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Predicting grower choices in a regulated environment

RESEARCH ARTICLE

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Abstract

The analysis of farmers' decision making process in the framework of agricultural policy is particularly complex as they take action within a structure of interacting opportunities, preferences, benefits and social factors which ultimately account for their behavior. This paper will study viticulturists' behaviour vis-à-vis this scenario. Their decisions in the face of different possible alternatives are analysed using a multinomial logit model and a sample of 74,502 plots in Castilla-La Mancha (Spain). The conclusion is that viticulturists from this region are more prone to maintaining the status quo in their plots due to the current public support security issues, uncertain scenarios and their natural risk aversion.

Keywords: agricultural policy, CMO, producer decisions, vineyard
JEL code: Q12, Q18

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1. Introduction

The European Union regulation in the wine growing sector has experienced a number of changes and adaptations throughout the period of integration of the Common Market. The latest general change in general regulation for the wine sector dates from 2008; the Council Regulation (EC) No. 479/2008 (EC, 2008) repealed direct market intervention (distillations and grape must aid programs), which promoted temporary adjustment (grubbing up), as well as changes in vineyard planting rights regulation as from 2015. The specific case of this liberalization process was later reconsidered in the June 2013 political agreement on the reform of the Common Agricultural Policy (CAP) for the 2014-2020 period, which made planting restrictions possible through new decisions by administrative authorizations, though it put an end to their exchange rate in the transaction market, which completed the market freedom model with the end of distillations and the aforementioned structural adjustment. All this requires rigorous analyses in a context that allows for the discerning of the possible consequences this may cause. However, studies presenting an assessment of farm producers' decisions in this context are still scarce.

Added to that, farmers' decision making is a complex process. Studies, such as Gasson (1973), Smith and Capstick (1976), Perkin and Rehman (1994), Sumpsi *et al.* (1997), Berbel and Rodríguez (1998), Costa and Rehman (1999), Willock *et al.* (1999), Solano *et al.* (2001), Bergevoet *et al.* (2004), Eastwood *et al.* (2012), Kanellopoulos *et al.* (2012), Leach *et al.* (2012) and Lybbert *et al.* (2012), all share the conclusion that when it comes to making decisions, farm producers take into account not only profit expectation but also the correct timing to make said decisions as well as a series of further considerations related to their economic, social, cultural and environmental context. Thus, the factors affecting farm producers' decision making on managing options and the risks inherent to that process have generated an extensive literature in recent years (Moschini and Hennessy, 2001). Engler and Toledo (2010), Jones (2006), Moran *et al.* (2007) and Toledo *et al*. (2011) have pointed out the impact of farmers' socio-demographic characteristics, such as educational level, age and gender (McRoberts *et al.*, 2011; Nainggolan *et al.*, 2013) on their decision making. An additional component is the degree of risk aversion of farm producers themselves, which is underlined by authors, such as Engler and Toledo (2010) and Girdžiūté (2012). Along with these decision makers' characteristics, further structural factors are relevant, namely land ownership and membership in producer organizations (Engler and Toledo, 2010; Nainggolan *et al.*, 2013). Economic determinants as well as those affecting business profits when it comes to making decisions are also important, as McRoberts *et al.* (2011), Moran *et al.* (2007), Nainggolan *et al.* (2013), Sattler and Nagel (2010) and Teschner *et al.* (2013) point out, as is receiving different types of subsidies (Nainggolan *et al.*, 2013).

That said, following Riesgo and Gómez-Limón (2006), farm producers will make decisions in such a way as to satisfy to the extent possible all their objectives taking into account all the relevant factors. Therefore, the main objective of this study is to analyze wine producers' decision making process from a global perspective, taking into account various factors (structural, market, geographical, social) and the European regulatory policy framework (measured by aid received). In terms of this latter aspect, as stated by Garrido (2006) and Riesgo and Gómez-Limón (2006), farm producers are the actors who ultimately receive the corresponding programs and as such the success or failure of these programs depends on farmers. Subjects' actions are taken within an opportunity structure interacting with their preference schemes, thus accounting for their behavior. In other words, whether or not farm producers decide to adhere to programs will be the result of the combination of their preference scheme (formed by their values and attitudes in relation to changes in agriculture and agricultural policy) and the structure within which they take action (Garrido, 2006).

The wine sector is not immune to this process. In recent years, as a result of the entry into force of CAP regulations in the European Community through the 2008 Common Market Organisation (CMO), this sector has witnessed a normative adaptation which greatly affects farm producers' decisions in relation to their holdings (among many other dimensions), especially those regulations related to structural aspects such as the management of potential production (planting management regime, permanent abandonment of wine-

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growing areas device or vineyard restructuring and reconversion aid scheme). Added to this, there are further structural, spatial, market and social determinants which also affect farmers' decision making process.

This research will present a logit multinomial model which, following Cabrer *et al.* (2001), will allow an analysis of economic agents' behavior by capturing the level of probability of certain factors affecting their decision making process. This study specifically formulates a Logit Multinomial Model whose data comes from the Castilla-La Mancha region (Spain) and the material amounts to a sample of 74,502 plots with information provided by the Junta de Castilla-La Mancha 2012 Vineyard Register.

2. Theoretical framework

Literature review

Agricultural policy as public sector action – and public policy in general – have for decades been a decisive factor in the decision making process of farm producers and agents involved in the agri-food sector. Following Garrido (2006), the different actors in this sector, i.e. administrations, farming organizations and farmers themselves have been adopting positions on the matter and have transferred the regulation measures and instruments to the strategies they adopt. That said, it is true that farmers are the final beneficiaries and as such they decide to accede to any given specific program freely and on an individual basis. It is equally true that the decision making process is affected by multiple factors, some of them related to instrumental rationales (e.g. the appeal of direct aid) and others based on value-oriented rationales (e.g. the reduction of the negative impact of their technology model of choice). Profit maximization, the economic, social, cultural and environmental context and the timing of decision making should also be added to the list (Riesgo and Gomez-Limon, 2006).

Research on farm producers' decision making process in different sectors regulated by European agrarian policy has been a constant across the EU. In the dairy sector, highly affected by the quota system due to the delayed implementation of the quotas, Giannakas and Fulton (2000) show that farm producers take an opportunistic course of action in relation to agricultural policy measures. Their paper introduces misrepresentation and cheating into the policy analysis of output quotas and subsidies. Analytical results show that when cheating occurs output quotas are a less efficient means of income redistribution than is traditionally believed. Furthermore, cheating increases the transfer efficiency of output subsidies. The result is that an all-or-nothing choice between quotas and subsidies will generally favor the use of subsidies. A combination of quotas and subsidies, however, usually remains the most efficient means of income redistribution through market intervention. Helming and Peerlings (2002) also study the dairy sector and conclude that the abolition of the milk quota system in the Netherlands would result in dairy farmers increasing the number of milking cows. Jongeneel and Tonini (2009) conclude that farmers' response capacities in terms of milk production is related to its price. The results in Kempen *et al.* (2011) show that if quotas were abolished, milk production in the EU would increase by more than 4%. Another study by Laepple and Hennessy (2012) notes that milk production depends of the real prices of milk.

In terms of the sugar sector, also highly determined by the laying out of production quotas, the study by Nolte *et al.* (2012) concludes that farmers would increase production if the world market price went up. An analysis carried out by Rabobank (2013) shows that the abolition of sugar quotas in the EU in 2017 is expected to cause an increase in sugar production in the EU, which would also increase competition amongst suppliers.

As to water, the basic input whose regulation is determining for farmers as they tailor the use of it according to said regulation, Jiménez *et al.* (2001) carried out an analysis of the impact that an increasing price of water would have in two irrigation zones. The comparison of the two communities studied show that irrigation aversion does not seem to be constant in farmers but rather has a clear relationship with property structure. Arriaza *et al.* (2002) conclude that irrigators' behavior derives from the maximization of a utility function whose sole attribute is profit. Dinar and Saleth (2005) and Gómez (2009) conclude that the public provision

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of water at subsidized prices has caused an increase in water consumption. Giannoccaro and Berbel (2011) point out that a CAP reform would have little impact on farmers' decisions related to water usage due to the decoupling of aids to production.

Finally, it is essential to note that economic, social and environmental dimensions do not have the same effects on farmers' decision making (e.g. CAP agri-environmental measures). Garrido (2006) concludes that when it comes to farmers' preference schemes in relation to agri-environmental policy, the overarching principle is an instrumental rationale; the programs are valued as opportunities to boost income. The economic dimension generally dominates farmers' preferences whereas other dimensions, such as the social and environmental ones, have little or no impact.

Therefore, although the economic dimension is indeed an important factor in decision making, the complexity of this process for farmers within the framework of public regulation and the different factors affecting them is nonetheless revealed as, following Freije and Rodríguez (1993), making a decision involves a reflection process which needs to take into account the pros and cons of the action alternatives and tries to opt for the more efficient one according to the objectives pursued. Now, as stated by Garrido (2006), taking a unidimensional approach which focuses solely on the economic dimension as the driving force in farmers' decisions is insufficient in terms of accounting for the complex and heterogeneous agriculture reality seen as a space of production and sociocultural reproduction. If we bear in mind the increasingly multi-functional task attributed to farmers, it is our belief that a multi-dimensional approach (considering multiple factors) to their preference schemes is the most appropriate in the current context.

In the case of the wine sector there are a few minor previous actions but so far exclusively related to the impact of the potential liberalization of planting rights (AEWR-UMR MOISA (2012), the European Parliament (2012), COPA-COGECA (2012) and the Report commissioned to the High Level Panel (2013). Furthermore, the paper by Deconinck and Swinnen (2013) provides a theoretical analysis of the economic effects and the social implications of planting rights. A model is proposed which takes into account land and production, trade restrictions and regional and national reserves. The model shows that liberalization creates winners and losers. Among the winners we find consumers, who benefit from larger wine supplies at lower rates. Owners of land other than vineyards also win due to the increase in land prices. A third group of winners are the new entrants in the sector, who will have the opportunity to plant vineyards. The losers are the owners of the original vineyards since the total value of their vineyards decreases and, furthermore, they face lower prices. Therefore, we believe it essential to carry out this research focusing on a multidimensional vision of farm producers' reactions to public regulation measures within the framework of the wine CMO.

Theoretical model

As is the case with other agri-food sectors, public policy is a key element to understanding wine producers' behavior when it comes to defining their management system. Throughout the 20th century the Spanish wine sector was subject to administrative regulations banning, promoting or regulating wine production, marketing and consumption. Then, when Spain signed the Accession Treaty to the European Community in 1986, the sector regulation and the CAP regulation became common to the twelve countries already in the European integration process by that year. Almost 30 years after that, the different actors in the European Community have been taking different positions, which are revealed in their discourses and strategies and in how they put them into practice through the corresponding policies (Garrido, 2006). It is thus essential to analyze and find out how the decision making process unfolds and study producers' behavior in terms of probability to define, as this research does, the most likely decision that farmers will make.

The decisions that farmers can adopt are strongly affected by European Union public regulation and are based on the premises in the 2008 CMO (EC, 2008), which sets out the guidelines for farmer behaviour. The deterioration of the balance between supply and demand in the wine sector, structural surpluses and lack of competitiveness in the sector justified the 2008 CMO. This regulation is based on four major objectives

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(statement of intentions). The first one pursues improvement in competitiveness, promoting quality through the production of higher value added wines and the use of oenological practices. The second pillar is the control of the productive potential to achieve balance between supply and demand cutting out distillation as a way out for surplus production, and setting out a specific date to remove the restriction on planting rights, which is one of our main concerns in this study. The third generic instrument is market intervention through promotion in third country markets. A fourth block aims at strengthening the social fabric in rural areas and guaranteeing environmental protection. In June 2013, the establishment of administrative authorizations for new vineyard plantations was announced in the framework of the political agreement on the PAC reform for the 2014-2020 period to substitute for the current rights as of 2016 (EC, 2013a). This announcement again stresses the importance of assessing potential decisions on the part of producers, which is the main objective of our study.

In an attempt to achieve all these goals in compliance with the regulations, a series of proposals were issued for farmers to choose from for their vineyards: (1) abandonment; (2) planting (provided they had planting rights or had acquired rights before the deadline for acquiring them and subsequent liberalisation); (3) grubbing up; and (4) restructuring. Articles 91 to 94 refer to planting and Chapter 3, to grubbing up (EC, 2008). Both options aim to achieve a balance between supply and demand of quality wine. The restructuring in Article 11 intended to increase producers' competitiveness (EC, 2008). If local conditions in farmers' plots are not conducive to viable production, they can also choose to abandon them. Article 68, which gives them an opportunity to cut costs and permanently withdraw these areas from wine production (EC, 2008). Faced with these options, the farmer can also choose to continue as usual (a 5^{th} alternative). These five alternatives will make up a discrete dependent variable of the model described below.

Thus, we can state that the main hypotheses (MH) analysed in this paper hold that the decisions made by winegrowers are a function of:

MH_1: structural characteristics of the vineyard (structural factors)

MH_2: price behaviour in the Spanish and international market (market factors)

MH_3: geographical location of the vineyards (geographical factors)

MH_4: land tenure and holding systems (social factors)

MH_5: payments received through the CAP measures (regulation)

Structural factors (MH_1) are directly related to land characteristics such as size, destination of production (table or quality wine), year of situation, management innovation and registration in the regulatory council. The expected effect of these variables will vary: (a) in terms of size, the smaller plots are more likely to be abandoned (Montagut and Gogliotti, 2008); and (b) destination of production. The process of planting and restructuring is more likely to take place in designation of origin or Protected Geographical Indication (PGI) areas (Basque Government, 2012); (c) innovation. Innovating plots are more dynamic and less prone to be abandoned (Giannoccaro and Berbel, 2011); and (d) Farmers' union membership would favour planting and restructuring (Giannocarro and Berbel, 2011).

The market variables (MH_2) deemed adequate for the analysis are the reference price of wine and export price. Price is the basic factor here given that farmers' income fosters vineyard development (HLP, 2013). Therefore, higher prices favor planting and restructuring and discourages abandonment and grubbing up.

The geographical variables (MH_3) analyzed are location in a Protected Designation of Origin (PDO) covered area and the population of the municipality where the plot is located. Geographical variables also need to be taken into account since unrestricted planting would cause the relocation of current vineyards

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to more productive areas (HLP, 2013), and because of the risk of vineyard expansion beyond the delimited geographic PDO area (Basque Government, 2012). Therefore, the expected effect is an increase in plantations in delimited geographic PDO areas.

As to social variables (MH_4), another key element in the current vineyard scenario, following Engler and Toledo (2010) and Naiggolan *et al.* (2013), we include type of holding, type of owner and land tenure system. There is a concern that the number of family businesses will decrease and a more intensive, industrial wine growing will emerge in the context of a production model based on family holdings which sustains economic activity and employment in rural areas (COPA-COGECA, 2012; HLP, 2013). Based on this, family holdings will most likely tend towards abandonment and grubbing up whereas the opposite will be the case with industrial units.

Finally, public regulation (MH_5) should not be neglected. There are different opinions in this regard (Atance *et al.,* 2001; Koráb, 2012) mainly because it raises producers' expectations so they anticipate and accommodate their decisions and actions. Here we consider direct aid from the CAP as from the 2003 reform as regulation indicator. This variable could be expected to be either positive as in Cortignani and Severini (2011) and Giannoccaro and Berbel (2011) or hardly influential as noted by Nowicki *et al.* (2007; 2009).

The theoretical model proposed in this research is summarized in Figure 1, which shows the framework within which farmers can act, the decisions they can adopt and the factors which can potentially affect them. The determining variables, as previously pointed out, have been divided into five large groups: Structural, Market, Geographical, Social and Public Regulation. These groups were inserted in the model estimate and will allow us to assess the degree of impact and significance of each variable and their groups in the

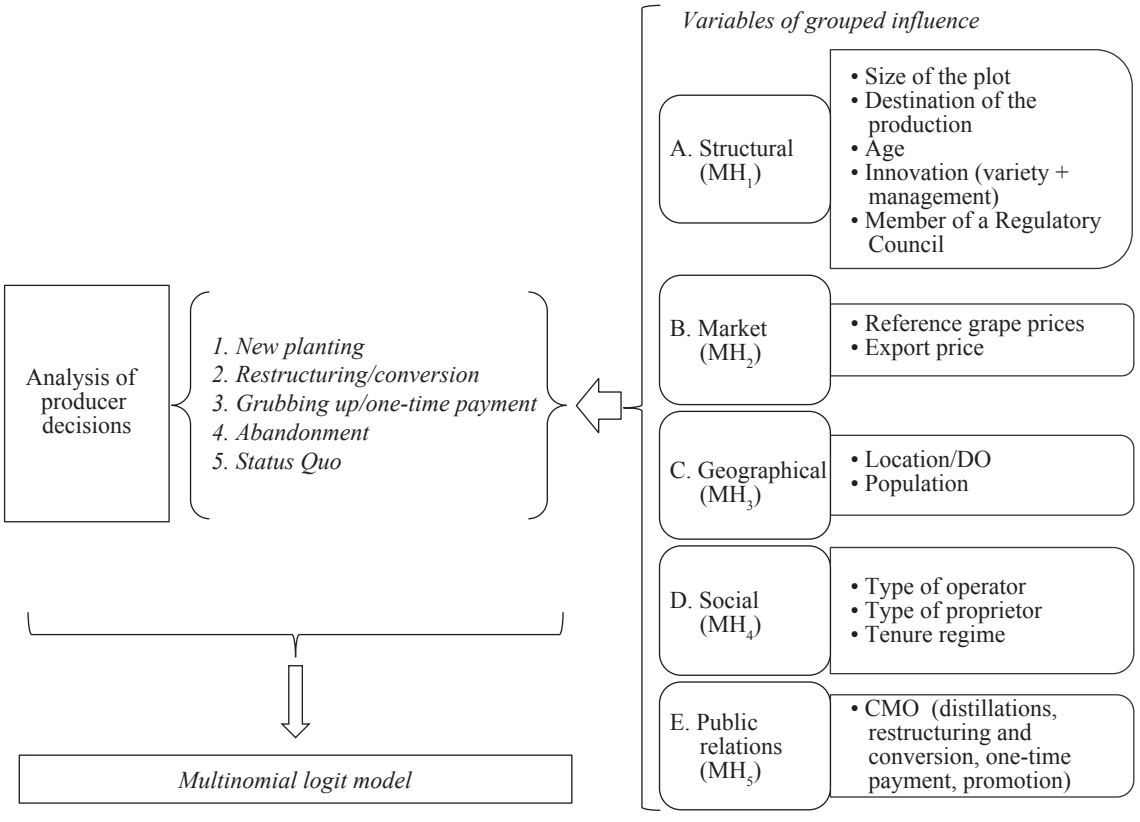

Figure 1. Determinants in decision making by producers. MH_1, MH_2, MH_3, MH_4, MH_5 represent the incidence variables in the producers decision that sustain the hypotheses. DO = designation of origin, CMO = Common Market Organisation.

face of the different options that emerge for farm producers in the new liberalising scenario: new planting, restructuring/converting, grubbing up, abandonment and status quo.

The characterisation of producers, as expected, is particularly heterogeneous, as is the structure of their holdings. Therefore, it is hard to conceive that their behaviour would be similar to that of a standard farmer. Different behaviours amongst farmers are more likely to be expected and any change in their environment will tend to have a different impact on them (Pascual, 2007). Therefore, this study uses a micro-econometric model, specifically a multinomial logit model (MNLM). Its aim is to explain actual producer behaviour and the heterogeneity of their individual behaviours in a scenario regulated by the CAP and the CMO for wine.

3. Material and methods

Sample and variables

This paper uses data from wine-growers' declared preferences in the Castilla-La Mancha Vineyard Register for each one of their plots (art. 8, 8/2003 Law of March 20th, on Vineyards and Wine from Castilla-La Mancha; GoE, 2003). The Vineyard Register is a tool for supporting the administrative management which considers the data relative to each holding. Both the 'Estatuto de la Viña, del Vino y de los Alcoholes' (Statute on Vines, Wines and Alcohols) and its Regulation (GoE, 1970) already considered in their articles 133 ff. in the constitution of a 'Catastro Vitícola y Vinícola' (Vineyard and Wine Register). At the EC level, the Council Regulation No 2392/86 of 24 July 1986 (EC, 1986) established a community Vineyard Register and the Commission Regulation No. 649/1987 (EC, 1987) laid down detailed rules for the establishment of said register. The region studied here is Castilla-La Mancha (Spain). However, following Recasens (2003) and Barco (2003), each wine region is susceptible to being analyzed through the same scheme; the results will be diverse but basically generalizable given the homogeneous behavior of producers as rational economic agents.

But as Sartori and Robledo (2012) point out, models estimated only from declared preference data can lead to unrealistic predictions. Therefore, the sample was completed with revealed preferences (Brownstone *et al.*, 2000; Page *et al.*, 2000; Train and Wilson, 2008). The units of analysis are the plots rather than the producers given that the producers make different decisions for each of their plots as indicated by Jiménez *et al.* (2001). The database includes 74,502 plots out of the 617,071 plots in the Castilla-La Mancha Vineyard Register for 2012 (https://www.jccm.es). They were selected by stratified random sampling, the study plot population was divided into the groups corresponding to the alternatives of the endogenous variable, that is, abandonment (646), planting (7,296), grubbing up (23,518), restructuring (8,007) and status quo (35,035). A quota was assigned to each of these groups through proportional allocation according to the size of the population. Simple random sampling was carried out in each stratum so that all the plots would have the same probability of being selected, therefore preventing information bias.

This reduction does not imply any significance problem for the results, firstly because it represents, as a whole, a sample error of 0.3% for finite mixtures. Individually, each of the categories of the dependent variable is also representative of the total population according to the sample errors that were obtained: 3.6% for abandoned plots, 1.1% for planted ones, 0.6% for grubbed up plots, 1% for restructured plots and 0.5% for those which remained unchanged.[1]

Second, it exceeds the minimum size of fifty observations marked by the asymptotic properties of maximum-likelihood estimators in a MNLM, (McFadden, 1974). It also surpasses the number of observations required by category and group of exogenous variables, established at a minimum of ten observations per exogenous variable in the endogenous variable category having the least representation (Schwab, 2012; Starkweather and

[1] Abandoned (n=646 and N=5,452); planted (n=7,296 and N=56,497); grubbed up (n=23,518 and N=222,259); restructured (n=8,007 and N=60,402); stayed the same (n=35,035 and N=272,234), in which n = sample size and N = population size.

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Kay, 2011). In our case, since there are 14 exogenous variables (13+ the independent term), there should be at least 140 plots. Yet our minimum number of plots in the least representative category (abandonment) is 646.

Therefore, a cross section is formed that is suitable to be treated by the MNLM. The specified variables are shown on the following table (Table 1).

The dependent variable consists of each of the alternatives which a vineyard farmer can opt for. These options are abandonment, planting, grubbing up, restructuring or staying the same, which are the regulatory instruments for vineyards in the EU established by the CMO for Wine (CMO, 2002). As shown on Table 1, it is a discrete variable which takes value 0 for plot abandonment; 1 for planting; 2 for grubbing up; 3 for restructuring; and 4 for status quo.

The independent variables are diverse and have been classified as previously indicated into five groups:

1. Structural variables. This section consists of size, destination of production, year of action, innovation and inscription in the regulatory council.
2. Market variables. Here the price of grapes and the price of exports are included.
3. Geographical variables. These variables are classified into two groups: the areas of designation of origin and the population.
4. Social variables. These include type of owner, type of holding, and land tenure system.
5. Public Regulation reflected in CAP subsidies.

Table 2 includes the descriptive statistics of the continuous exogenous variables and the frequencies of the discrete variables.

The (mean) statistics on Table 2 (continuous variables: descriptive) show that within the action periods (AA) the year 1986 was the most dynamic, which was due partly to the expectations raised by the entry of Spain in the EEC (Arnalte, 2007). The mean reference price of wine (MRPW) has a mean value during the period under analysis of 2.54 euros/hectograde, a value slightly higher than the national mean. This difference widens during seasons of lower production. In the year 2012, there was a difference of 0.54 euros/hectograde more for Castilla-La Mancha (MAGRAMA, 2005). The mean unit price of wine exports (MUPWE) is 0.52 euros/litre lower than the national mean for bulk wine sales. This difference has been increasing in recent years while Castilla-La Mancha has been adapting to the disappearance of distillations. In 2012 the price was 1.21 euros/litre in Spain, (OEMV, 2012). The mean population (MPOP) of the towns where the plots are located is close to 7,000 inhabitants; in Castilla-La Mancha 96% of all the towns have a population of under 10,000 inhabitants (INE, 2013), which in the sample represents 93.5%. Regarding CAP aid (MCAP), the provincial mean since 2000 is 58.5 million euros, 59% of the provincial mean for the rest of Spain according to data from the FEGA (FEGA, 2013).

The analysis of Table 2 (discrete variables: frequencies) shows that farmers' majority decisions (CSITDE) after not changing the status quo (47%) were grubbing up (31%) and restructuring (11%). The size (NSUPER) of 66% of the plots is less than 10,000 m^2. The production (CDESPR) from 72% of the vineyards was destined to QWpsr. Innovation techniques have been applied (INNOVA) in 11.65% of the plots, a number that coincides with the vineyards that underwent restructuring. Farmers registered in the regulatory council (CTPINS) reach 46% of the total. The plots located in a DO area come to 96.4%. In 95% of the cases, farmers who utilise the land (TIPEXP) are induvial. In 97% of the cases, the owners (TIPPRO) are also individuals. And regarding land tenure system (CREGTE), in 75% of the cases the land is their own property.

Functional form of the model

A MNLM was used to develop the research, as in papers by Geta *et al.* (2013), Ayuya *et al.* (2012) and Velandia *et al.* (2009), in which farmers choose the alternative *J* that gives them the greatest utility. In this research, the polytomous variable *Y* has five response categories that we named $Y_0, Y_1, \ldots, Y_4$ (Y_0: abandonment; Y_1:

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Table 1. Table 1: Definition of the dependent and independent variables of the model logit.

Variables	Typology	Description
Dependent		
CSITDE	discrete	Plot situation: 0 abandonment; 1 planting; 2 grubbing up; 3 restructuring; and 4 Status quo prepared by the authors using data from the 2012 JCCM Vineyard Register (Council of Castilla-La Mancha Communities)[1].
Independent		
Structural		
NSUPERF	discrete	Plot surface area: 1 (≤10,000 m^2); 2 (>10,000 and ≤100,000); 3 (>100,000). Prepared by the authors using data from the 2012 JCCM Vineyard Register (Council of Castilla-La Mancha Communities[1]).
CDESPR	discrete	Destination of production: 1 QWpsr; 2 Wine from the land; 3 Table wine. EC Regulation No. 479/2008 (EC, 2008). Prepared by the authors using data from the 2012 JCCM Vineyard Register (Council of Castilla-La Mancha Communities[1]).
AA	continuous	Year in which the situation of the plot began. Prepared by the authors using data from the 2012 JCCM Vineyard Register (Council of Castilla-La Mancha Communities)[1].
INNOVA	discrete	Innovation: 1=innovation; 0=no innovation. A plot is said to innovate when it has wire-trained vines and improved grape varieties. Prepared by the authors using data from the 2012 JCCM Vineyard Register (Council of Castilla-La Mancha Communities[1]).
CTPINS	discrete	Plot registered with the Regulatory Council: 1 if it is registered; 0 if it is not. Prepared by the authors using data from the 2012 JCCM Vineyard Register (Council of Castilla-La Mancha Communities[1]).
Market		
MRPW	continuous	Reference price of grapes (€/hectograde) in the central region. The central region is limited to a series of towns. The remaining towns from the sample take the price of the closest town from the central region, the town least distant in kilometres. The variable is calculated as the average price of grapes from 2005 to 2012. Prepared by the authors using data from SEVI, 2005 to 2012 (Semana Vitivinícola, a winegrowers' journal[2]).
MUPWE	continuous	Unit export price of wine (€/litre). Calculated as the quotient between the exported wine value and the volume. It is the mean provincial price from 2000 to 2012. Prepared from data from OEMV, 2012 (Spanish Wine Market Observatory[3]).
Geographical		
DO	discrete	Plot belonging to a Designation of Origin area: 1 if it belongs and (0) if not. Prepared by the authors using data from the 2012 JCCM Vineyard Register (Council of Castilla-La Mancha Communities[1]).
MPOP	continuous	Average population of the town from 2000 to 2012. Data from INE (Spanish Statistical Office[4])
Social		
TIPEXP	discrete	Type of operator: 1=individual; 2=legal entity.
TIPPRO	discrete	Type of owner: 1=individual; 2=legal entity.
CREGTE	discrete	Tenure system: 1=ownership; 2=leased/sharecropping (prepared by the authors using data from the 2012 JCCM Vineyard Register) (Council of Castilla-La Mancha Communities[1]).
Regulatory		
MCAP	continuous	Mean aid received in the period from 2000-2012 in euros. The mean was calculated for each province. Average calculated from data from FEGA (Spanish Agricultural Guarantee Fund[5]).

[1] Available at: https://www.jccm.es.

[2] Available at: http://www.sevi.net.

[3] Available at: http://www.oemv.es/esp/-oemv.php.

[4] Available at: http://www.ine.es.

[5] Available at: https://www.fega.es.

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Table 2. Descriptive statistics of the variables of the specified multinomial logit model.[1]

Continuous variables: descriptive

	AA	MRPW	MUPWE	MPOP	MCAP
Obs.	74,502	74,502	74,502	74,502	74,502
Mean	1,986	2.5444090	2.2297	6,929.076	$5.85e^{+07}$
Std. Dev.	23	0.1847888	0.2846211	8,384.903	$3.99e^{+07}$
Min	1,900	2.3709	0.9324641	5.538	350,990
Max	2,012	3.39766	2.429253	161,515.1	$1.24e^{+08}$

Discrete variables: frequencies

Code	CSITDE	NSUPERF	CDESPR	INNOVA	CTPINS	DO	TIPEXP	TIPPRO	CREGTE
0	646			66,723	39,804	2,658			
1	7,296	48,942	53,750	7,779	34,698	71,844	70,674	72,300	55,585
2	23,518	25,187	4,702				3,828	2,202	18,917
3	8,007	373	16,050						
4	35,035								
Σ	74,502	74,502	74,502	74,502	74,502	74,502	74,502	74,502	74,502

[1] AA= year; MRPW = reference price of grapes; MUPWE = unit export price of wine (€/litre); MPOP = mean population size; MCAP = received aid; CSITDE = plot situation; NSUPERF = plot surface area; CDESPR = destination of production; INNOVA = innovation; CTPINS = plot registered with the Regulatory Council; DO = Designation of Origin; TIPEXP = operator; TIPPRO = owner; CREGTE = tenure system.

planting; Y_2*:* grubbing up; Y_3*:* restructuring; and Y_4*:* remaining unchanged). The aim was to explain the probability of each category depending on the group of observed co-variables $X = \{x_1, x_2, ..., x_i\}$,where $i=13$. That is to say, the aim was to adjust a model of the form $p_j(x) = P[Y = Y_j \mid X = x] f_j(x)\ \forall\ j=0, ..., 4,$ for each vector x of observed values of the explanatory variables X. Therefore, the estimated formulations will provide a set of probabilities for the five alternatives $(J+1)$ from which a farmer having X individual characteristics can choose. The covariables follow a multinomial distribution with probability parameters from each of the response categories, $(Y \mid X = x) \rightarrow M(1; p_0 x), ..., p_k(x))$, where the sum of probabilities is one:

$$\sum_{j=0}^{k} p_j(x) = 1.$$

To construct the MNLM, *(k–I)* logit transformations were considered, defined as depending on a reference category, in this case Y_4. Therefore the generalised logit transformations were defined as:

$$L_j(x) = ln\left[\frac{p_j(x)}{p_4(x)}\right] \quad \forall\ j=0, ..., 3$$

where $L_j(x)$ is the logarithm of the response advantage Y_j. Therefore, the model for each of the transformations is the following:

$$L_j(x) = \sum_{s=0}^{13} \beta_{sj} x_s = x' \beta_j$$

$\forall\ j=0, ..., 3,$ for each vector of values observed from the explanatory variables $x=(x_0, x_1, x_2, ..., x_{13})'$ where $x_0=1$ and $bj=(b_{0j}, b_{1j}, ..., b_{13j})'$ are the parameter vector associated to the Y_j category. The β coefficients are estimated by the maximum-likelihood method.

After estimation, the model will be validated by means of the Likelihood Ratio Test and the pseudo coefficients of determination (McFadden, Cox&Snell, Nagelkerke, Count R^2). Finally, the significance of the variables

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was analysed jointly and individually. A group validation was obtained, as pointed out by Long (1997), with the Wald statistic and the LR test. The individual significance of each independent variable was analysed with the *P*-value associated with the *z*-distribution. The impact of each explanatory variable on the dependent variable will be interpreted through the marginal effects. Marginal effects have to be accounted for separately for each category of the dependent variable.

The STATA 12 econometric software (StataCorp LP, College Station, TX, USA) was used to obtain statistical and econometric results.

4. Results

This section shows the results obtained from the estimated MNLM, with a sample of 74,502 observations. The observations disaggregated by alternatives are: abandonment 646 plots; planting 7,296 plots; grubbing up 23,518 plots; restructuring 8,007 plots, and remaining unchanged 35,035 plots. First, the model was validated and then the significant variables in the model were ascertained.

Regarding the validation of the model, the estimation of the multinomial logistic regression was obtained after nine iterations using the Newton-Raphson method. On the whole the model is significant with a probability associated with the Global Likelihood Ratio Test of zero (Prob>chi^2=0.0000). This result is supported by the fit indicators: R^2_{Mc} =0.60 (excellent fit); $R^2_{Cox\&Snell}$=0.773 (high fit, near the upper boundary; $(\ln \tilde{L}_0)^{2/N}$ =0.91; $R^2_{Nagelkerke}$ =0.845 (a value close to 1). Besides, the MNLM provides a 70% higher prediction level (Adj Count R^2) than the highest frequency of the sample. Therefore, in 70% of the cases the prediction derived from the logistic regression model would be right (Table 3).

Furthermore, the goodness of the model is verified by the likelihood ratio estimation (Table 3). The number of cases correctly predicted, 62,763 total plots, appears along the main diagonal of the matrix. It was 84.24% of the sample, a number that shows the goodness of the model.

We continued with the combined significance of the model through the Likelihood-ratio and Wald tests, tests for independent variables. As observed on Table 3, both tests showed similar results (Long, 1997) and rejected the null hypothesis that the coefficients of the exogenous variables are simultaneously equal to zero since, with a confidence interval of 100, all variables were significant. Finally, the MNLM was validated with the Hausman test of independence of irrelevant alternatives (IIA) (Table 3). All five alternatives have negative coefficients, which, according to Hausman and McFadden (1984), is common for this type of tests. They conclude that this shows the necessary evidence that the independence of irrelevant alternatives was not violated, so that the null hypothesis of IIA was likewise accepted. In conclusion, it verified that the model is well specified. Finally, we focused on the individual estimate and significance (Table 4).

We analysed the results of the estimation using the categories of the dependent variable: abandonment, planting, grubbing up, restructuring and status quo, this last being used as the base category.

Abandonment

With regard to abandonment, the smallest plots (NSUPERF) are most prone to it due to their lower level of profitability. Plots intended for production of table wine (CDESPR) are the ones that have experienced most abandonment; these being the most common in the region. At present (AA) abandonment of a plot is the least likely option. Innovation and technical change (INNOVA) are not present in the abandoned plots. Normally abandonment is linked to plots of unirrigated land, a long useful life and with head-pruned vines. The biggest drop occurs in seasons of low grape prices (MRPW) and therefore a less profitable crop, a result that has a clear effect on the short term expectations of the producer. By contrast, the price of wine in the international market (MUPW) is less influential in the decision to abandon. Being in a DO area has no significant influence due to its limited ability to generate significant added value based on territorial

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Table 3. Diagnoses – evaluation model.

Log likelihood=-36,257.766 (iteration 9)
Base outcome=4
Log-Lik intercept only: -91,429.826
Log-Lik Full model: -36,257.766
LR $chi^2(50)$=110,344.12; Prob>chi^2=0.0000
Pseudo R^2=0.6034
ML (Cox-Snell) R^2: 0.773; Cragg-Uhler (Nagelkerke) R^2: 0.845
Count R^2: 0.842; Adj Count R^2: 0.703

Tests for independent variables[1,2]	**Likelihood-ratio**			**Wald tests**		
	chi^2	**df**	***P*>chi^2**	**chi^2**	**df**	***P*>chi^2**
NSUPERF	177.926	4	0	176.672	4	0
CDESPR	2,910.332	4	0	1,719.674	4	0
AA	72,316.893	5	0	14,768.996	4	0
INNOVA	19,597.566	5	0	6,937.924	4	0
CTPINS	2,910.732	4	0	2,237.418	4	0
MRWP	135.753	4	0	135.356	4	0
MUPWE	40.395	4	0	37.196	4	0
DO	576.684	4	0	348.053	4	0
MPOP	88.550	4	0	88.763	4	0
TIPEXP	68.442	4	0	64.897	4	0
TIPPRO	98.915	4	0	97.936	4	0
CREGTE	670.112	4	0	621.35	4	0
MCAP	149.390	2	0	136.869	4	0

Hausman tests of IIA assumption (N=74,502)[3]

Omitted	**chi^2**	**df**	***P*>chi^2**	**evidence**
0	-97.216	33	–	–
1	-1.2e+03	33	–	–
2	-541.783	33	–	–
3	-119.002	33	–	–
4	-1,094.697	31	–	–

Likelihood ratio. Correctly predicted cases

pred_ choice	**0**	**1**	**2**	**3**	**4**	**Total**
0	6	1	0	0	35	42
1	1	559	102	301	90	1,053
2	3	4,918	22,591	1,803	694	30,009
3	2	1,076	77	5,680	289	7,124
4	634	742	748	223	33,927	36,274
Total	646	7,296	23,518	8,007	35,035	74,502

[1] NSUPERF = plot surface area; CDESPR = destination of production; AA= year; INNOVA = innovation; CTPINS = plot registered with the Regulatory Council; MRPW = reference price of grapes; MUPWE = unit export price of wine (€/litre); DO = Designation of Origin; MPOP = mean population size; TIPEXP = operator; TIPPRO = owner; CREGTE = tenure system; MCAP = received aid.

[2] H_0: all coefficients associated with given variable(s) are 0.

[3] H_0: odds (outcome-j vs outcome-K) are independent of other alternatives; N = average population size.

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Table 4. Multinomial logistic regression results (number of observations=74,502).[1,2,3]

	Alternative 0 abandonment	Alternative 1 planting	Alternative 2 grubbing up	Alternative 3 restructuring
NSUPERF	-0.3777215***	-0.0004644	0.1752252***	0.5060231***
	(0.1399474)	(0.039878)	(0.0383997)	(0.0482814)
CDESPR	3.09756***	0.0498769**	-0.5615843***	0.1807192***
	(0.1516839)	(0.024188)	(0.0241528)	(0.029624)
AA	-0.046084***	0.1860118***	0.2881561***	0.1832233***
	(0.0955732)	(0.0021109)	(0.0024812)	(0.0026866)
INNOVA	-1.32855**	2.10372***	-2.46045***	5.14439***
	(0.7236203)	(0.08734)	(0.1572926)	(0.0887803)
CTPINS	0.0080845	-0.0380567	-0.0812698**	2.28329***
	(2.18e-09)	(0.0420916)	(0.0403093)	(0.0584437)
MRPW	-2.38149***	0.3327845***	-0.3232281***	0.5118017***
	(0.4788038)	(0.0983089)	(0.1011016)	(0.115763)
MUPWE	0.2016144*	-0.3066293**	-0.6495867***	0.1644401
	(0.1194986)	(0.1498377)	(0.1359153)	(0.2250356)
DO	0.5675078***	1.91491***	-1.04461***	2.61186***
	(0.1220812)	(0.2258258)	(0.1366729)	(0.2492616)
MPOP	-0.0000128	0.0000224***	0.0000172***	9.21e-06***
	(0.1516839)	(2.82e-06)	(2.83e-06)	(3.12e-06)
TIPEXP	0.0812888	-0.1754093*	0.4599622***	-0.0116506
	(0.4562126)	(0.1091514)	(0.1022304)	(0.1286273)
TIPPRO	0.0741402	0.2104598*	-0.2321033*	-0.9780544***
	(0.5225937)	(0.1328757)	(0.1306718)	(0.1626933)
CREGTE	-1.77612***	0.0365987	-0.6604744***	-0.084878*
	(0.1853053)	(0.0414341)	(0.0415891)	(0.0521772)
MCAP	1.01e-08***	1.10e-08***	5.69e-09***	6.96e-09***
	(0.0000139)	(1.05e-09)	(9.68e-10)	(1.49e-09)
Cons	85.74217***	-374.58970***	-570.81290***	-373.23300***
	(4.745932)	(4.237612)	(4.956957)	(5.424165)

[1] Standard errors are in parenthesis.

[2] *, **, *** denotes significance at the 10, 5, and 1% level, respectively.

[3] NSUPERF = plot surface area; CDESPR = destination of production; AA= year; INNOVA = innovation; CTPINS = plot registered with the Regulatory Council; MRPW = reference price of grapes; MUPWE = unit export price of wine (€/litre); DO = Designation of Origin; MPOP = mean population size; TIPEXP = operator; TIPPRO = owner; CREGTE = tenure system; MCAP = received aid.

differentiation of quality. Plot owners in Castilla-La Mancha are very reluctant to leave (CREGTE). The option of definitively abandoning the cultivation of vines with or without obtaining financial aid or replanting rights is the least likely, since it would mean a capital loss (MCAP).

Planting

With regard to the planting category, the results of the model show that the size of the plot (NSUPERF) does not have excessive influence when it comes to carrying out planting, possibly because it is not so geared towards increasing competitiveness, nor it is associated with financial support or administrative restrictions. As for the destination of the production (CDESPR), the importance of table wine prevails due to its better performance in terms of yield and adaptation of the grape variety. Over the most recent years (AA), more dynamic planting, associated with a greater degree of innovation (INNOVA) was observed. Higher grape prices (MRPW) and the higher export price (MUPW) are significant in making the decision

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to plant, contributing to an increased profitability of the crop. Planting takes place mostly in DO areas, due to the wide area they cover coupled with the potential added value that production there could acquire. The plots located in municipalities with the largest populations (MPOP) are more dynamic when it comes to planting tasks. Producers in these municipalities have greater competitive advantages over other areas since their increased economic activity results in increased availability of resources, infrastructure and services, such as access to wineries and input supplies. Planting is promoted by the owners of the plots (TIPPRO), and more by companies than by individual owners, because they usually have more entrepreneurial culture and economic resources.

Grubbing up

With regard to grubbing up, it is larger plots (NSUPERF) that are most prone to it because either renewing the vines or switching to another crop allows for greater profitability. The plots that produce table wine (CDESPR) are least likely to be grubbed up because most of region's wine is produced to this end and as a result of the expertise with which this is done it produces the best domestic results. The plots where the least innovation occurs (INNOVA) are the most grubbed up. Being registered with the Consejo Regulador (Regulatory Board) (CTPINS) does not induce the grubbing up of plots, since although the majority destination of production is table wine, wines that are finally classified as DO and bottled as such have higher added value. The price of grapes (MRPW) is crucial the decision to grub up, the result obtained being that the lower the price the more the grubbing up. The export price (MUPW) influences the decision to grub up since the international market is the main destination for the table wine production and this has expanded greatly in recent years. The municipalities with the biggest populations (MPOP) show greater dynamism in terms of grubbing up because producers have greater competitive advantages. The reticence towards grubbing up on the part of producers in Castilla-LaMancha (CREGTE) is contributed to by their receiving certain economic measures that involve income maintenance (MCAP). In this regard there are also certain intangible factors in play related to cultural and family values, combined with a lack of profitable crop alternatives. Regarding those who manage the land (TIPEXP), companies grub up more than individuals because they usually have more entrepreneurial culture and the economic resources to restructure the business and/or make more profitable use of it.

Restructuring

Restructuring is carried out on larger plots (NSUPERF), which allow producers to increase productivity by achieving economies of scale. Plots producing table wine (CDESPR) are the ones which have most undergone restructuring. This is because of the need to find an outlet for the large volumes of wine which previously ended up being distilled and which have now to be exported in bulk, without DO, PGI or having the grape variety identified. The plots in DO areas have a positive correlation with restructuring. This is because the majority of the plots in the region are located in DO areas, though not all wine produced there receives the DO label, as is evident from the fact that a large part of the region's production is table wine. Innovation and technological development (INNOVA) are present in the restructured plots. In part, this is due to the application of norms which regulate financial assistance for the restructuring of vineyards. Market conditions, particularly the price of grapes (MRPW) are critical to the decision on restructuring. Thus, a price increase directly encourages the decision to restructure since this system of cultivation enables a boost to yield along with lower production costs. Also regarding market conditions, the export price on the international market (MUPW) is less important than the grape prices when it comes to restructuring. Plots in municipalities with the largest populations (MPOP) show greater dynamism with regard to restructuring due to their greater competitive advantages. Wine producers in Castilla-La Mancha (CREGTE) are reluctant to restructure due to the costs involved and, especially, due to the limitations on irrigation. More owners (TIPPRO) take the decision to restructure than renters (TIPEXP). There are more owners than renters or other types of ownership of vineyards. CAP (MCAP) financial assistance is an important stimulus for restructuring. We complete these results with the information provided by the marginal effects (Table 5).

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Table 5. Multinomial logistic regression marginal effects (number of observations=74,502).[1,2]

	Alternative 0 abandonment	Alternative 1 planting	Alternative 2 grubbing up	Alternative 3 restructuring	Alternative 4 status quo
NSUPERF	-0.0000707**	-0.0028089	0.0074532***	0.0153123***	-0.0198859***
CDESPR	0.000547***	0.0073592***	-0.0270093***	0.0062552***	0.0128479***
AA	-0.0000153***	0.0162302***	0.0122395***	0.0045277***	-0.0329822***
INNOVA	-0.0001948***	0.0637108***	-0.0641998***	0.6541154***	-0.6534315***
CTPINS	-0.0000134	-0.013529***	-0.0080629***	0.0893657***	-0.0677604***
MRPW	-0.0004249**	0.0330704***	-0.0178348***	0.0151008***	-0.0299114*
MUPWE	0.0000462***	-0.02745**	-0.0291254***	0.0071769	0.0493524***
DO	0.000072***	0.1003191***	-0.093655***	0.0319352***	-0.0387609**
MPOP	-2.88e-09	2.10e-06***	6.69e-07***	1.77e-07*	-2.94e-06***
TIPEXP	0.0000138	-0.0199295**	0.0226292***	-0.0004595	-0.002254
TIPPRO	0.0000164	0.0256674**	-0.0105458*	-0.0305056***	0.0153676
CREGTE	-0.0003065***	0.0076283**	-0.0311279***	-0.0016944	0.0255004**
MCAP	1.47e-12	1.03e-09***	1.96e-10***	1.66e-10***	1.46e-09***
y	0.00017569	0.11183567	0.04949867	0.03130968	0.80668028

[1] *, **, *** denotes significance at the 10, 5, and 1% level, respectively.

[2] NSUPERF = plot surface area; CDESPR = destination of production; AA= year; INNOVA = innovation; CTPINS = plot registered with the Regulatory Council; MRPW = reference price of grapes; MUPWE = unit export price of wine (€/litre); DO = Designation of Origin; MPOP = mean population size; TIPEXP = operator; TIPPRO = owner; CREGTE = tenure system; MCAP = received aid.

It should be noted that an increase of 1% in the size of the plot has a high impact on vineyard restructuring probability (1.5% increase) and on status quo (1.9% fall). The effect is not significant on any of the remaining alternatives. Moreover, large, more professionalized producers are revealed to be more prone to modernizing their holdings. Plots destined for table wine production are the ones that have been most often restructured and least often grubbed up. The importance of table wine still predominates in new plantings (according to the results of marginal effects, the likelihood of planting increasing is 1.6% with every passing year). The most recent years are the ones when more movement has taken place toward planting, grubbing up and restructuring. Abandonment is currently the least probable option. With every passing year, new planting is the option most likely to occur (1.6%) whereas the likelihood of maintaining the status quo in the plots decreases (-3.3%). Therefore, the consolidation of holdings and a stable regulation framework favor structural changes. Innovative plots were less prone to being abandoned or grubbed up. Rather, there was innovation in those which are newly planted or restructured. According to marginal effects, innovating farmers' are most likely to decide for restructuring (65%). Being registered in the Regulatory Council stimulated restructuration (8.9% according to Table 5) and the opposite occurred for grubbing up and maintaining the status quo (-6.7%). With regard to market variables, the higher the price for grapes, the more motivation for farmers to plant and restructure and the less to abandon and grub up. The alternative most likely to occur after a 1% increase in price is planting, with a 3.3% increase. The status quo in the plots can also change by almost 3% after an increase in price. This reveals the importance of the economic variable as a determining factor in farmers' decisions regarding their holdings. The price of wine on the international market was less important than the price of grapes in farmers' decision making. Grubbing up and the status quo are worth highlighting; according to marginal effects a 1% increase in price results in a 2.9% decrease in grubbing up and a 4.9% increase in the status quo. This effect reveals a clear trend in farmers to take exporting as a profitable point of reference and as the pillar of the economic viability of holdings, underlined by the fact that the ones who focus on international markets when it comes to making decisions regarding their holdings are the most active and dynamic farmers. In terms of geographic variables, the majority of the sample plots are located within a DO area (96.4%; Table 3). Planting and restructuring are predominant as opposed to grubbing up. According to marginal effects, the probabilities of planting and restructuring increasing in PDO areas are

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10 and 3% respectively. This shows that a territorial reference label guarantees production and commercial invigoration and encourages farmers to take action.

Plots located in towns with large populations are more dynamic in terms of planting, grubbing upand restructuring. On the other hand, in the least populated towns there was a higher probability of abandonment. With regard to social variables, farmers in Castilla-La Mancha are very reluctant to grub up and restructure, owners being the ones who make that decision. From the viewpoint of the agents who profit from the holdings, legal entities who are not land owners are the ones who promote grubbing up. As to regulatory variables, aid from the CAP is an important element in farmers' decision making, which is revealed by its significance for all the alternatives (except for abandonment according to marginal effects; planting is the course of action of choice when aids increase, which reveals the high impact of subsidies on the decision to grub up and start new planting).

The analysis of the influential variables in each of a producer's alternatives led to the creation of the following plot categories: abandoned, planted, grubbed up and restructured plots. An abandoned plot corresponds to a small plot (<10,000 m^2) with no innovations, whose grapes are destined for table wine, it located in small towns, grape price is low and has received subsidies. In a newly planted vineyard the size of the plot is irrelevant, there is innovation, the destination of production is table wine, the size of the town is irrelevant, grape prices are high and aid is important. Legal entities are more prone to planting. Grubbing up takes in large plots of where there is no innovation, the production is for table wine, the location is in larger towns, market prices are low (for grapes as well as exports) and aid is received. As for owners, neither individuals nor legal entities are inclined to grub up, particularly legal entities. Finally, a restructured plot is a large plot which innovates, grapes are destined for table wine, it is located in more highly populated towns and market prices for both grape and exports are high. Similarly to grubbing up plots, all types of owners are reluctant to choose this alternative.

Summing up, the weight of each variable affects producers' decisions, but the final decision is derived from the interaction of the whole of these variables, and not so much from the specific individual weight of any one of them. It is true that there are variables that turned out to be significant in all the alternatives. Destination of production (CDESPRO), year of action (AA) and innovation (INNOVA) were significant in structural variables; reference price (MRPW) in market variables; belonging to a DO area (DO) in geographical variables; and aid from the CAP in regulatory variables. Ultimately, farmers decisions are not easy to predict; hence the complexity of the analysis we have carried out.

Then, we assessed the most probable alternative for a plot in Castilla-La Mancha using (1) all the plots from the sample, and (2) a standard plot whose characteristics are the average mean value of each of the exogenous variables of the sample. For all the plots from the sample (74,502), the most probable alternative was to remain unchanged with a mean probability of 0.47 (Table 6). For the standard plot, the option of remaining unchanged was also the most likely one with a probability of 0.8067.

Therefore, the results in relation to the variables that affect winegrowers' decisions were similar to the results obtained in previous research. Giannoccaro and Berbel (2011) studied how the CAP reform would affect farmers' decisions on the use of water and they noted the importance of considering multiple factors simultaneously in their choices. Structural factors related to the size of the holding, interest in adopting innovations and belonging to agricultural groups, such as DO are specifically worth noting. Market and economic variables also affect decisions, in this case mainly through prices. Geographical and social variables are noteworthy depending on the location of producers. Finally, aid and subsidies received by the winegrowers were also important. Therefore, when it comes to designing agricultural policies, economic aspects have to be considered, but social and environmental ones are also important because of the effects they have on agricultural production activities, in this particular case on winegrowing.

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Table 6. Prediction of the probability of occurrence of each of the farmer's decision alternatives: abandonment; planting; grubbing up; restructuring and status quo.

	Alternative[1]				
	0	**1**	**2**	**3**	**4**
Predicted probabilities for all plots in the sample					
obs	74,502	74,502	74,502	74,502	74,502
mean	0.0086709	0.0979303	0.3156694	0.1074736	0.4702558
std. dev.	0.0377504	0.1053838	0.3664378	0.2444321	0.442035
min	5.50e-11	5.38e-10	1.19e-13	3.14e-10	0.0002215
max	0.7516627	0.8278624	0.9948151	0.9837361	0.9999548
Predicted probabilities for a standard plot, while all other variables are held constant at their mean					
probability	0.0002	0.1118	0.0495	0.0318	0.8067
95% conf. interval (confidence intervals by delta method)	[0.0001; 0.0003]	[0.1063; 0.1174]	[0.0461; 0.0529]	[0.0291; 0.0345]	[0.7995; 0.8139]

[1] 0 = abandonment; 1 = planting; 2 = grubbing up; 3 = restructuring; 4 = status quo.

5. Discussion

Based on the analysis and results of the estimation, the conclusions contribute new elements that are complementary to most previous papers regarding potential structural imbalances. Regardless of the structural characteristics of the plots, the basic variables which affect producers' decisions are market variables such as the price of grapes and regulation variables such as CAP budgetary aid for grubbing up and restructuring and conversion (R&C).

However, from the market variables viewpoint, the cost of exporting wine is not necessarily that important since producers do not take it as a direct reference in the decision strategy for their vineyards. In this study no relationship is observed between the price of exportation and the development of vineyards in the EU, including in Castilla-La Mancha. On the other hand, in countries outside of the EU supply is closely related to the market and tends to adjust to variations in price. The inexistence of a significant relationship could be due to the measures applied in the EU under the CMO for wine.

From the structural viewpoint, there is a clear dichotomy between the actions of large and small holdings, as indicated above in the MAGRAMA report (2005). The former are much more inclined to modernise (R&C) (Gallego, 1996) but they also give priority to grubbing up, whereas small holdings have a greater probability of being abandoned. The same thing happens in the Autonomous Community of Navarre, where large holdings have higher survival rates than small ones (Aldanondo and Casanovas, 2009). This is what is generally the case in the agri-food sector in other geographic contexts as well (Montagut and Dogliotti, 2008).

Furthermore, there is also a dominant structural variable with a clear tendency towards the concentration of vineyards in those areas with a denser amount of wine crops. It is in the areas featuring more vineyards where producers have decided to invest in modernising their vineyards and in new plantations. Studies of the Rheinland-Pfalz region in Germany (Bogonos *et al.*, 2012a,b) and on the Priorat region in Catalonia, Spain (Bove, 2012) produce arguments along these same lines. The objective is to take advantage of the wine-growing potential in these areas. Innovation plays an important role in these new plantations and especially in restructured and converted holding. Producers feel that new plantations should be accompanied by changes and innovations to improve their competitive position, as established in the Council Regulation

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No 479/2008, Article 11, item 3 (EC, 2008). The same thing has happened in the community of Castilla-Leon in the Toro Designation of Origin (Sanchez, 2003), in the Aragon region (Government of Aragón, 2010) and in the wine producing sector of Priorat (Bove, 2012).

On the other hand, the R&C process is probabilistically closer to taking place in areas having a DO and/or PGI than in areas where there is no territorial denomination. The same process happened in Aragon (Government of Aragón, 2010). Therefore, this geographical variable, as well as market positioning, affect producers' decisions. However, new plantations have also been significant in terms of the potential tendency to choose these areas for their location. These new plantations, according to the report by the Basque Government (2012), would interfere with the quality objectives pursued by DO areas, since part of the objectives are obtained through a control of the vineyard surface area as well as of the conditions of production.

6. Conclusions

This paper studied winegrowers' decision making processes in Castilla-La Mancha in relation to public regulation in matters of structural changes in vineyards. The results show that farmers are faced with a complicated, ever-changing scenario and that their decisions are not easily predictable.

In this scenario, the typical farmer from Castilla-La Mancha is generally more likely to adopt the decision of not carrying out any action in their vineyards. Grubbing up comes in second, restructuring and planting are found farther behind while the likelihood of abandonment is practically zero. Giannoccaro and Berbel (2011) also state that the majority of EU farmers declared their intention not to introduce any changes in their holdings.

However, the model has shown that the provision of public aid and guaranteed prices stimulates investment on the part of farmers to expand their production capacity, exactly as Winter (2002) also suggests. As pointed out in the results analysis, the marginal effects studied reveal interesting conclusions in terms of winegrowers' behavior; the economic variables focused on price (both grape price and average export price) are decisive for farmers to decide on modernizing their holdings. Along the structural dimension, larger holdings are more prone to opt for adding technological advances and changing production methods to reduce unit costs (restructuring and reconversion). Differentiation in production origin is an important element to prevent farmers from deciding to abandon and grub up vineyards, which validates the European DO and geographical indication labelling as a key element of wine policy in relation to other regions in the world. Finally, we have observed that the incentive of public aid favors farmers' decision to move forward and decide on abandonment and grubbing up or new planting.

Therefore, is would be safe to conclude that the effects of this potential measure, *coeteris paribus* the other factors and other EU actors, could affect farmers' income through prices and this would increase the probability of abandonment and grubbing up. Taking into account that the probability of abandonment in Castilla-La Mancha is practically null and that of grubbing up is low, the effects of this potential measure are much more limited than what could be deduced *a priori* from a structural measure of this type, mainly due to the high probability of Castilla-La Mancha farmers maintaining the status quo in their plots (with a probability of 0.8067 according to the logit results). Therefore, agricultural policies have different effects and different degrees of impact because they are conditioned, as has been observed, by structural, market, geographic and regulatory variables. The results by Giannoccaro and Berbel (2011) are along the same lines. Therefore, this paper has aimed at improving research on farmer choices – a quite complex but at the same time highly appealing issue – both from the methodological and experimental point of view (Beckford and Barker, 2007; Bigliardi and Dormio, 2009; Fortuin and Omta, 2009).

Furthermore, general patterns of behavior can be anticipated using the same methodology and an interesting line of future research is opened on the potential effects on producers' decisions that the inclusion of the

so-called authorisations for vine planting (EU Regulation No. 1308/2013 (EC, 2013b)) would cause in the wine growing sector to substitute for previous rights in the CAP reform for the 2015-2020 period.

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