# Family farm's features influencing socio-economic sustainability: An analysis of the agri-food sector in southeast Spain

*Emilio GALDEANO-GÓMEZ*[1], *José A. ZEPEDA-ZEPEDA*[2], *Laura PIEDRA-MUÑOZ*[1*], *Laura L. VEGA-LÓPEZ*[2]

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## Abstract

*Family farming multifunctionality is increasingly recognized as an element for promoting sustainable development in rural areas. Although environmental issues traditionally receive more attention, this paper focuses on the implications of farm features in relation to the socio-economic dimension. Taking the farming system in southeast Spain as reference, an analysis was done considering several indicators of socio-economic performance. The results, along with economic factors, characteristics related to innovation proactivity, increased agroecological production, education, and farm inheritance, have a positive influence on young age structure, average income, employment and multiculturalism. The study presents an evaluation of multifunctional characteristics that can be extended to other family farm sectors and analyses of their impact on the sustainability of rural areas.*


***Keywords:*** *family farming, multifunctionality, socio-economic sustainability, rural development, southeast Spain.*


## Résumé

La multifonctionnalité de l'agriculture familiale est de plus en plus reconnue comme un élément de promotion du développement durable dans les zones rurales. Bien que les questions environnementales reçoivent traditionnellement une plus grande attention, cet article se concentre sur les implications des caractéristiques agricoles dans la dimension socio-économique. Prenant le système agricole du Sud-est de l'Espagne comme référence, cette étude a été réalisée compte tenu de plusieurs indicateurs de performance socio-économique. Les résultats, concernant les facteurs économiques, les caractéristiques liées à la proactivité face à l'innovation, l'augmentation de la production agro-écologique, l'éducation et l'héritage de l'exploitation, ont une influence positive sur la structure d'âge, le revenu moyen, l'emploi et le multiculturalisme. Cette étude présente une évaluation des caractéristiques multifonctionnelles qui peuvent être généralisées à d'autres secteurs de l'agriculture familiale et analyse leur impact sur le développement durable des zones rurales.


**Mots-clés:** agriculture familiale, multifonctionnalité, développement durable socio-économique, développement rural, Sud-est de l'Espagne.

## 1. Introduction

The family production structure of agrarian systems is increasingly recognized as one of the elements that can foment interrelationships among economic, social and environmental goals (Calus and van Huylenbroek, 2010; HLPE, 2013). Family farms play a key role in long-term maintenance of the economy in many rural agricultural areas due to their knowledge of local production and ability to adapt, as well as the know-how handed down over the generations. Moreover, the motivation of family farmers often goes far beyond maximizing their profit, to encompass social and ecological aspects that benefit their community (Ikerd, 2013; Roberts *et al*., 2013).

This role is widely and implicitly recognized by the concept of 'multifunctionality' associated with farmers (i.e. providing commodity and non-commodity outputs) in development programs and sustainability strategies, such as European Union rural policies (Mölders, 2013). Nevertheless, while ecological topics have been receiving most of the attention in analyses on these issues, there are fewer studies concentrating on socioeconomic goals and achievements (Dumont *et al*., 2016).

Though sustainable development has been conceived in many ways, the interplay of economic and social issues involves providing the population with satisfactory, long-term quality of life[1]. However, at the same time, it also implies maintaining a balanced structure within said population over generations with respect to equity, culture, environment, etc. (Copus and Crabtree, 1996; European Commission, 2001; OECD, 2001).

From this socio-economic perspective, in a productive sector with a broad base consisting mainly of family farms and involving a large segment of the population, these farms are indispensable for maintaining employment and economic viability within local communities in many rural areas (Calus and van Huylenbroek, 2010). They can play an important role in management and entrepreneurship in this economic context, for instance as members of farming-marketing cooperatives, interprofessional associations, etc. At the same time, these farmers and their networks can develop social capital and promote welfare equity, participation and social cohesion over generations (Calus and van Huylenbroek, 2010; Galdeano-Gómez *et al*., 2013).

The family structure in rural areas has usually been associated with traditional production systems as opposed to corporate agriculture, and with systems that are unprofitable and/or insignificant in regional or local economic activity. However, recent analyses (e.g. HLPE, 2013) have

[1] Department of Economics and Business, University of Almería (Agri-food Campus of International Excellence, ceiA3), Almería, Spain.
[2] Department of Economics and Administrative Sciences, Universidad Autónoma Chapingo, Texcoco de Mora, México.
[*] Corresponding author: lapiedra@ual.es

[1] This also implies self-sufficiency, since sustainability implies the absence of external economic support or permanent subsidies (Copus and Crabtree, 1996; Galdeano-Gómez *et al.*, 2013).

shown the importance of family farms, which is on account of both their economic weight and their role in the development of certain agrarian systems. For example, in North America and Asia (two quite markedly different continents), the family structure represents over 80% of agricultural production and of the area cultivated. In Europe, family operations represent 65% of the area cultivated, and employ 25 million people (FAO, 2013). Therefore, interest in analyzing it is not just in the context of developing countries, but also on a much wider international scale.

In this line, there are several works that analyze the role of these farms in environmental issues (HLPE, 2013; Rivaroli *et al*., 2016); however, the specific factors of family farms which have an impact on regional socio-economic development have received scant attention in the literature. When farm organization and management are performed in a family setting, they imply a series of specific connotations which affect not only the achievement of economic goals, but also the social ones (Ikerd, 2013), making it a driving force behind integrated rural development (Ellis and Biggs, 2001).

This study attempted to analyze the role of the family farm in socio-economic sustainability, taking as a reference the agro-food system in southeast Spain. Production in this region is based on the small-scale family farm that has developed over more than five decades, and is strongly endogenous, i.e. there has been no outside public planning or political support (Aznar-Sánchez *et al*., 2011). To achieve this objective, the study considers the influence of sociocultural variables and the economic configuration of family operations on a diversity of socio-economic sustainability indicators in this area of production, including age structure, income, employment rate and multicultural diversity.

The analysis carried out intended to contribute to the literature on family farms and rural sustainable development by: a) reviewing the role of the family component in rural socioeconomic development goals; b) empirically determining the impact of factors related to family production organization and its multifunctional farming characteristics on the achievement of socioeconomic sustainability.

The paper is structured as follows. The following section reviews the concepts and facets of family farming that could have implications for socioeconomic sustainability, describing agricultural development in southeast Spain within this framework. Next, an empirical study of data from a sample acquired from family farms in this area of Spain is carried out using regression analysis to determine the influence of the characteristics of the farms on diverse socioeconomic sustainability indicators. The final section discusses the main conclusions of our work.

## 2. Family farms and rural socio-economic sustainability

### 2.1. Family farm: economic and social elements

The persistence of the family farm in advanced capitalist societies is a paradox, since farming is perhaps the only sector in which a relatively large number of independent family-based enterprises exist (Calus and van Huylenbroeck, 2010; Shucksmith and Ronningen, 2011; Roberts *et al*., 2013). Certain characteristics of the family farm display all the signs of a business and, in addition, it combines those of intrafamily relationships. However, there is no consensus as to these features, as specific factors intervene in each region. Salcedo and Guzmán (2014) mention that the socioeconomic and cultural diversity that characterizes the farming sector among different countries, comprises a large number of varied elements, impeding a conclusive definition.

Johnsen (2004) says the particularities of the family farm have been studied since the eighties by a limited number of researchers. However, important efforts have been made by authors such as Hill (1993), Djurfeldt (1996), Gray (1998) and more recently Calus and van Huylenbroek (2010). Although their conceptions diverge slightly, all of these theorists have differentiated family operations from others based on land, company ownership and organization of work.

In a compilation of 36 definitions of the family farm concept, Salcedo and Guzmán (2014) show their enormous diversity, whether because of the number of variables considered, or due to their quantitative dimension, making comparison practically impossible. Nevertheless, the different conceptualizations of family farming are considered to have the following elements in common:

a) Family labor predominates on the farm.
b) Administration of the economic-production unit is assigned to the head of the household.
c) The size of the operation and/or production is a determining factor in its classification.

The 2014 International Steering Committee for the International Year of Family Farming published the following conceptual definition:

> Family farming includes all family-based agricultural activities, and it is linked to several areas of rural development. Family farming is a means of organising agricultural, forestry, fisheries, pastoral and aquaculture production which is managed and operated by a family and predominantly reliant on family labour, including both women's and men's. The family and the farm are related to each other, evolve together and combine economic, environmental, social and cultural functions (FAO, 2013).

Other family farming concepts are possible, and therefore, their classification could be based on several different criteria (Hill, 1993) and depend on each particular situation. Gray (1998) deems some criteria as absolutely necessary in his definition of the family farm, such as ownership of the business combined with control and management. However, other factors, for example labor and capital supply, are not strictly essential for a family farm (e.g. HLPE, 2013).

The intention of cross-generational family control plays an important conceptual and empirical role in family oper-

ations. It also has other functions, such as meeting family obligations, preserving the family and its values, and altruism toward the members of the family (Ikerd, 2013). Survival of family farming depends on the participation and inclusion of the next generation, whether as employees or owners. Their commitment and willingness is essential to the continuity of the family farm (Calus and van Huylenborek, 2010).

## 2.2. Family farm in socio-economic development: from multifunctionality to rural sustainability

The characteristics typifying family organization as a production unit in rural environments involve meeting sustainable development goals. In particular, farming is recognized as an economic activity which provides multiple benefits to society, from satisfying basic needs to promoting rural amenities (Rivaroli *et al*., 2016). Agriculture provides a number of market and non-market benefits, such as environmental protection, food security, cultural heritage, rural employment and socioeconomic development of rural areas. All of these aspects also constitute the concept of multifunctionality, and have a clear relationship with sustainability (Mölders, 2013).

Both sustainable development and multifunctionality have been subject to European policies, e.g. the European Union Sustainable Development Strategy (EC COM, 2009) and Organisation for Economic Cooperation and Development (OECD, 2001).

However, the interpretations of both concepts and the role of farming in both has been the subject of wide discussion (e.g. Van Huylenbroeck *et al*., 2007; Mardsen and Sonnino, 2008; Mölders, 2013). In general, the differences in interpretation have been related to the application of policies directed at agricultural and rural development, particularly in the EU, e.g. Pillars I and II of the Common Agricultural Policy (CAP). In spite of this, the OECD, in its document "Multifunctionality, Towards an Analytical Framework", makes a practical conceptualization considering sustainability as a goal-oriented element of agriculture (mainly related to the use of resources without diminishing its capacity for future generations), while multifunctionality is a characteristic of the production process that has implications for achieving multiple societal goals (OECD, 2001)[2]. Along this line, authors such as Mardsen (2006) consider the multifunctional character of agriculture a basic instrument for rural development as it provides income and employment opportunities, satisfies the needs and expectations of the society at large, and contributes to the adequate management of rural resources. Mölders (2013) thinks agricultural multifunctionality can provide essential adaptation and transformation elements for sustainable rural development.

In this context, policies, e.g. EU agricultural policy, which has repercussions on family farm support, have been upheld, depending on the interests, due to the ambiguity and diverse conceptions of multifunctionality and sustainable development (Mardsen, 2006; Shucksmith and Rönningen, 2011). However, these protectionist policies are not always enough to explain the survival of family farms or their role in socioeconomic development. Thus, Shucksmith and Ronningen (2011) show in some examples in Scotland and Norway how trends toward integrating neoliberalism, the household, property and business into family farms and transmitting these values over generations (Gray, 1998; Ikerd, 2013) are essential not only for environmental, but also socioeconomic goals in rural areas. Nevertheless, situations in which the institutional support is not so influential also have to be considered. De Meyer (2014) shows in family farms in south Tyrol (Italy) that in spite of support from the CAP, the innovative and organizational character of the fruit growers is the most important factor for the development of this system. Galdeano-Gómez *et al*. (2016) show that in Almeria (Spain), the role of governmental support and EU agricultural policy in family farms is not significant at all to the socioeconomic achievements that have come about in the horticultural sector. Therefore, determining the persistence of family farms requires specific analysis of their characteristics and intrinsic capabilities, beyond policy strategies and the potential they could represent for rural development (Shucksmith and Ronningen, 2011).

For the purposes of an applied study maintaining this theoretical framework of multifunctionality and sustainability, the first concept may be understood as a series of structural capabilities or characteristics associated with family farms (OCDE, 2001; Mardsen and Sonino, 2008; Ikerd, 2013), while socioeconomic sustainability would be the goals or performance related to the activity of these farms (Copus and Crabtree, 1996; OECD, 2001; EC COM Agriculture Directorate, 2001[3]; Gómez-Limón and Arriaza, 2013). Although the present work does not aim to further the theoretical debate on these two terms, we believe that the conceptual differentiation may be of interest in determining the features of farming which in practice can influence the assessment of sustainable development.

## 2.3. Description of family farming in southeast Spain

In Spain, the family farming model is clearly predominant, representing 70% of the agricultural sector. A relevant example of this model is the southeast of the country, particularly in the coastal areas of the provinces of Granada and Almería, characterized by a structure with over 15,000 small family farms of approximately 2 hectares on average, representing over 95% of agricultural activity in this region. The agriculture in these areas has become specialized in

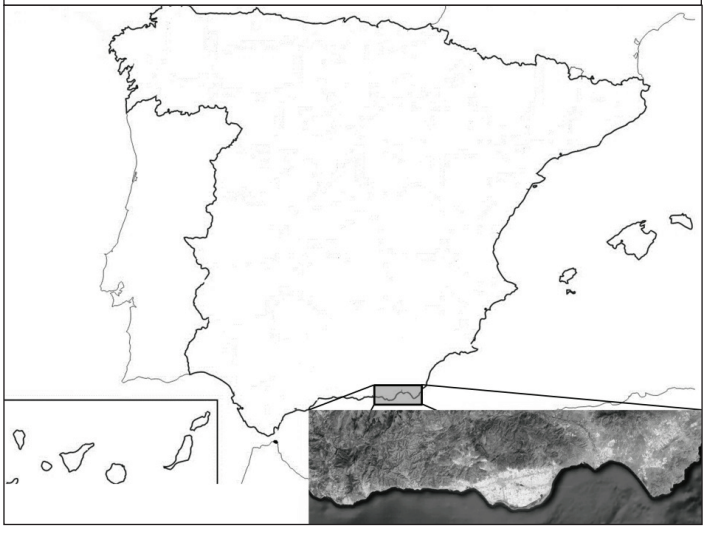
[2] According to the OECD (2001) this would be the 'positive' perspective of multifunctionality. It can also be considered a goal from a 'normative' perspective, related essentially to policy implications and achievement of goals in the implementation of rural policies.

[3] We understand the indicators for sustainable agriculture and rural development of the EC COM Agriculture Directorate (2001), for example, in which they use the term 'stocks' to refer to the structural characteristics and 'efficiency' and 'equity' for performance, along a similar line.

horticultural crops: pepper, tomato, cucumber, green bean, zucchini, eggplant, watermelon and melon. Farmers tend to rotate the production of these different crops and apply appropriate technologies. In the last decade, these technologies have been applied in organic agriculture, using integrated pest management and organic production (Van der Blom, 2010), which together currently represent over 90% of total production. With some 30,000 hectares of crops at present, this system accounts for approximately 30% of all vegetables grown in Spain and the produce is destined for both the domestic and foreign markets (Cajamar, 2015).

This system has led to significant socioeconomic development in the region in the last 50 years, despite having received little or no support from the government or the CAP in recent times (Aznar-Sánchez *et al*., 2011). For instance, the support programs of the CAP have a repercussion on about 50% of the family farms, and the aid accounts for no more than 2% of farmers' sales (Galdeano-Gómez *et al*., 2013). The existence of an ample family structure has also generated development with few disparities in terms of income and well-being (Downward and Taylor, 2007).

Figure 1- *Southeast Spain Region: horticultural family farming area.*



In this area, agriculture has a huge impact on the entire regional economy, to the point that for years the evolution of provincial income and employment has been determined by how the agricultural season progresses (Céspedes López *et al*., 2009). The uniqueness of the development in this area questions one of the traditional paradigms of classical economics, which links the possibilities of development of a territory to industrialization. Family agriculture has developed its own sociocultural dimension, characterized by the generation of intergenerational links, and the transfer of knowledge, traditions and customs from generation to generation. Participation in community life and in forms of organization, such as cooperatives, also represents a distinctive quality, highlighting its good social management and the establishment of a network of relationships and strategies reinforced by values of solidarity and long-term commitment (Van der Ploeg, 2014).

In this region, the owners of family farms have strong local roots and have created strong connections with their local setting, and therefore, are more locally integrated than other owners of businesses whether their profile is the same or not. Most of the owners grew up in the region in which their business is located and over the years these families have developed strong relationships in the region where they live (Ellis and Biggs, 2001). The families of growers contribute to strengthening the local rural economy, where they buy, spend and participate in other economic activities (Valera *et al*., 2016).

This agrarian system represents 27 and 24% of employment and GDP (Gross Domestic Product), respectively. Services (mainly, handling and marketing) and the associated auxiliary industry, which represent approximately 32% of the GDP in this region, must also be taken into account (Aznar-Sánchez *et al*., 2011).

Table 1 - *Production structure in southeast Spanish area and Spain (% GDP).*

| | 1970 | | 2010 | |
|---|---|---|---|---|
| Activities | Southeast Spain | Spanish national average | Southeast Spain | Spanish national average |
| Agriculture (farming) | 29.1 | 12.8 | 24.2 | 4.1 |
| Industry | 13.8 | 30.9 | 14.1 | 19.4 |
| Construction | 9.2 | 7.8 | 9.3 | 9.8 |
| Services | 47.9 | 48.5 | 52.4 | 66.7 |

Source: Aznar-Sánchez *et al*. (2011); Galdeano-Gómez *et al*. (2013).

Another aspect to be taken into account is the gradual incorporation over the last two decades of foreign workers, many of whom have become the managers of their own farms and members of cooperatives (García-Lorca, 2010; Galdeano-Gómez *et al*., 2016). This has led to a multicultural situation in production in which farmers (about 9% are foreigners) and workers from Morocco, Romania and Ecuador are the most numerous (Figure 2).

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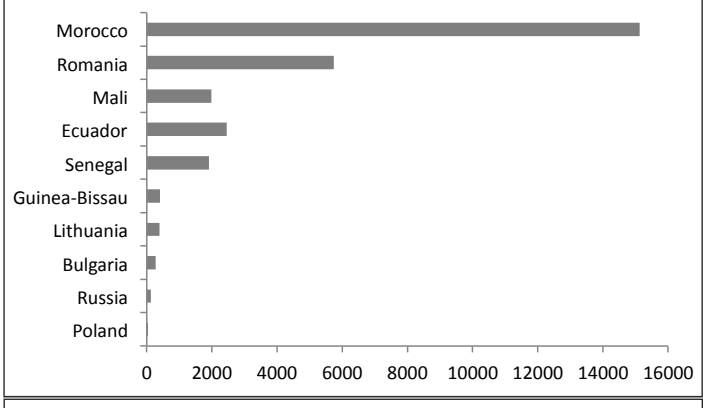
Figure 2 - *Country of origin of foreign farmers and workers affiliated to the Social Security Agriculture Category in 2012.*




Source: Cajamar (2015)

# 3. Empirical analysis

## 3.1. Model specifications and methods

Determining the impact on socioeconomic sustainability may involve the consideration of a multitude of indicators (for a review see e.g. Chatzinikolaou and Manos, 2011), even in the case of a specific study on a limited area. Nevertheless, based on numerous previous studies (Copus and Crabtree, 1996; EC COM Agriculture Directorate, 2001; Rasul and Thapa, 2004; Stedman *et al*., 2004; Van Caywenbergh *et al*., 2007; Zahm *et al*., 2008; Tonts *et al*., 2012; Gómez-Limón and Arriaza, 2013; Galdeano-Gómez *et al*., 2013, 2016), three more frequent indicators related to family farming were chosen, and the multicultural situation of the current agricultural activity was included as a more specific indicator (Table 2):

– Farmer age structure, which is an indicator related to population stability (Tonts *et al*., 2012) and movement (migrations) in the region (Copus and Crabtree, 1996; Gómez-Limón and Arriaza, 2013), and also to intergenerational farming (Van Cauwenbergh *et al*., 2007; Ikerd, 2013).
– Average income from farming, which is related to the GDP per capita and equitable income distribution (Copus and Crabtree, 1996; Rasul and Thapa, 2004; Galdeano-Gómez *et al*., 2016). The difference between this income and GDP per capita in other regions in Spain is particularly indicative of welfare expenditure per capita (Stedman *et al*., 2004; Zahm *et al*., 2008).
– The employment rate, since employment/unemployment rates are basic indicators of socioeconomic well-being in any rural activity (European Commission, 2001; Zahm *et al*., 2008; Gómez-Limón and Arriaza, 2013).
– Multiculturalism in farming, which is associated with sociocultural sustainability (integration) and is also indicative of positive migratory movements to the rural area (Copus and Crabtree, 1996; Aznar-Sánchez *et al*., 2011). Although some analyses on sustainability also included this variable (e.g. Copus and Crabtree, 1996; Hodgett and Clark, 2011), in this case, these data are of special interest because of the incorporation of numerous workers and their families from other countries into farming in southeast Spain.

Table 2 - *Indicators of socioeconomic sustainability and measurements*.

| Indicators | Description of measure |
|---|---|
| Age structure | Average farmer age |
| Income | Available income per worker (paid and family workers) over the national legal minimum wage[a] |
| Employment rate | Average number of workers per cultivated area (hired and family workers) over the national average in agricultural sector[b] |
| Multiculturalism | Number of nationalities per family farm (hired and family workers) |

[a] This measurement is the difference between the national legal minimum wage (648.60 euros per month) and the monthly wage of a family worker (net income from farming) on the one hand, and the legal monthly wage of a hired worker (1,038.40 euros) on the other.
[b] The average employment in Spanish agriculture is 0.90 (work/year units per farm, UTA – National Statistics Institute of Spain) while in the horticultural sector in southeast Spain it is 2.5 per farm. In this study, this variable was measured as jobs per hectare (1.77 workers).

### 3.1.1. Data

A survey was designed in order to obtain a complete picture of family farm characteristics, including: a) social facets of family farm management (age, education, family relationship, inheritance of the business, who participates in decision-making, number of workers, whether family or hired, gender and nationality), b) economic characteristics of the farm (size, income, crop specialization, innovative character, and influence of other businesses in the farming sector), c) environmental facets (agroecological practices, environmental innovation and efficiency in natural resource management). A total of 55 family farms, chosen by random cluster sampling, were surveyed by personal interviews, during the 2014-2015 fruit and vegetable growing season (September to June). The results found, grouped in the same manner, are as follows:

a) Social facets. Concerning property, 90.91% of the family farm owners are men and 9.09% women, in all cases licensed self-employed business owners. In the family structure, of the total owners, 92.73% are the head of the family and only 7.27% are the children who manage the business alongside with their parents. The average age of decision-makers is 43 and the participation of women in decision-making is 35.19%. Insofar as education is concerned, 40.91% have had a high school education or advanced (second cycle) vocational training, 12.73% have a university or higher education and only 3.64% had no education. Regarding generational change and inheritance, it is predominantly the second generation (49%), and to a lesser extent the first (29%), or third and fourth generations (22%). In general, 9 out of 10 owners intend to leave their business to their children or another family member. With respect to employment, family farms have an average of five permanent workers during the growing season and these vary depending on the production cycle and activities derived from it. 80% are men and 20% women. 65.19% are hired workers and 34.81% are family. The generation of employment has led to constant migration, such that workers of different nationalities are hired by the same farm, and the average is around four different nationalities per farm, including the owners.

b) Economic facets. The average area in production per family farm is 3.6 hectares. In the 2013-2014 season, the growers surveyed had an average production of 7.4 tons per hectare, which sold for an average of 42,835.05 euros per hectare. The owners of the family farms were asked to e-

valuate the different stakeholders in their production activities on a 5-point Likert-type scale. The results show a high mean valuation of 4.2. Their relations with other local companies, marketing cooperatives and auxiliary industries, as well as with other stakeholders, such as the financing entities, receive a valuation of 3.4, while proactive cooperation in innovation through participation in university and research center projects is also high with a mean of 3.5. On the other hand, they show low valuation of the level of government support received, with a mean of 1.8. Although crops may be quite diversified (pepper, tomato, zucchini, eggplant, cucumber, melon, watermelon, etc.), a strong trend toward specializing in one or two crops, not considering the type of crop, is observed. The innovative nature of these farms is important, since 80% of those surveyed state that they had been using or are open to new technological innovation for the constant improvement of their farms, mostly related to environmental matters.

c) Environmental matters. Almeria fruit and vegetable companies have quality and environmental management systems based on the UNE-EN-ISO 14001, UNE 155400, GLOBAL GAP and Integrated Pest Management (IPM) standards, representing 94% of the area cultivated by the farms surveyed. These improvements are valued, not only from the environmental standpoint, but also for improving working conditions on the farm. Of the family businesses, 71.82% had received some environmental certification between 2000 and 2012. Innovation is already a traditional component in this agriculture, particularly related to water: 78.18% of the growers interviewed had implanted some means of making their water consumption more efficient by improving the distribution network and irrigation systems. Other innovations are directed at improving the farm's surroundings, waste management and energy use, especially in collaboration with research centers.

### 3.1.2. Description of variables

Based on data from the sample described above, measurements were obtained for the socioeconomic performance indicators: age structure, income, employment and multiculturalism. The descriptive statistics are included in Table 3 as dependent variables.

Family farm multifunctionality characteristics or components, grouped together as social, economic and environmental as described above, constitute a set of explanatory variables which are specified below.

- *Dec_makers*: Number of people on the family farm making decisions.
- *Women*: Number of woman decision-makers. According to Farmar-Bowers (2010), the contribution of female growers to strategic business decisions on sustainable development is very important.
- *Education*: Average education of family farm decision-makers. The education of each was measured on a scale of 1 (no education), 2 (primary education), 3 (middle school), 4 (high school or vocational training) or 5 (university or higher education).
- *Generation:* Number of generations that have run the family farm. This is also indicative of experience and know-how accumulated on the farm.
- *Inherit*: Dummy variable scoring 1 if the farmer thinks the next generation will inherit the family farm or 0 when he does not.
- *Scale*: Number of hectares currently cultivated by the family farm as an indication of its size.
- *Specialization*: Number of crops cultivated by the family farm. Thus, the lower this variable is, the higher the family farm's specialization.
- *Aux_sector:* Weighted mean of the farmer's valuation of the efficiency of the marketing cooperatives and auxiliary services in the sector, scored from 1 to 5.
- *RD_proactivity:* Farmer's proactive work with research centers and universities on new cultivation techniques and structural innovations in the farm to improve his competitiveness, scored from 1 to 5.
- *Env_certification*: Integrated Pest Management and/or other certification of agroecological production (in kilograms) per hectare of total cultivated area. A weighted mean of all the crops was calculated.
- *Env_innovation*: This variable measures the extent of the family farm's awareness of efficient use of natural resources and openness to specific innovation to improve the relationship of its activity with the environment. Specifically, whether the family farm had implanted any improvement, innovation or new technology for reducing environmental impact, scored from 0 to 5.

Table 3 - *Descriptive statistics of variables*.

| Variable | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|
| Age | 42.6727 | 10.1362 | 22 | 66 |
| Income | 10,603.85 | 10,845.93 | -14,081.4 | 45,615.19 |
| Employment | 1.7717 | 1.1069 | .5714 | 6.5 |
| Multiculturalism | 3.9455 | 2.3207 | 2 | 7 |
| Dec_makers | 1.9636 | .9421 | 1 | 4 |
| Women | .7091 | .5985 | 0 | 2 |
| Education | 3.1115 | .9869 | 1 | 5 |
| Generation | 1.9455 | .7557 | 1 | 4 |
| Inherit | .9455 | .2292 | 0 | 1 |
| Scale | 3.5691 | 3.2138 | .4 | 20 |
| Specialization | 1.7636 | .8381 | 1 | 4 |
| Auxil_sector | 3.9455 | .7529 | 1 | 5 |
| RD_proactivity | 3.5364 | .8916 | 1 | 5 |
| Env_certification[a] | 89.458 | 27.301 | 17.308 | 156.586 |
| Env_innovation | 3.5818 | 1.1657 | 2 | 5 |

[a] Thousands of kilograms.

The varied number of explanatory variables makes it possible to test several of the influences on socio-economic indicators, which is in line with other studies focused on these aspects. Among others, it is expected that the greater number of decision-makers and the participation of women can have a positive impact on income (Farmar-Bowers, 2010) and age (younger), due to the greater participation of family members in farm activities and the interest in achieving goals such as productivity (Céspedes López *et al*., 2009).

Regarding education, it is likely that a higher education level can have a positive effect on younger age (Rivaroli *et al*., 2016) and on better multicultural relationships on the farm (García-Lorca, 2010). In the same line, a larger number of generations can imply positive effects on the younger age of farmers and greater multiculturalism (Copus and Crabtree, 1996). It is believed that the inherit variable will have positive effects on income and on employment rate, due to the existence of objectives such as interest in improving management or obtaining a larger farm (Céspedes López *et al*., 2009). The scale and specialization are expected to have positive effects, not only on income (Valera *et al*., 2016), but also on employment rate and multiculturalism. In all likelihood the higher valuation of auxiliary sector will be positively related to the income and the multicultural relationships of the farm (Galdeano-Gómez *et al*., 2016). On the other hand, it is foreseen that greater R&D proactivity will correlate positively with income and the younger age of the farmer (De Meyer, 2014; Rivaroli *et al*., 2016). Regarding environmental certification, it is likely that more agroecological produce will have a positive effect on income and employment rate as of a result of the necessity for more stability and specialized labor, due to the recent application of new agro-ecological techniques in this sector (Valera *et al*., 2016). Environmental innovation can be positively related to younger farmers (Gómez-Limón and Arriaza, 2013) and higher income of the farm (Aznar-Sánchez *et al*., 2011).

### 3.1.3. Modeling strategies

Developing the models that relate a series of dependent variables (socioeconomic performance indicators) and a set of explanatory variables (multifunctionality features of family farms) is not exempt from uncertainty and misspecification problems (Harrell, 2015). Even though this work was based on a theoretical framework relating certain family farm characteristics to socioeconomic indicators, application to specific cases involves selection of ad hoc models after statistical-econometric testing (e.g. Tonts *et al*., 2012). In this application, based on general model specification, we progressed to specific modeling by considering estimations of the variance explained in the different models (Harrell, 2005). To begin, we proceeded to analyze the correlation coefficients of all the variables to avoid multicollinearity and correlation with the error term in the estimations (Appendix A, Table A.1). To corroborate this, the variance inflation factor was also calculated. Variance levels over 5 begin to be problematic, while a value over 10 is a real problem (Greene, 2011). In this case it was found that all the VIF values for each item were below the recommended value of 5, so multicollinearity is not a problem. These results are available upon request.

As mentioned above, a first regression analysis was carried out of the four equations corresponding to the socioeconomic indicators, including all the explanatory variables. Thus, we started with a general model as follows: $Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + \ldots + \varepsilon_i$ ; $\varepsilon_i$: $N(0, \sigma^2)$, where $Y_i$ represents each of the socioeconomic indicators *i*, $X_{ji}$ is the value of each of the explanatory variables, and $\beta_j$ is the parameter to be estimated using the data. Assuming that the residuals, $\varepsilon_i$, are normally distributed and have a constant variance, ordinary least squares (OLS) is the best linear unbiased estimator of unknown parameters (Greene, 2011). Preliminary tests (Breusch-Pagan tests) confirmed the absence of heteroskedasticity in Age and Income equations. However, Employment and Multiculturalism models show signs of heteroskedasticity. This problem was corrected by performing a robust regression, i.e. finding a heteroskedasticity robust variance-covariance estimator. Appendix B, as supplemental material, includes diagnostic plots for the models estimated.

## 3.2. Estimates and results

Based on these preliminary estimations, we proceeded to a final analysis with empirical models with more parsimonious parameter estimates, that is, more specific and congruent with the application to the specificities of this particular study of family farms in southeast Spain. The following four equations were considered:

1) Age structure = *f* (women, education, generation, inherit, auxil_sector, RD_proactivity, env_certification, env_innovation)
2) Income = *f* (dec_makers, education, scale, specialization, auxil_sector, RD_proactivity, env_certification)
3) Employment = *f* (dec_makers, women, generation, inherit, scale, specialization, env_certification)
4) Multiculturality = *f* (dec_makers, education, scale, specialization, auxil_sector, RD_proactivity)

The results are shown in Table 4 and diagnostic plots for these models are included in Appendix C, included as supplemental material of the study.

According to the results, the mean age of farmers is related to higher education, the consideration that their children will inherit the farm, more proactive innovation, and to more significant parameters, higher valuation of the efficiency of the auxiliary sector. However, the generational effect displays a negative influence (possibly because many owners interviewed still share the farm with their children). Other positive influences are from the role of the woman in decisions on the farm and the environmental variables, which include both application of agroecological production and proactive development of projects related to improving the use of natural resources.

Apart from this, mean income on family farms depends more on the size of the farm (in this case, an analysis of possible economies of scale would be of interest) and product quality certifications. Specialization in crops and activity related to marketing and auxiliary industry companies also play an important role. On the contrary, the number of decision-makers shows a negative relationship with the income. This is due to the fact that when the number of decision-makers - which is usually the number of family members who work on

Table 4 - *Estimations of the influences on socioeconomic indicators*.

| Independent variables | Equation 1. Dependent variable: **Age structure** | Equation 2. Dependent variable: **Income** | Equation 3. Dependent variable: **Employment** | Equation 4. Dependent variable: **Multiculturality** |
|---|---|---|---|---|
| dec_makers | | -3.1416** P>\|t\| 0.019 | -.1749* P>\|t\| 0.092 | .2172* P>\|t\| 0.074 |
| Women | 1.1830* P>\|t\| 0.057 | | -.3762* P>\|t\| 0.066 | |
| Education | 1.5085** P>\|t\| 0.021 | 0.6819* P>\|t\| 0.068 | | .3540** P>\|t\| 0.035 |
| Generation | -3.9785** P>\|t\| 0.031 | | -.1852 P>\|t\| 0.365 | |
| Inherit | 8.3671** P>\|t\| 0.017 | | -1.2739 P>\|t\| 0.142 | |
| Scale | | 1.1295*** P>\|t\| 0.007 | -.1291** P>\|t\| 0.009 | .6135*** P>\|t\| 0.000 |
| Specialization | | -2.5236** P>\|t\| 0.017 | -.1071 P>\|t\| 0.379 | .1560* P>\|t\| 0.053 |
| auxil_sector | 6.7060*** P>\|t\| 0.000 | 1.3655** P>\|t\| 0.040 | | .1091** P>\|t\| 0.041 |
| RD_proactivity | .8374** P>\|t\| 0.036 | .8054* P>\|t\| 0.057 | | .0534 P>\|t\| 0.747 |
| env_certification | .1112* P>\|t\| 0.067 | .1624*** P>\|t\| 0.001 | 2.7407*** P>\|t\| 0.002 | |
| env_innovation | .0863* P>\|t\| 0.074 | | | |
| Constant | 30.1513 P>\|t\| 0.005 | -7.6948 P>\|t\| 0.442 | 3.6202 P>\|t\| 0.014 | .0316 P>\|t\| 0.974 |
| $R^2$ | 0.3260 | 0.4480 | 0.2790 | 0.8195 |
| $F$ | 0.0068 | 0.0001 | 0.0505 | 0.0000 |

Note: Significance level: *p<0.1; **p<0.05; ***p<0.01.

the farm- is larger, the net benefits are distributed among a larger number of people. In contrast, proactive innovation to improve competitiveness and farmer education also has a positive influence.

The mean employment rate is influenced positively by environmental certification due to the need for more specialized use by crop and with more traditional methods, but diminishes as the size of the farm increases. In this case, variables related to family members have a negative influence, such as participation of women, and to a lesser extent, the number of decision-makers and intention of bequeathing it , possibly because family labor here is more intense and less external labor is hired.

Finally, the number of workers of different nationalities increases when the business is larger and production is less specialized. Better educated farmers and more decision-makers on the farm have a positive influence on the farm itself. As mentioned above, the number of decision-makers relates to the number of family members working on the farm. If more family members are working on the farm, that usually means younger family members have been incorporated into the activity and they also tend to be those with higher levels of education. Another variable with a significant positive parameter is the corresponding auxiliary sector, since many foreign workers have also been hired by auxiliary and marketing companies.

[4] E.g.: university, TECNOVA (Foundation for Auxiliary Agricultural Technologies), COEXPHAL (Association of Producers and Exporters of Horticultural Products of Almería) or IFAPA (Andalusian Institute of Agricultural and Fisheries Research and Training).

## 4. Discussion and conclusions

Sustainable development in recent decades has become one of the most frequent discourses in rural policy strategies. More recently, farming and, particularly its family production structure, is increasingly recognized as one of the elements that can promote sustainability goals (HLPE, 2013). Family farms are associated with multifunctionality more than other forms of organization in agriculture, providing market and non-market output, protection of the environment being one of the most considered facets. However, from the less analyzed socioeconomic viewpoint, these family farms have a role, among others, in long-term maintenance of the economy in agricultural rural areas due to their knowledge of local production, their ability to adapt, and the fact that their know-how is handed down over generations (Ikerd, 2013). In spite of the extensive debate existing between multifunctionality and sustainability, these aspects associated with family farming imply a close relationship between capabilities and potential (i.e., multifunctional character) and the socioeconomic goals of sustainable development. In any case, these matters also need to be supported by applied studies considering the specificity of the different sectors and activities in rural areas. Thus, this paper analyzed these issues from a theoretical framework perspective, taking the specific case of farming development in southeast Spain as a reference, considering farmer age, income of family and paid workers, employment rate and multiculturalism as indicators of achievement of socioeconomic goals.

We consider the following points from the perspective of the multifunctionality characteristics of family farms analyzed:

– Farmer age is determined largely by the dynamism in this sector, where factors such as inclination toward innovation, influence of the local agro-food cluster and education of the farmers are very influential. In this respect, it is worth mentioning the numerous research centers, both public and private, that have been established in recent decades[4], and which are having rather positive effects on innovation and the specialized education of farmers (Aznar-Sánchez, 2011). Other factors also have an impact, such as the family-oriented nature of farms, namely the role of women and the possibilities of transferring the farm to future generations (Farmar-Bowers, 2010). Environmental concerns also have a positive role in maintaining a relatively young population in the activity, as has been shown in other analyses on these issues (Gómez-Limón and Arriaza, 2013; Rivaroli *et al*., 2016).

– Income of workers and family members on these farms is determined by economic variables such as the larger scale and specialization of production, especially when working with produce that have environmental quality certifications, as also suggested by other studies in this sector, particularly due to the recent adoption of several green farming techniques (Valera *et al*., 2016). Proactivity toward innovation to improve competitiveness and the farmer's education are important as well, as it also relates to future changes in types of farming (Aznar-Sánchez *et al*., 2011).

– Mean employment per farm decreases as mean size in-

creases, but it increases as a result of environmental certification of crops[5], which requires more manual labor (Céspedes-López *et al*., 2009). Here, where family members are more prominent, including female participation, mean employment diminishes, which is associated with a larger share of work being done by parents and their children.

– The multicultural component on these farms may be considered high (Cajamar 2014) and the education and number of decision-makers influences it positively. There are also economic factors related to increased scale of farms and the existence of a local auxiliary sector, since many foreign workers have also been working for auxiliary and marketing companies, increasing attraction for immigrants of different nationalities (Galdeano-Gómez *et al*., 2013).

In summary, these results show that, together with positive economic factors related to the existence of a cluster of local auxiliary industries, there are also characteristics related to proactive innovation, the trend toward more agroecological production, better educated farmers, and bequeathing the farm which positively influence a relatively young age structure, mean income, employment rate and multiculturalism in the agricultural area studied. These characteristics should therefore be recognized by public policy programs as a matter of policy priority and farming opportunity. Policy-makers involved in regional development should promote training and innovation, intergenerational transfer of farms, a local services cluster, and any actions that improve organic production, with the goal of achieving a more sustainable farming system.

This research, however, is not exempt from limitations, and overcoming them could be lines of work for future studies. Firstly, the analysis was limited to the agricultural sector in southeast Spain. As explained in the previous sections, this is a particular case in which the rural production structure is based on small family farms, with little outside influence from European development programs and policies. It would therefore be of interest to explore similar matters in other more international contexts or even in other farming sectors, e.g. in Morocco, Libya or Egypt (Galdeano *et al*., 2013). Secondly, the data in this study focused on socioeconomic development, but future work could also include sustainability from a more holistic perspective. Thirdly, the surveys collected data on variables at a specific moment in time. A longitudinal analysis would prove revealing for determining whether the relationships identified in this study persist over time. Additionally, it would be of interest to study the causality relationships between the dependent variables as important indicators of sustainability (Galdeano *et al*., 2016).

In general, the study provides evidence on the influence of family farming features and behavior on socioeconomic sustainability that may be useful to analyse in agriculture of rural areas, particularly those based on family farming.

[5] The main environmental certifications obtained by many family farms in Almería are the Integrated Pest Management (Andalusian regional government), Organic Production (Andalusian regional government), GLOBAL GAP and UNE 155000.

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# Appendix A

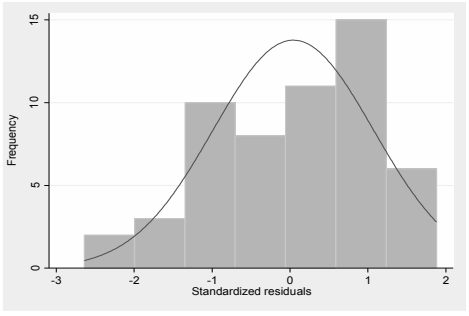
Table A.1 - Pairwise correlation coefficients of variables.

| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. dec_makers | 1 | | | | | | | | | | |
| 2. women | 0.769 | 1 | | | | | | | | | |
| 3. education | -0.028 | -0.121 | 1 | | | | | | | | |
| 4. generation | -0.080 | 0.005 | 0.044 | 1 | | | | | | | |
| 5. inherit | 0.076 | 0.017 | 0.027 | 0.196 | 1 | | | | | | |
| 6. scale | 0.211 | 0.069 | 0.207 | 0.062 | 0.173 | 1 | | | | | |
| 7. specialization | 0.153 | 0.008 | -0.138 | 0.213 | 0.028 | 0.143 | 1 | | | | |
| 8. auxil_sector | -0.02 | 0.087 | -0.172 | 0.016 | -0.053 | -0.179 | 0.008 | 1 | | | |
| 9. RD_proactivity | 0.056 | -0.083 | -0.057 | 0.140 | 0.281 | 0.112 | 0.073 | 0.182 | 1 | | |
| 10. env_certification | 0.09 | 0.055 | 0.076 | 0.189 | 0.252 | 0.117 | -0.272 | 0.028 | 0.288 | 1 | |
| 11. env_innovation | 0.002 | 0.167 | 0.002 | 0.141 | 0.051 | 0.075 | -0.122 | 0.107 | 0.068 | 0.142 | 1 |

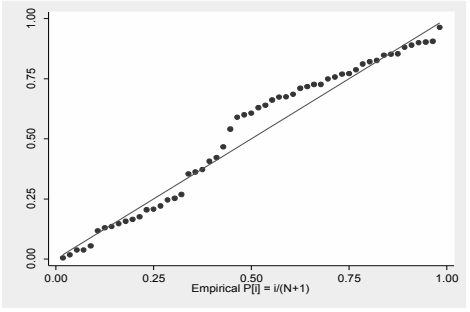
## Appendix B - *Diagnostic plots for preliminary estimations*.

B.1. Dependent variable: Age structure

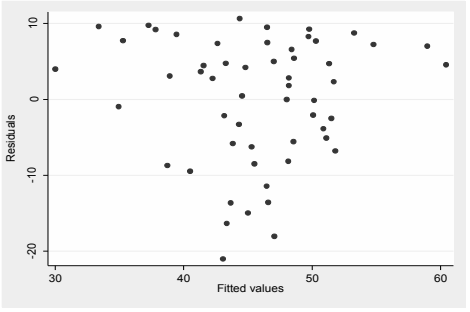
B.1.1. Histogram




B.1.2. Normal P-P Plot Rregression Stand. Residual

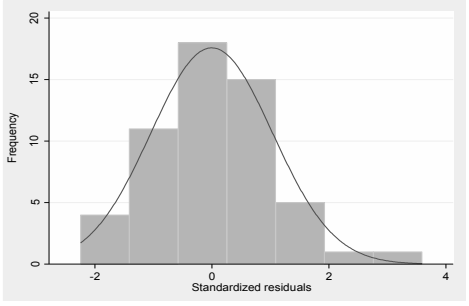



B.1.3. Scatterplot.

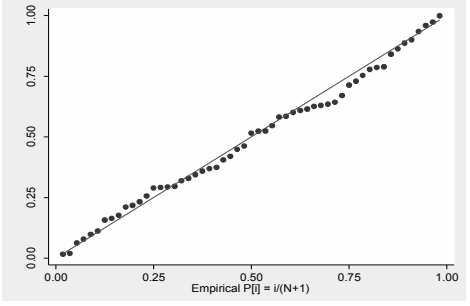



B.2. Dependent variable: Income

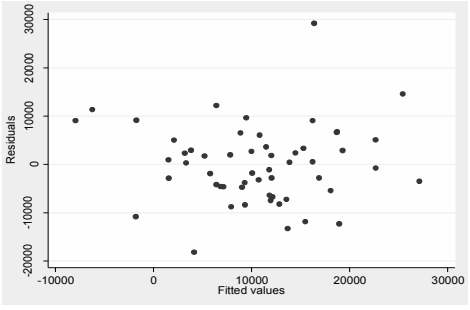
B.2.1. Histogram




B.2.2. Normal P-P Plot Rregression Stand. Residual

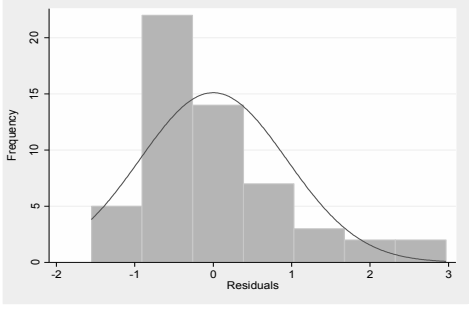



B.2.3. Scatterplot.

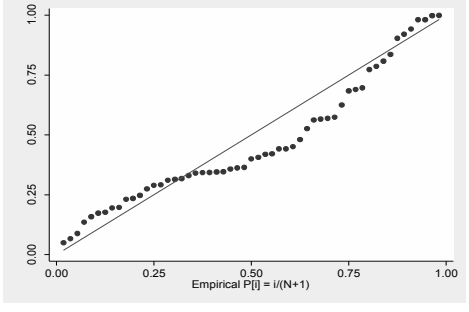



B.3. Dependent variable: Employment

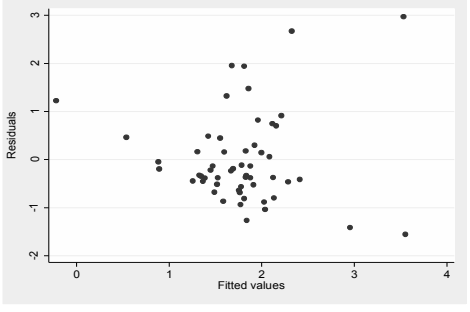
B.3.1. Histogram




B.3.2. Normal P-P Plot Rregression Stand. Residual

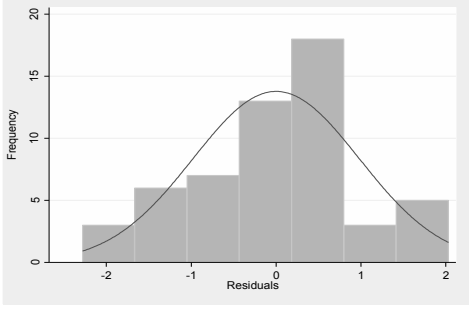



B.3.3.. Scatterplot.

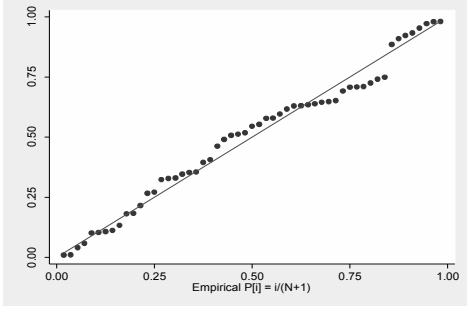



B.4. Dependent variable: Multiculturality

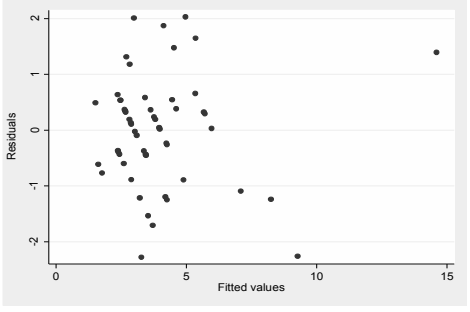
B.4.1. Histogram




B.4.2. Normal P-P Plot Rregression Stand. Residual



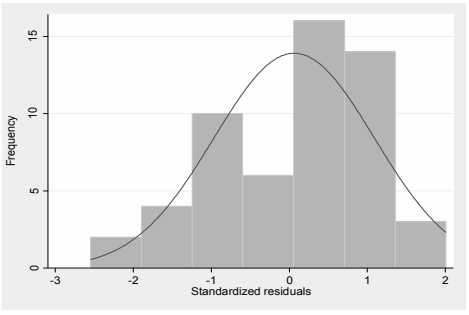

B.4.3. Scatterplot.



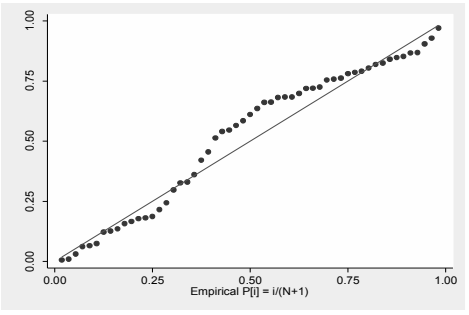
## Appendix C - *Diagnostic plots for final models*.

C.1. Dependent variable: Age structure

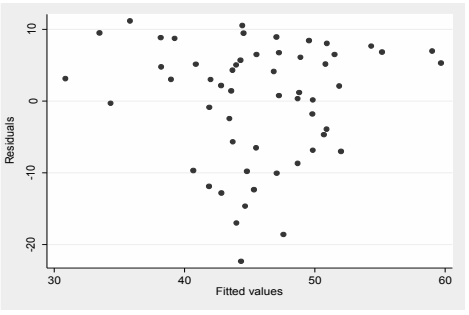
C.1.1. Histogram




C.1.2. Normal P-P Plot Rregression Stand. Residual

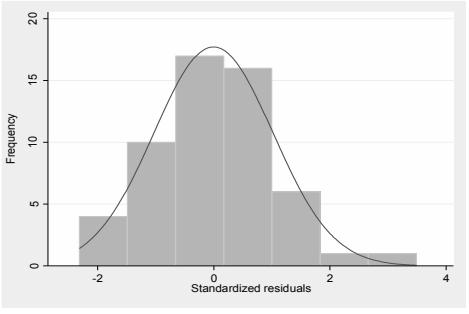



C.1.3. Scatterplot.

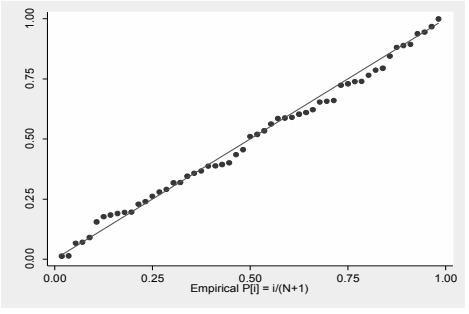



C.2. Dependent variable: Income

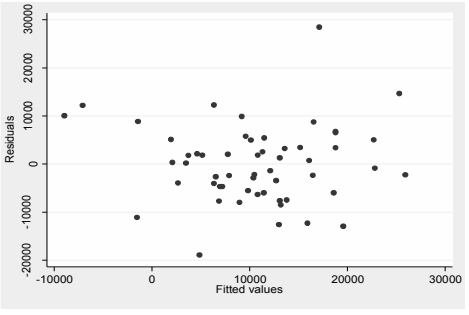
C.2.1. Histogram




C.2.2. Normal P-P Plot Rregression Stand. Residual

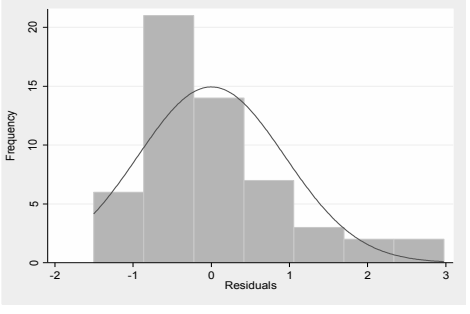



C.2.3. Scatterplot.

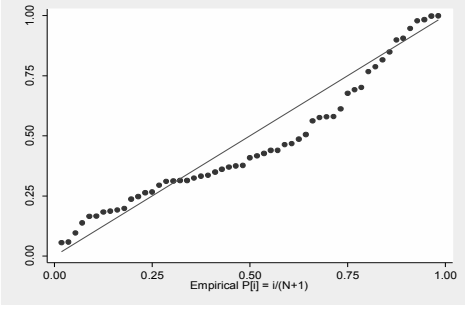



C.3. Dependent variable: Employment

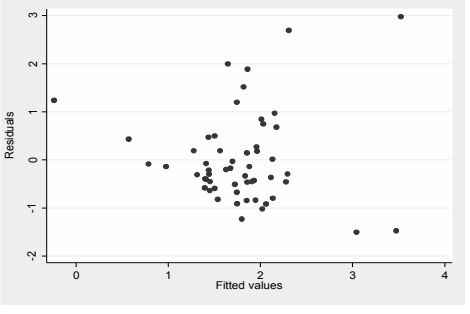
C.3.1. Histogram




C.3.2. Normal P-P Plot Rregression Stand. Residual

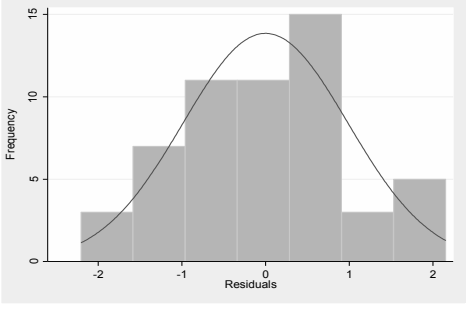



C.3.3. Scatterplot.

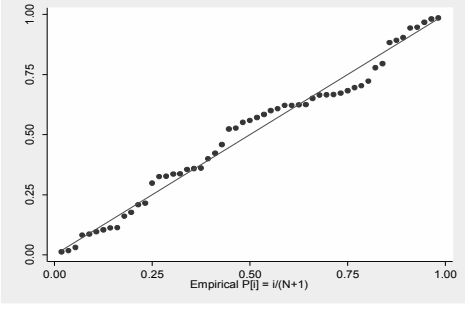



C.4. Dependent variable: Multiculturality

C.4.1. Histogram




C.4.2. Normal P-P Plot Rregression Stand. Residual




C.4.3. Scatterplot.