
	Sig. (2-tailed)	.829	
	N	112	112

A significant positive association (0.862) is also detected between total IRS land value and land fragmentation (Table no. 17) with the coefficient to be significant at the 0.01 level.

Table no. 17 – Correlation between total IRS land value and Land Fragmentation

		Total IRS Land Value	Land Segmentation - Fragmentation
Total IRS Land Value	Pearson Correlation	1	.862**
	Sig. (2-tailed)		.000
	N	112	112
Land Segmentation - Fragmentation	Pearson Correlation	.862**	1
	Sig. (2-tailed)	.000	
	N	112	112

Note: **. Correlation is significant at the 0.01 level (2-tailed).

The opposite evidence appears concerning the link between per m^2 IRS land value and the land segmentation-fragmentation (Table no. 18), with the coefficient (0.027) to be positive but non-significant. All these results again force us to further analyze them in the form of the GLM procedure that follows.

Table no. 18 – Correlation between per m^2 IRS land value and Land Fragmentation

		IRS Land Value/m^2	Land Segmentation - Fragmentation
IRS Land Value/m^2	Pearson Correlation	1	.027
	Sig. (2-tailed)		.779
	N	112	112
Land Segmentation - Fragmentation	Pearson Correlation	.027	1
	Sig. (2-tailed)	.779	
	N	112	112

Finally, a positive but again non-significant association (0.014) is also found between the land fragmentation and the number of heirs (Table no. 19).

Table no. 19 – Correlation between Land Segmentation – Heirs and Land Fragmentation

		Land Segmentation - Fragmentation - Heirs	Land Segmentation - Fragmentation
Land Segmentation - Fragmentation - Heirs	Pearson Correlation	1	.014
	Sig. (2-tailed)		.885
	N	112	112
Land Segmentation - Fragmentation	Pearson Correlation	.014	1
	Sig. (2-tailed)	.885	
	N	112	112

The GLM Univariate Procedure

Under these conditions, we apply the crucial GLM Univariate procedure that allows us to model the value of a dependent scale variable based on its relationship to categorical and scale predictors. The first following Table no. 20 describes the average values and standard deviations for the market land values per square meter for all category combinations (variables) “irrigated or not” and “location area”. We notice that both average values of the two categories (variables) “irrigated or not lands”, despite of the “location area” variable, and the average values of the location categories despite of the “irrigated or not lands”, are significantly differentiated among them. The average value for the non-irrigated (dry) lands is 0.5680, whereas for the irrigated ones is 1.104. Also, the average value for land area (location area) is 1.6448, this being significantly higher compared to the corresponding average value of all the other regions (location areas).

Table no. 20 – Descriptive statistics

Irrigation	Location Code	Mean	Std. Deviation	N
No	2	.5521	.0757	5
	3	.5416	.	1
	4	.5739	.0626	4
	5	.5704	.1269	34
	Total	**.5680**	**.1149**	**44**
Yes	1	1.6448	.7655	4
	2	1.1057	.0542	3

Irrigation	Location Code	Mean	Std. Deviation	N
	4	.8301	.	1
	5	1.0724	.2425	60
	Total	**1.1040**	**.31241**	**68**
Total	1	1.6448	.7655	4
	2	.7597	.2936	8
	3	.5416	.	1
	4	.6251	.1267	5
	5	.8908	.3191	94
	Total	**.8934**	**.3649**	**112**

Note: Dependent Variable: Market Land Value/m^2

The next Table no. 21 presents the relative ANOVA, with respect to the "irrigated or not" and the "Location area" factors (variables). We notice that the logic followed in ANOVA for the dependent variable "Market Land Value/m^2, is the multiple regression analysis. The first line of the table shows the (F=23.008) criterion (test), under the "Corrected Model" heading, for the model's evaluation in total (i.e. "together"). Under (sig. < 0.01), we get that the two factors ("irrigation or not" and "location area") interact, in total (i.e. "together"), the market land values per m^2.

Absence of significant mutual interaction (association) between the two variables (sig=0.623) means that these two variables (factors) affect the market land value per m^2, independently of one another. From the significance values of the main interactions of irrigated (or not) lands (sig=0.000) and location area (sig=0.001), we get a significant influence from both variables. The R^2 of 60.8% for the total variability of the market land value per m^2 is due to the irrigated (or not) and the location area variables (factors).

Table no. 21 – Tests of Between-Subjects Effects

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	8.982[a]	7	1.283	23.008	.000
Intercept	13.733	1	13.733	246.252	.000
Irrigation	.941	1	.941	16.865	.000
Location Code	1.181	4	.295	5.294	.001
Irrigation * Location Code	.053	2	.026	.475	.623
Error	5.800	104	.056		
Total	104.179	112			
Corrected Total	14.782	111			

a. R Squared = .608 (Adjusted R Squared = .581)

Note: Dependent Variable: Market Land Value/m^2

Evaluating the model, we get that "irrigation", "location" and "owner ID" variables, along with "owner ID" and "location" interaction, affect significantly the "land market value per m^2".

Table no. 22 – Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	10.249[a]	11	.932	20.554	.000
Intercept	15.823	1	15.823	349.069	.000
Owner ID	.244	1	.244	5.378	.022
Irrigation	1.525	1	1.525	33.632	.000
Location Code	1.394	4	.348	7.687	.000
Owner ID * Irrigation	.062	1	.062	1.372	.244
Owner ID * Location Code	1.208	2	.604	13.322	.000
Irrigation * Location Code	.058	2	.029	.642	.528
Error	4.533	100	.045		
Total	104.179	112			
Corrected Total	14.782	111			

Note: Dependent Variable: Market Land Value/m^2

Having the interaction term "owner ID" * "irrigation" and "owner ID" * "location code" insignificant, we subtract them, resulting to the following Table no. 23.

Table no. 23 – Tests of Between-Subjects Effects

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	10.126[a]	8	1.266	28.001	.000
Intercept	14.848	1	14.848	328.478	.000
Owner ID	.290	1	.290	6.412	.013
Irrigation	6.214	1	6.214	137.458	.000
Location Code	1.341	4	.335	7.419	.000
Owner ID * Location Code	1.144	2	.572	12.652	.000
Error	4.656	103	.045		
Total	104.179	112			
Corrected Total	14.782	111			

a. R Squared = .685 (Adjusted R Squared = .661)

Note: Dependent Variable: Market Land Value/m^2

We next examine Table no. 24 the association of "market land value/m^2" with "irrigation", "location" and "land segmentation-fragmentation", while controlling for "IRS land value/m^2" (which is expected to increase the "market land value/m^2). We used the GLM Univariate procedure to perform an analysis of covariance (ANCOVA) on the "market land value/m^2". An extra assumption of ANCOVA is that there is no significant interaction between the covariate and factor, so we begin by fitting a model with an interaction term. Here "IRS land value/m^2" is considered as a covariate. The significance value for all the factors (with the only exception being the main effect of "location"), is less than 0.05; thus indicating that all the factors, their interaction, as well as the interaction between the covariate and "irrigation" ("irrigated Yes=1 No= 0" * "IRS land value per m^2") have a significant effect on "market land value/m^2". The coefficient of determination, R^2 equals 0.846, indicating that 84.6% of variance in the dependent variable is explained by the model.

Table no. 24 – Tests of Between-Subjects Effects

Source	Type III Sum of Squares	Df	Mean Square	F	Sig.
Corrected Model	12.503[a]	25	.500	18.872	.000
Intercept	.348	1	.348	13.128	.000
Irrigation	.147	1	.147	5.529	.021
Location Code	.162	4	.041	1.530	.201
Land Segmentation – Fragmentation	1.646	10	.165	6.211	.000
IRS Value/m^2	.616	1	.616	23.227	.000
Irrigation * Location Code	.090	1	.090	3.412	.068
Location Code * Land Segmentation-Fragmentation	2.204	6	.367	13.863	.000
Irrigation * IRS Value/m^2	.419	1	.419	15.822	.000
Error	2.279	86	.026		
Total	104.179	112			
Corrected Total	14.782	111			

a. R Squared = .846 (Adjusted R Squared = .801)

Note: Dependent Variable: Market Land Value/ m^2

5. CONCLUSIONS AND IMPLICATIONS

Our main conclusions point that the mean commercial-market land value (per m^2) is greater in the case of irrigated farmlands. It is of great interest that in the severe economic crisis year of 2015, the average commercial market land value was lower than the corresponding one in 2008. Still further, we get statistical evidence that the owner identity (farmer vs. non-farmer land owner) does not represent a significant differentiating factor for the mean market land value/m^2.

Our results make clear that location is indeed, as expected, a significant differentiating factor for the two per m^2 mean land value categories (market and IRS), for all the examined intestate succession cases. We can provide evidence that the number of heirs, through intestate succession, does not appear as a significant differentiating factor for the mean market land and the corresponding IRS values. In contrast, land segmentation/fragmentation seems to affect significantly the total market and the corresponding IRS land values.

However, the land segmentation/fragmentation (or, fractionation, in fact) does not seem to affect significantly the mean per m^2 market and IRS land values. In contrast and quite interestingly, the correlation coefficient between the total market land value in € and the land segmentation due to the intestate succession number of heirs, is positive, suggesting, as it was expected, that a higher number of heirs coexists with higher land values. However, this link is not statistically significant. The respective coefficient concerning the relationship between the per square meter market land value and the number of heirs, is found to be negative and significant at the 0.1 level, thus pointing towards the anti-commons theory verification.

In contrast, we face a strong relationship between total market value and land fragmentation. This also important finding that questions the fundamental previous anti-commons tendency needs further detailed analysis, this being done in the form of the GLM procedure below.

However, a non-significant positive relationship is fount between land segmentation-fragmentation and per m^2 market land value. A significant positive association is also

detected between total IRS land value and land fragmentation. Under these conditions, we apply the crucial GLM Univariate procedure that allows us to model the value of a dependent scale variable based on its relationship to categorical and scale predictors. In this process, the association of "market land value/m^2" with "irrigation", "location" and "land segmentation-fragmentation", while controlling for "IRS land value/m^2" (which is expected to increase the "market land value/m^2), thus indicating that all the factors (with the only exception being the "single-main" effect of "location"), their interaction, as well as the interaction between the covariate and "irrigation", all have a significant effect upon the "market land value/m^2". Under these special statistical characteristics, it seems that under GLM, productive farmers, relating negatively their land market value per m^2 to the increasing number of heirs, are seeking better land locations (as irrigated farmlands), a fact that characterizes portions within their highly fragmented (fractionated/segmented) land properties, for all existing intestate succession cases, at the Serres Municipal farmlands in Central Macedonia, Northern Greece. These significant statistics convince us towards an initial justification of the anti-commons theory.

Thus, considering that our population data point significantly towards the anti-commons theory verification and the relevant negative burdening upon regional development, it becomes imperative to further investigate whether intestate succession expands (or, not) as a negative side-effect of the seven years severe economic crisis that still continues.

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Research contribution

This research is unique and the first of its kind that relates the case of "Intestate Succession", Land values and National Cadastre official data, in Greece, all from the Serres Regional Cadastre and Municipal Offices, for the Serres Regional Farmlands of the primary sector. It also represents the first of its kind case study analysis that investigates the relevance of the established and significant theories of the "Commons" versus the "Anti-Commons" case. Official research cooperation with the University of Guelph, Canada, is also of high importance and it continues as well as that with all local and regional authorities involved at the Serres Municipality in Central Macedonia, Northern Greece.

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