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# The relationship between product quality and transaction costs with vertical coordination in DOC Rioja winegrape industry

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## Abstract

This paper analyzes the relationship between product quality and governance mode choice (market mode, hybrid mode or vertical integration) using the results of a survey of 187 qualified appellation of origin (DOC) Rioja wineries. By estimating a generalized ordered logit, it is concluded that wineries that produce high-quality wines are more likely to vertically integrate than are wineries that produce low-quality wines. Consistent with transaction cost economics, evidence is found that asset specificity and uncertainty are important determinants of vertical integration. Finally, the size of the winery is also an important factor that affects governance mode choice in viticulture.

**Additional key words:** quality, transaction cost, vertical relationship.

## Resumen

**La relación entre la calidad del producto y los costes de transacción asociados a la coordinación vertical en la industria del vino de DOC Rioja**

Este trabajo analiza la relación entre la calidad del producto y la elección del mecanismo de gobierno (mercado, modo híbrido o integración vertical) utilizando los resultados de una encuesta realizada a 187 bodegas adscritas a la denominación de origen calificada Rioja (DOC Rioja). Estimando un modelo logit ordenado generalizado, se concluye que las bodegas que producen vinos de alta calidad son más probables de integrarse verticalmente que aquellas que producen vinos de baja calidad. Consistente con la economía de costes de transacción, se encuentra evidencia de que la especificidad de activos y la incertidumbre son importantes determinantes de la integración vertical. Finalmente, el tamaño de la bodega es también un importante factor que determina la elección del modo de gobierno en viticultura.

**Palabras clave adicionales:** calidad, coste de transacción, relación vertical.

## Introduction

The agri-food system is undergoing a fundamental transformation that is altering traditional marketing relationships to better serve customer needs. These changes are drawing customers, processors and growers into increasing coordination relationships, improving the flow of information up the supply chain and enabling firms to better meet customer needs (Barkema, 1993; Boger, 2001).

Food quality is an increasingly important issue in the agricultural sector. Indeed, the competitiveness of food companies in national and international markets depends upon their ability to adopt production processes which meet quality requirements (Holleran *et al.*, 1999).

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Abbreviations used: $AV_{HIGH}$ (high added value), $AV_{LOW}$ (low added value), BU (behavioral uncertainty), DAS (dedicated asset specificity), DOC (Qualified Appellation of Origin), EU (environmental uncertainty), GOV_MECH (mechanism of governance), GPAS (grower's physical asset specificity), IIA (independence of irrelevant alternatives), SIZE (size), TCE (transaction cost economics), WPAS (winery's physical asset specificity).

To date, research about vertical relationships in agriculture has come to be dominated by the principal-agent framework (Otsuka *et al*., 1992). In this approach, protecting input quality has been suggested to be a possible motivation for the use of contracts over the spot market alternative, especially in the presence of imperfect quality measurement (Hueth and Ligon, 1999a,b, 2001, 2002). A majority of this literature relies on theoretical models and simulation exercises. While these contributions have enhanced the understanding of vertical relationships, supporting evidence has been weak. Hence, empirical studies of vertical relationships tend to ignore risk preferences and focus exclusively on transaction costs (Allen and Lueck, 1995).

Most empirical transaction cost economics (TCE) - research has focuses on the motives for vertical integration in non-food sectors, finding support for the theory´s main hypotheses. That is, asset specificity and uncertainty are the main determinants of the integration choice. (*e.g.*, Monteverde and Teece, 1982; Anderson and Schmittlein, 1984; Masten, 1984; Joskow, 1985).

It has been recognized that the concept of food quality is an important consideration in many industries. For this reason, protecting product quality has been identified as a motivation for vertical coordination (Goodhue *et al.,* 2003). Yet, most empirical studies have ignored this fact. Among the few existing studies, Boger (2001) investigates the relationships between quality and the marketing channels used for Polish hog transactions. Goodhue *et al*. (2003) analyze the relationship between product quality and contracting choices using the results of a survey of California winegrape growers.

Taking into account that the increasing demand for food quality accentuates the degree of interdependence among different levels of the supply chain, it is an important omission from most of the previous empirical literature not to analyse quality issues as a possible determinant of vertical relationships.

This paper analyzes qualified appellation of origin (DOC) Rioja wine market, an industry with a wide variety of vertical relationships and a considerable variation among types of wines. Industry participants implicitly associate having own vineyard with protecting grape quality. Using data from a survey of DOC Rioja winegrape processors, it is identified how wine quality interacts with the choice of governance mechanism. Like Goodhue *et al*. (2003) and Fraser (2004), this work seeks to enhance understanding of the determinants of vertical coordination by studying an industry where quality is an important consideration. Unlike these studies, this study examines the choice not only of spot market and contracts, but of vertical integration as well.

The remainder of the paper is divided into four sections. The following section provides the theoretical background and hypothesis for governance mode choices. An empirical section follows that discusses collection of field data from 187 wineries. The findings of several models and how these relate to the hypotheses are described in the third section. A final section presents a discussion of the implications of the study and suggestions for future research.

## Theoretical framework

In this section a transaction cost analysis is realized to postulate a model of governance mode choice. First, the basic hypothesis of TCE -discriminating alignment- is explained. Next, an analysis of the main governance structures is presented. Finally, theoretical and empirical literature is revised to formulate hypotheses on factors determining the governance mode decision.

Williamson (1975) maintains that transaction costs are not directly measurable since they represent the potential consequences of alternative decisions. Hence, Williamson (1975) builds the TCE framework on a set of dimensions that are proposed to determine the transaction costs incurred under different organizational forms. In his words (Williamson, 1991a, p.79), economic organization is mainly an effort to "align transactions (which differ in their attributes) with governance structures (market, hybrids, firms), which differ in their costs and competencies, in a discriminating (mainly, transaction cost economizing) way".

### Analysis of the discrete governance structures

Williamson (1991b) distinguishes three generic forms of economic organization, market, hybrid and hierarchy, by different characteristics that are: instruments, performance attributes and contract law. The first attribute consists of incentive intensity meaning to what extent incentives are being used and administrative controls meaning to what extent control mechanisms are being used. Incentive intensity is high in the case of the market (self-interest seeking), and low within the hierarchy because changes in effort expended have little or no immediate effect on compensation. While control mechanisms do not exist in the market, they are neces-

sary to compensate for the weaker incentive intensity of the hierarchy. The second attribute consists of performance attributes. This refers to the way in which adaptability takes place. Williamson distinguishes between autonomous adaptability (price mechanism)- a concept of Hayek (1945)- and coordinative adaptability- a concept of Barnard (1938). Hierarchy adapts itself better than market when coordinated adaptation is called for, but the situation is reversed when autonomous adaptation is required. The third attribute is contract law. Williamson distinguishes between classical contract law (or dispute settling by court), neoclassical contract law (or dispute setting by arbitration) and excuse doctrine and forbearance (or internal dispute settling). Interpreted in a legalistic way in the case of the market, adapted and flexible for the hybrid modes, contract law is replaced by the power of hierarchy within the firm. As compared with market and hierarchy, which are polar opposites, the hybrid mode is located between the two of these, as Table 1 shows (Williamson, 1991b; Barkema and Drabenstott, 1995; Joskow, 2005).

## Determinants of governance mechanisms

The factors determining the governance mode choice are grouped into four broad categories: (1) the specificity of the assets required to produce the good, (2) the uncertainty surrounding the transaction, (3) the size of the winery and (4) the product quality.

## Asset specificity

The degree of specificity can be measured by the difference between the cost of the asset and the value of its second best use (Williamson, 1985). Transaction cost theory argues that the employment of specialized assets incurs small-number conditions with considerable exposure to opportunism and subsequent transaction costs. This contractual hazard is denominated as hold-up, whereby the party whose investments in the transaction have significant value in alternative use expropriates quasi-rents from the party who invested in transaction-specific assets that have low value in alternative use (Klein *et al*., 1978; Williamson, 1985). Accordingly, investments in specific assets lead to vertical integration because it reduces the potential for such opportunistic behavior.

**Table 1.** Analysis of the organizational menu: market, hybrid, and hierarchy[a]

| Attributes | Market | Hybrid | Hierarchy |
|---|---|---|---|
| Incentive intensity | ++ | + | 0 |
| Administrative controls | 0 | + | ++ |
| Autonomous adaptation capacity | ++ | + | 0 |
| Coordinated adaptation capacity | 0 | + | ++ |
| Contract law | ++ | + | 0 |

[a] ++= strong; +=semi-strong; 0=weak. Source: Adapted from Williamson (1991b, p.281)

Williamson (1979, 1985) emphasized asset specificity as the critical factor in determining choice of governance structure. Asset specificity can take several forms: physical asset specificity, human asset specificity, site specificity, dedicated assets, temporal specificity and brand name capital. Given the activity of this study, physical asset specificity and dedicated assets specificity are chosen.

Physical asset specificity describes the situation where assets are tailored to a specific relationship and are difficult to re-deploy for other purposes without the sacrifice of productive value Wine grapes can be a highly specific asset for growers if they cannot easily find alternative use for the whole grape vintage. Likewise, physical asset specificity can be high for wine makers as wineries include technological equipment and casks for maturation, which cannot easily be redeployed. Many empirical studies find support to the basic TCE assumption that physical asset specificity is positively associated with the decision to integrate. These studies have used measures as diverse as the amount of specialization in a component (Masten, 1984; Ohanian, 1994), capital intensity (McDonald, 1985; MacMillan *et al.,* 1986), small numbers of suppliers and buyers (Levy, 1985; McDonald, 1985) and research and development expenditures (Caves and Bradburd, 1988; Frank and Henderson, 1992) are all associated with a greater probability of integration. Accordingly, the TCE hypothesis that has been repeatedly in the literature, and that it is tested in this paper as well, is the following:

– *Hypothesis 1 ($H_1$): The higher the value of physical specific assets, the more likely it is that the governance structure will be of the "hierarchy" mechanism.*

Dedicated asset specificity refers to grapes which were cultivated for the purpose of one particular vintner. Since winegrapes are extremely perishable, the vintner could seek to appropriate rents by taking advantage of

the grower´s need to harvest and sell his grapes in a relatively short period of time (Goodhue *et al*., 2003).

Compared with physical asset specificity, less attention has been paid to this type of specificity. One exception is Adler *et al*. (1998), who operationalised dedicated asset specificity as the time to meet the buyer's requirements from contract start date to the acceptance of the product. Similarly to the previous specificity, it is expected that when the value of dedicated asset specificity increases, vertical integration is more likely to be used.

– *Hypothesis 2 ($H_2$): The greater the value of dedicated specific assets, the more likely it is that the governance structure will be of the "hierarchy" mechanism*

## Uncertainty

A second transaction dimension is uncertainty, which affects the ability of parties in a transaction to specify fully the range of future contingencies (Williamson, 1985).

A basic assumption of transaction cost theory is that all transactions are conducted under a certain level of imperfect information, which takes different forms- behavioral and environmental- that can impact exchanges.

Behavioral uncertainty is linked to measurement. Contracting parties should be able to evaluate the elements exchanged, in quantity and quality. If performance cannot be easily assessed, the market will fail because it is known what to reward and how (Williamson, 1981). Based on this reasoning, it is hypothesized that increased behavioral uncertainty will lead to increased use of vertical integration. This general hypothesis has gained some degree of support in empirical research (*e.g.* Anderson and Schmittlein, 1984; Anderson, 1985; Gatignon and Anderson, 1988; John and Weitz, 1988; Majumdar and Ramaswamy, 1994).

– *Hypothesis 3 ($H_3$): The greater the behavioral uncertainty, the more likely it is that the governance structure will be of the "hierarchy" mechanism.*

When the circumstances surrounding the exchange cannot be specified in advance, environmental uncertainty appears. In the activity of analysis of this paper, the high level of dependency of viticulture to exogenous conditions such as hazardous and risky natural environment (drought, pests, flooding, insect infestations, disease, etc) is one of the main reasons of environmental uncertainty. Nevertheless, Williamson argues that unpredictability per se does not favour vertical integration, only in interaction with asset specificity. This interaction effect between unpredictability and asset specificity have been found by Anderson (1985), Coles and Hesterly (1998a), Fan (2000), Leiblein and Miller (2003) and Díez-Vidal (2007). The following hypothesis can therefore be proposed:

– *Hypothesis 4 ($H_4$): The higher environmental uncertainty, in presence of asset specificity, the more likely it is that the governance structure will be of the "hierarchy" mechanism.*

Frequency is another important factor mentioned by Williamson (1975). It refers to the regularity of the transaction. For the purposes of this particular study, however, it is not measured the effects of the frequency because all transactions that were examined occurred with the same frequency.

## Winery size

Williamson (1974) points to diseconomies of scale as a factor limiting the extent of vertical integration. This is because hierarchy comes at the cost of additional bureaucracy and lower-powered incentives, which limit the size of firms (Williamson, 1974). Empirical evidence has been offered in support of this idea (Martin, 1986; Scherer and Ross, 1990; Russo, 1992; Arruñada *et al*., 2004; Bhuyan, 2005). All of this leads to consider the following hypothesis:

– *Hypothesis 5 ($H_5$): The larger the firm, the less likely it is that the governance structure will be of the "hierarchy" mechanism.*

## Product quality

Another factor that may affect the governance mechanism choice is whether the differentiation is an important feature of the delivered product. Agricultural products in general, and viticulture in particular, are extremely sensitive to the differentiation effects. In the wine grape supply industry, differentiation is a critical issue, and one that is important in distinguishing competitors. If a winery has a reputation for highly differentiated wines, given the relatively low price sensitivity of consumers, that winery will have a distinct competitive advantage over other wineries that do not have the same reputation. When the importance of differentiation is combined with measurement problems, the contracting poses special hazards, consistent with the standard moral hazard problem. In this sense, wineries producing

highly differentiated wines are exposed to serious risks of loss and damage if the quality of the grapes they use is not as it is expected. Consequently, such wineries will seek the maximum control of the process to minimize the chances of reputation losses. Since the third party use is associated with loss of control (Fernie, 1989), it is hypothesized that wineries producing differentiated wines are more likely to integrate their grapes. Coles and Hesterly (1998b) tested this theory using hospital services. Their findings support the proposition that hospitals will be more likely to integrate those services when there is a significant potential to impact quality and cause harm to a patient. The results of Coughlan and Flaherty (1983) and Coughlan (1985) have also found support for the proposition that differentiated products are more likely to be integrated. In recent years, Goodhue *et al.* (2003) obtain that more formal coordination is associated with higher product quality in the California winegrape industry. Accordingly, processors of higher-valued grapes are more likely to vertically integrate than processors of low-valued grapes are.

– *Hypothesis 6 ($H_6$): The more important the quality is in the input, the more it is likely that the governance structure will be of the "hierarchy" mechanism.*

## Research design

The above hypotheses were tested on survey data from the wine industry with an illustration of a specific case in Spain, the Qualified Appellation of Origin "DOC Rioja". This industry was chosen because it exhibits considerable variation in the nature of their assets, the perceived uncertainty of its environment, wineries size and wines quality, and usage of governance mechanisms. It was selected one industry, rather than several, to detect real differences in practice that might otherwise be confounded with industry-specific effects. This limits the generalizability of results, but does allow establish internal validity (Anderson, 1985).

### Relevance of quality assurance in DOC Rioja

DOC Rioja is wine produced in a region having appellation of origin status of high quality. This is the highest level of the Spanish quality system and it was introduced in 1991. Currently the only region belonging to this category is Rioja.

Besides the norms set and required for DOC wines, Rioja wines are also classified according to the quality of grapes and the aging time. Rioja wines, mainly identified with red wines, are classified into four categories: *Joven*, *Crianza*, *Reserva* and *Gran Reserva*. *Joven* wines are young wines usually aged for about one year in cask, or none at all, and they are not usually exported. Wines belonging to this category are generally produced with lower quality grapes and are intended for an immediate consumption. *Crianza* red wines are aged for at least two years of which one in cask. *Reserva* wines are usually produced with carefully selected grapes, and are aged for three years of which at least one in cask. *Gran Reserva* red wines are produced with exceptional grapes. It explains why they are so rare. Their minimum aging period is of at least five years of which at least two in cask. *Gran Reserva* red wines represent the best of Rioja wines.

Although DOC Rioja has consistently demonstrated very good quality wines over many years, acquiring high quality grapes is becoming an increasing concern among producers. It is due to the current competition, which has forced Rioja´s wine producers to search for higher levels of quality than the ones set as a minimum requirement by the designation of DOC.

The population from which the sample is drawn consists of wineries who fulfil the following requisites[1]: (1) to belong to the Designation of Origin Rioja (2) to be wine-making processors (3) to have the obligation to present accounting information in the public registry and (4) not to be cooperatives.

The survey was returned by 187 participants[2], the 88.2% of the population. In order to limit the influence of external shocks, the study period refers to the 3-year period 2002-2004. A comparison of responding wineries with the population of all general wineries using the chi-square test ($p=0.094$) showed no statistically significant differences between the sample and the population in regard to size using the European Commission´s classification of small and medium-sized firms. The largest number (68%) of wineries in the sample had less than 10 employees while 27% had between 10 and 49 employees and 5% had more than 50 employees.

[1] The population was drawn from the 2007 list provided by the Control Board of the Designation of Origin Rioja.

[2] All the questionnaire returned were usable responses because we followed up missing questionnaires.

## Variable operationalization

The constructs were operationalized with a mix of original and adapted scales relied on previous survey-based transaction cost studies (see appendix).

*Dependent variable: Governance mode choice*

The dependent variable (GOV MECH) was built according to Williamson´s classification where three generic types of governance structures have been distinguished: market, hybrid and hierarchy.

As it was explained in the theoretical framework, market governance is supported by classical contract law, in which the identity of the parties of the transaction is irrelevant and no dependency relations exist between them. Hard bargaining between parties characterizes these transactions, and their rules of governance are strictly applied. Neoclassical contract law, which applies to the hybrid forms, better facilitates continuity and adaptation than classical contract law. In this regime the parties to the transaction maintain autonomy but are bilaterally dependent in a nontrivial way. By contrast with a market contract, this contract foresees unanticipated disturbances, provides a "tolerance zone" within which misalignments are absorbed, requires information disclosure if adaptation is proposed, and provides for arbitration (prior to resorting to the courts) in the event of disagreement. The internal organization, hierarchy, is still a more elastic and adaptive mode of organization. Bilateral adaptation effected through fiat characterizes this structure. Rather than relying on the courts, which is denied, the parties must resolve their differences internally, being the hierarchy its own court of ultimate appeal. This implicit contract law of internal organization is known as contract law of forbearance.

The survey asked the respondent to indicate the percentage of each type of governance mechanism they used to provide their grape needs. Consistent with most previous literature studies (e.g., Lilien, 1979; Harrigan, 1986; John and Weitz, 1988; and Parmiagini, 2007), a 10% cutoff was used such as the dependent variable, named "Mechanisms of Governance", is built as follows:

- GOV_MECH=0 or "Market mode" if a winery buys at least 90% of its grape needs through the market governance.
- GOV_MECH=2 or "Hierarchical mode" if a winery has integrated vertically at least 90% of its grape needs.
- GOV_MECH=1 or "Hybrid mode" if a winery establishes a hybrid mode for at least 90% of its grape needs.

In short, the higher value of the dependent variable, the more the governance mechanism is located to the hierarchy pole.

It is not used a 99% cutoff because it involves several problems related to the respondents´ memory (Parmiagini, 2007). To establish the robustness of the results, it is also obtained a simulation exercise with the cutoff changed to 70% and 80%.

*Independent variables*

It is used items on seven-point scales anchored by "strongly disagree" and "strongly agree" to measure both transaction cost dimensions, specificity and uncertainty. This form of measuring presents the disadvantage of its subjectivity; it depends on a personal evaluation. However, subjective estimations of specificity and uncertainty have been frequently used in empirical studies, which is mainly due to absence of direct qualitative information (*e.g.*, Anderson and Schmittlein, 1984; Anderson and Coughlan, 1987; Anderson and Weitz, 1992).

—*Physical asset specificity*: This variable shows the degree to which the investments in the relationship cannot be redeployed to other relationships. Two complementary measures of asset specificity were developed. The first measure is grower's physical asset specificity (*GPAS*), which measures the level of idiosyncratic investments made by the grower. A second measure, winery's physical asset specificity (*WPAS*), asked about the investments made by the winery.

—*Dedicated asset specificity* (*DAS)*: Measured as the excess of capacity that a grower has to support if the grapes which were cultivated for the purpose of one particular winery are rejected by it.

—*Behavioral uncertainty (BU)*: This variable shows the degree to which it is difficult for the winery to know the real effort made by the grower in the grape production process in absence of monitoring.

—*Environmental uncertainty (EU)*: The scaling of this concept is based on one item that indicates respondents´ perception on the uncertainty existing in grape production. That is, the difficulty to predict the exact production of grape that will be obtained taking into account the numerous contingencies that may arise during the grape productive life cycle. As it was mentioned earlier, the effect of environmental uncertainty on governance mode choice is conditioned by the presence or

not of specificity. Following to Coles and Hesterly (1998a), this condition was operationalized by means of an interaction between a dummy variable (λ) and environmental uncertainty. This dummy variable takes a value of 1 if the value of all items of specificity is above 1 (the minimal value of the scale), and 0 for values of 1.

—*Size (SIZE)*: A number of variables have been used to measure firm size in the literature, including assets (Anderson, 1985), sales (Pisano, 1990; Leiblein and Miller, 2003) or logarithm of the capacity (Ohanian, 1994). In particular for wineries, there are two direct indicators of a winery´s size: the number of acres owned by the winery and the storage capacity of the winery (Benjamin and Podolny, 1999). It is used the logarithm of the second one because the variables based on assets owned by the winery are directly dependent upon the decision to integrate production activities (Leiblein and Miller, 2003).

—*Product quality*: Previous studies (*e.g.*, Coughlan and Flaherty, 1983; Coughlan, 1985; Anderson and Coughlan, 1987) have measured product differentiation with dummy variables coded 1 for highly differentiated goods and 0 for lowly differentiated goods.

In order to examine the impact of vertical differentiation on the integration decision it is adapted the measure of quality utilised by Coles and Hesterly (1998b). Rioja wines are divided into three categories according to the classification provided by the Board: *Joven, Crianza* and *Reserva*[3]. As there are three groups, they are coded with two dummy variables. On the one hand, *low added value* ($AV_{LOW}$), coded 1 if a winery produces at least 50% of the first group and zero otherwise. On the other hand, *high added value* ($AV_{HIGH}$) coded 1 if a winery produces at least 50% of the third group and zero otherwise.

### Descriptive analysis

A preliminary analysis[4] was conducted to determine the relationships between pairs of the independent variables. Table 2 displays Spearman's correlations[5] for each pair. Correlations ranged from -0.08 to 0.37, which indicates weak to moderate associations.

Next, Table 3 provides means of the independent variables for each category of the dependent variable, as well as the results of ANOVA tests evaluating significant differences across functional groups. As expected, the differences are statistically significant.

## Model estimation and results

To test the hypotheses, the distribution of the dependent variable, the governance mechanism choice, was analysed, resulting in a discrete variable with three outcomes: market, hybrid and hierarchy mode. Consistent with transaction cost theory, these outcomes are ranked by vertical coordination. When the dependent variable is inherently ordered, the most appropriate method for estimating this model is an ordered logit[6] (Borooah, 2001). This is the reason why an ordered logit was first

**Table 2.** Spearman´s correlations

| | GPAS | WPAS | DAS | BU | EU | SIZE | $AV_{LOW}$ | $AV_{HIGH}$ |
|---|---|---|---|---|---|---|---|---|
| GPAS | 1 | | | | | | | |
| WPAS | 0.246** | 1 | | | | | | |
| DAS | 0.103 | 0.322** | 1 | | | | | |
| BU | 0.262** | 0.134 | 0.236** | 1 | | | | |
| EU | 0.035 | 0.298** | 0.302** | 0.277** | 1 | | | |
| SIZE | -0.019 | -0.094 | -0.156* | -0.083 | -0.259** | 1 | | |
| $AV_{LOW}$ | -0.075 | -0.020 | -0.028 | -0.007 | 0.119 | -0.236** | 1 | |
| $AV_{HIGH}$ | 0.110 | 0.013 | -0.054 | 0.068 | -0.049 | 0.060 | -0.372** | 1 |

GPAS: grower´s physical asset specificity; WPAS: winery's physical asset specificity; DAS: Dedicated asset specificity; BU: behavioural uncertainty; EU: environmental uncertainty; SIZE: size; $AV_{LOW}$: low added value; $AV_{HIGH}$: high added value. * $p<0.05$, ** $p<0.01$

[3] *Gran Reserva* is included in this category.

[4] The empirical analysis was performed in SPSS and Stata 9.

[5] The Kolmogorov-Smirnov test determined that the variables aren't normally distributed. Consequently, we cannot use the Pearson´s correlations.

[6] A discrete dependent variable destroys the linearity assumption between the dependent and independent variables so that least squares method is clearly inappropriate (Amemiya, 1984).

**Table 3.** Means and standard deviation for independent variables, and ANOVA tests

| Variable | Entire sample (n=187) | Market (n=27) | Hybrid (n=92) | Hierarchy (n=68) | F Statistic | Significance |
|---|---|---|---|---|---|---|
| Upstream physical asset specificity [a] | 4.545 (1.847) | 3.370 (1.621) | 4.457 (1.667) | 5.132 (1.939) | 9.865 | 0.000 |
| Downstream physical asset specificity [a] | 4.813 (2.041) | 2.815 (2.001) | 4.902 (1.905) | 5.485 (1.732) | 20.172 | 0.000 |
| Dedicated asset specificity [a] | 3.904 (2.092) | 2.519 (1.762) | 3.598 (1.933) | 4.868 (2.001) | 16.464 | 0.000 |
| Environmental uncertainty [a] | 4.679 (1.794) | 3.185 (2.039) | 4.478 (1.551) | 5.544 (1.530) | 21.836 | 0.000 |
| Behavioural uncertainty [a] | 3.588 (1.833) | 3.259 (1.789) | 3.033 (1.572) | 4.471 (1.996) | 13.482 | 0.000 |
| Size Ln(capacity) | 14.132 (1.340) | 14.213 (1.095) | 14.606 (1.455) | 13.457 (0.935) | 16.881 | 0.000 |
| Low Added Value Dichotomous variable | 0.401 (0.491) | 0.556 (0.506) | 0.359 (0.482) | 0.397 (0.493) | 1.691 | 0.000 |
| High Added Value Dichotomous variable | 0.171 (0.378) | 0.074 (0.267) | 0.130 (0.339) | 0.265 (0.444) | 3.612 | 0.000 |

[a] 1, strongly disagreed - 7, strongly agreed

estimated. The ordered logit model is based on the assumption of parallel slopes, which requires the coefficients to be equal when comparing across equations based on ordinal outcomes (Long and Freese, 2006; Williams, 2006). There are two ways of testing this assumption: the approximate likelihood-ratio test of proportionality of odds across response categories and the Brant test (Brant, 1990). Both tests were used to test the validity of this assumption. The results[7] indicate that the ordered logit model is not appropriate because the parallel regression assumption of the ordered logit is violated. Then, more flexible parametric models for ordered dependent variables are searched, in which the multinomial logit model stands at one extreme in terms of high flexibility. The multinomial logit model builds in the assumption that the choice between any pair of alternatives is independent of the availability of other alternatives. There are three different tests to validate this assumption: the Hausman test, the suest-based Hausman test and the Small-Hsio test. These tests frequently arrive at different conclusions (Long and Freese, 2006). Table 4 shows that was the case when the data of this paper were tested. Therefore, the results of the independence of irrelevant alternatives (IIA) tests were inconclusive and hence, a model which does not require this assumption is needed.

Finally, a generalized ordered logit is estimated, which is less restrictive than an ordered logit and more parsimonious than a multinomial logit (Williams, 2006). Consequently, a slightly modified version of ordinal logit is modelled where a series of regressions are reported predicting differences at each level of the dependent variable, holding constant those variables that do not violate the parallel regression/proportional odds assumption across the regression models. By holding constant many of the independent variables in the model, the model can be run without violating the assumption. This is confirmed in the data of this paper: cutoff 90: $\chi^2(6)=6.51$, $p>0.05$; cutoff 80: $\chi^2(6)=5.39$, $p>0.05$; cutoff 70: $\chi^2(6)=4.05$, $p>0.05$.

Unlike traditional regression coefficients, the logit coefficients cannot be interpreted directly as estimates of the magnitude of the marginal effects of changes in the explanatory variables on the expected value of the dependent variable. Then, to interpret the sensitivity of the probability of observing a certain outcome (market, hybrid and hierarchy) with respect to explanatory variables, marginal effects are calculated, which are the question of interest.

[7] Validity of the parallel regression assumption. Approximate likelihood–ratio test of proportionality of odds across categories: $X^2(8)=38.37$ Prob> $X^2 = 0.000$. Brant Test of Parallel Regression Assumption: $X^2(8)=29.72$ Prob> $X^2 = 0.000$

**Table 4.** Tests of independence of irrelevant alternatives (IIA) assumption. $H_0$: Odds (Outcome-J *vs* Outcome-K) are independent of other alternatives

| Omitted category | Hausman | | Suest-based Hausman | | Small-Hsiao | |
|---|---|---|---|---|---|---|
| | $X^2(9)$ | $P> X^2$ | $X^2(9)$ | $P> X^2$ | $X^2(9)$ | $P> X^2$ |
| 0 | 3.267 | 0.953 | 5.729 | 0.767 | 3.030 | 0.963 |
| 1 | 20.700 | 0.014 | 6.359 | 0.704 | 20.639 | 0.014 |
| 2 | -0.569 | --- | 7.826 | 0.552 | 18.950 | 0.026 |

Note: If $X^2<0$, the estimated model does not meet asymptotic assumptions of the test.

The marginal effects of the generalized ordered logit used to test the hypotheses are presented in Table 5. As it was mentioned earlier, a model for each cutoff (90, 80 and 70) of the dependent variable was estimated for maximum likelihood. Given that the statistical significance of coefficients is quite similar in all cut-offs (an exception is the variable winery's physical asset specificity), evidence of robustness of the results is obtained.

The first hypothesis is expressed by the coefficients of winery's and grower's physical asset specificity. These should be positive, indicating that the employment of physical specific assets positively influences vertical integration. The coefficients of grower´s physical asset specificity provide support for this hypothesis. Table 5 shows that as grower's physical asset specificity increases, the probability of choosing vertical integration increases, while the probability of the hybrid mode decreases as does the probability of the market mode. The coefficients for winery's physical asset specificity fail, however, to support strongly hypothesis 1. They are not stable for all cut offs, so results with this variable must be carefully interpreted. In general, this variable is not statistically significant or its significance is not important, which is consistent with the fact that a winery's profitability is increasingly not limited to winemaking. Indeed, many regional winemakers diversify their winery activities in order to develop additional income streams through a commitment to wine tourism (Lumbreras, 2004).

Hypothesis 2 argued that greater value of dedicated asset specificity would correspond to a higher probability of vertical integration. With respect to this variable, its effects are the same in direction and significance than grower´s physical asset specificity; Thus, these results support hypothesis 2.

In accordance with hypothesis 3, the probability of vertical integration is reinforced as behavioural uncertainty increases. Conversely, the coefficients on hybrid mode are negative and highly significant. With regards the market mode, this variable has not a significant influence on it. Consistent with transaction cost theory, Hypothesis 4 predicted that environmental uncertainty, in presence of asset specificity, would increase exchange hazards and therefore increase the likelihood that wineries would integrate their grape production activity. The interaction effect between specificity and environmental uncertainty ($\lambda EU$)[8] used to test the hypothesis 4 appears with the expected positive sign and was statistically significant for vertical integration mode. However, it displays negative and significant effects on hybrid and market mode, indicating support for hypothesis 4.

With respect to size, increases in this variable do not affect the market mode, but they result in more hybrid mode and less vertical integration. Thus, hypothesis 5, which argues that firms having greater size are less likely to internalize their input needs due to diseconomies of scale, is supported. It is known that a key aspect of improving wine quality is control of the entire production process from vineyard planting to the finished product. When a winery needs large quantities of grapes, their supplying vineyards cannot all be near the winery. Hence, in large wineries with integrated production of grapes, managers need to spend a lot of time visiting their vineyards. It could explain the negative association between size and vertical integration.

Finally, the estimated results provide partial support for the added value hypothesis (H6) as determinant of governance mode choice. For discrete change[9] of the variable $AV_{HIGH}$ from 0 to 1 the probability of choosing

[8] We also performed these analyses for the case where the dummy variable $\lambda$=1 for all values of the overall level of asset specificity above 2, and 0 otherwise. The results of the generalized ordered logit analyses were not substantially changed by altering the interaction variable in this manner.

[9] In order to evaluate the marginal effects of dummy variables, they should be analyzed by comparing the probabilities that result when the dummy variable takes one value with the probabilities that are the consequence of it taking the other value, the values of other variables remaining unchanged between the two comparisons (Borooah, 2001).

**Table 5.** Marginal effects for generalized ordered logit models

| Parameter[a] | Vertical integration | | | Hybrid | | | Market | | |
|---|---|---|---|---|---|---|---|---|---|
| | **90** | **80** | **70** | **90** | **80** | **70** | **90** | **80** | **70** |
| GPAS ($H_1$) | 0.061** | 0.094** | 0.078** | -0.040** | -0.072** | -0.044* | -0.020** | -0.022** | -0.035** |
| WPAS ($H_1$) | 0.040* | 0.012 | 0.039 | -0.027* | 0.007 | -0.021 | -0.013* | -0.019** | -0.017 |
| DAS ($H_2$) | 0.063** | 0.074** | 0.064** | -0.042** | -0.057** | -0.036* | -0.021** | -0.018** | -0.028** |
| BU ($H_3$) | 0.051* | 0.088** | 0.095** | -0.066** | -0.102** | -0.089** | 0.016 | 0.015 | -0.006 |
| λEU ($H_4$) | 0.076** | 0.137** | 0.148** | -0.051** | -0.104** | -0.082** | -0.025** | -0.033** | -0.066** |
| SIZE ($H_5$) | -0.159** | -0.210** | -0.177** | 0.154** | 0.210** | 0.160** | 0.005 | -0.000 | 0.017 |
| $AV_{LOW}$ ($H_6$) | -0.066 | -0.116 | -0.174 | 0.042 | 0.086 | 0.091 | 0.023 | 0.030 | 0.083 |
| $AV_{HIGH}$ ($H_6$) | 0.382** | 0.498** | 0.350** | -0.312** | -0.424** | -0.233** | -0.070** | -0.074** | -0.117** |
| | | | ***Cutoff 90*** | | ***Cutoff 80*** | | | ***Cutoff 70*** | |
| Chi-square statistic | | | 0.000 | | 0.000 | | | 0.000 | |
| McFadden´s Adj $R^2$ | | | 0.345 | | 0.401 | | | 0.350 | |
| Predicted capacity | | | 74.33% | | 73.26% | | | 72.19% | |

[a] See Table 2. * $p<0.05$, ** $p<0.01$

hierarchical mode increases while the probability of choosing hybrid and market mode decreases. It implies that highly differentiated wines are more likely to be integrated, in the direction hypothesis 6 predicts. However, marginal effects of the variable $AV_{LOW}$ have the expected sign, but they are not significant, indicating lack of support for hypothesis 6.

The overall goodness of fit for the models was good. The chi-square statistic in each model allows to reject the null hypothesis that all of the estimated coefficients are jointly zero. Likewise, these models have reasonably good explanatory power, as shown by their pseudo $R^2$ values[10] over 0.35 and 0.40. Moreover, the models appear to have good prediction power (the percentages of observations correctly classified are over 72%).

## Conclusions and implications

Food and agribusiness firms have increasingly to deal with competitive markets in which food quality has become a decisive aspect for competitiveness. In this context, this paper has established the nature of the relationship between product quality and transaction costs with vertical coordination in DOC Rioja winegrape industry. Consistent with TCE, it is found that vertical integration can be an efficient means of protecting relationship-specific investments or mitigating other potential conflicts under incomplete contracting in viticulture. In particular, evidence is found that asset specificity and uncertainty are important determinants of vertical integration. Likewise, the results reinforce the importance of the interaction effect between specificity and environmental uncertainty on vertical integration. As predicted by the model of this paper, the size of the winery is a factor that should be taken in account in this area of study. Further, this analysis of the choice among market, hybrid and vertical integration suggests that more vertical coordination is associated with higher product quality.

The results in this paper fail, however, the Williamson´s assumption of a make-or-buy continuum described as "discrete market exchange at the one extreme to centralized hierarchical organization at the other, with myriad of mixed or intermediate modes filling the range in between" (Williamson, 1985, p.16). Consequently, the governance mode choice does not appear to be a simple weighted average along a market/hierarchy continuum.

There are a number of important limitations to this particular study that suggest the need for further empirical work. The fit of the model, though good for basic

[10] Values of 0.2 to 0.4 for the McFadden $R^2$ measure represent an excellent fit (McFadden, 1997).

research, may be improved not only be developing better measures (*e.g.*, using multi-item measures), but also by including variables no covered here, such as the existing regulation.

In spite of these limitations, this paper may have interesting managerial implications which are worth mentioning here. Given that this analysis characterizes the quality-coordination relationship and the determinants of governance mode choice, it is believed that the findings of this paper will be of interest to those industries with a variety of governance modes, and with a significant concern for quality.

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## APPENDIX: SURVEY ITEMS

**Dependent variable**

1. For the three-year period 2002-2004, what % of your grape requirements do you …

| | |
|---|---|
| Produce internally | % |
| Acquire through a hybrid mechanism* | % |
| Acquire at the spot market | % |

*Hybrid mechanism: In this regime the parties to the transaction maintain autonomy but are bilaterally dependent in a nontrivial way (e.g., short-term contracts, long-term contracts…).

**Independent variables**

**a) Transaction cost items**

Each item included a response scale of 1 to 7, indicating totally disagreed to totally agreed.

*Grower´s physical asset specificity*

1. Indicate the degree to which the investments in viticulture realized by the grower (vineyard, machinery…) cannot be redeployed to other activities.

*Winery´s physical asset specificity*

2. Indicate the degree to which the investments realized in the winery to elaborate wine cannot be redeployed to other activities.

*Dedicated asset specificity*

3. If the transaction terminated prematurely, indicate the degree to which the assets which were assigned for the purpose of that transaction would result in significant excess capacity.

*Behavioural uncertainty*

4. Indicates the degree of difficulty to evaluate grower´s effort in growing grape if there no exist supervision.

*Environmental uncertainty*

5. Indicate your perception of environmental volatility, that is, the difficulty to predict the exact production of grape that will be obtained taking into account the numerous contingencies that may arise during the grape productive life cycle.

**b) Size item**

6. Indicate the storage capacity of your winery in litres

**c) Quality item**

7. According to the classification of the Board, indicates what % of your wines are…

| | | | |
|---|---|---|---|
| Joven | % | Crianza | % |
| Reserva | % | Gran Reserva | % |