Contractual arrangements and food quality certifications in the Mexican avocado industry

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Abstract

The adoption of private quality certifications in agrifood supply chains often requires specific investments by producers which can be safeguarded by choosing specific contractual arrangements. Based on a survey data from avocado producers in Mexico, this paper aims to analyze the impact of transaction costs and relationship characteristics of the joint choice of contractual arrangements and quality certifications. Using a bivariate probit model, it shows that a producer's decision to adopt private quality certifications is directly linked to high levels of asset specificity and price. In order to ensure the high level of specificity under the presence of low levels of price uncertainty, producers have relied on relational governance supported by the expectation of continuity in their bilateral relationships with buyers.

Additional key words: bivariate probit; *Persea americana* Mill.; relationship characteristics; transaction costs.

Introduction

The introduction of quality certifications is an important part of the restructuring process taking place in the agrifood sectors of transition and developing countries (Reardon & Barrett, 2000). Introducing quality certifications in the agrifood value chain can be beneficial both for producers, who gain access to higher value western markets and thereby increase their income, and for buyers, who gain access to a larger quantity of products with consistent quality (Trienekens & Zuurbier, 2008).

Adoption of private quality certifications has been cited as a motivation for the use of contractual arrangements rather than simple market arrangements (spot market transactions). This is due to the fact that private quality certifications are associated with both higher asset specificity and higher transaction costs, which result from monitoring and certification (Raynaud *et al.*, 2005). Emphasizing the relationship between quality and vertical coordination, Goodhue *et al.* (2003) have

shown how quality issues that have relied on formal written contractual arrangements have been important in explaining the vertical relationship between buyers and suppliers in the winegrape industry. Despite some valuable publications that have focused on written contractual arrangements, and hence have enhanced the understanding of vertical relationships (Goodhue *et al.*, 2003; Fernández-Olmos *et al.*, 2009), the relationship of transaction costs with the type of quality certification and type of contractual arrangement has received only limited attention.

Mesquita & Brush (2008) have explained that written contractual arrangements present limitations because they are incomplete. The reason is that contracting parties will find it difficult and expensive not only to foresee all the possible contingencies, but also to enforce these types of arrangements, especially when outcomes are unobservable or non-verifiable by a third party (Hart, 1995). Therefore, because formal contracts are incomplete, both parties expose themselves to *ex post* costs

This work has three Supplementary Tables that do not appear in the printed article but that accompany the paper online.

Abbreviations used: *Arrangement^R* (relational arrangement); *Arrangement^S* (simple market arrangement); *Asset_sp* (asset specificity); *BU_damage* (uncertainty whether buyer will damage the orchard); *BU_payment* (uncertainty whether buyer will stick to the payment arrangement); *Buyer commitment* (buyer commitment); *continuity* (expectation of continuity); *EU_demand* (demand uncertainty); *EU_price* (price uncertainty); *EU_volume* (volume uncertainty); *information* (information exchange); *JLSV* (Local Plant Health Board).

related to performance and enforcement. As a feasible alternative to reduce the *ex post* costs, relational contractual arrangements based on social and economic relationships are used (McMillan & Woodruff, 1999). Relational contractual arrangements reflect the norms (provisions and incentives) established by a repeated interaction between parties or within society (Guo & Jolly, 2008), and therefore, counterweigh opportunism (Demsetz, 1993).

Increasing adoption of quality certifications has been observed in the Mexican avocado (*Persea americana* Mill.) industry where the possibility to export to the US market has provided an incentive to enhance product quality. Up until 1997, private quality certifications were only adopted by a select group of export producers (Stanford, 1998). Since then, an increasing number of producers have been adopting public quality standards, and a smaller number of producers have been adopting private quality certifications (Sánchez, 2007).

The objective of this paper is to analyze the impact of transaction costs[1] and relationship characteristics on the joint choice of contractual arrangements and quality certifications in the agrifood supply chains. Two decisions are modeled using a bivariate probit model. First, the type of arrangement will be explained by the transaction costs, relationship characteristics, and producer characteristics. Second, adoption of a particular quality certification is modeled by transaction costs, external and internal incentives, and producer characteristics. A survey among avocado producers in the State of Michoacan is constructed to obtain detailed information on contractual arrangements and quality certifications.

Conceptual framework

Transaction costs are the costs of undertaking an exchange between buyer and supplier, and encompass all aspects of the contractual relationship (Hobbs, 1996). Rindfleisch & Heide (1997) identified three sources of transaction costs: safeguarding specific asset, adaptation of the transaction to changing conditions (environmental uncertainty), and performance evaluation (behavioral uncertainty). Williamson (1985) argues that uncertainty is only problematic in the presence of specific assets. Thus, when transaction costs are present and asset specificity is absent or low, economic actors will favor market governance. However, if specific in-

vestments are high, firms will favor internal organization (Geyskens *et al.*, 2006). Between the extremes of market and internal organization, the hybrid can be found as a third category of governance structures (Williamson, 1991; Ménard, 2004). The hybrid may achieve the benefits of internal organization without complete vertical integration, thus avoiding the burdens of bureaucracy to which internal organization is subject (Williamson, 2008).

Defining both market governance and relational governance and how they are related to the contractual arrangements, Williamson (1991) explains that market governance is one structure in which individual buyers and sellers bear no dependency relation to one another. Instead, each party can go its own way at a negligible cost to the other. Under this form of governance, simple market arrangements are more efficient for transactions where the terms of the exchange can be relatively easily defined (Raynaud *et al.*, 2005), asset specificity is low (Williamson, 1985), and transactors can be substituted at a very low cost (Ménard, 2002). On the contrary, when individual actions have potential negative side effects, are less observable, and are coupled with high asset specificity, the relative efficiency of market arrangements is reduced.

Relational governance is based on the proposition that relational characteristics moderate the relationship between asset specificity and negotiation costs (Artz & Brush, 2000). This type of governance is better supported by relational arrangements that do not attempt to define the complete set of terms and conditions for the entire frame of arrangement *ex ante*; rather, the presence of characteristics such as expectation of continuity and commitment moderates the costs for periodic renegotiations (Geyskens *et al.*, 2006) to adjust price, quantity, and payment conditions during the life of the arrangement (Ménard, 2002).

Transaction costs, governance structure, relationship characteristics and quality certifications

Transaction costs

As food safety and quality assurance affect the cost of carrying out transactions, private companies have an incentive to adopt voluntary quality assurance systems

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[1] Transaction costs are operationalized by transaction characteristics associated to asset specificity, environmental uncertainty and behavioural uncertainty. The transaction characteristics are defined in Section "Data preparation".

(Holleran *et al.*, 1999). Transaction costs are directly affected and may often be increased by food safety regulations, product liability law, and customer requirements. Quality certifications can mitigate the transaction costs depending on their attributes (*e.g.*, asset specificity, behavioral uncertainty, and environmental uncertainty).

Perishable products such as fresh fruits and vegetables are subject to climatic uncertainty, which influences both the quality and the quantity of products available. To reduce high perishability constraints and achieve homogeneity of product quality, producers invest in fine-tuning the production process to meet the quality certification determined by the buyers (Raynaud *et al.*, 2005). The solution is adoption of quality certifications that consider aspects such as specification of products and/or related production processes, environmental concerns, human rights, and social and ethical values. Furthermore, investments in specific knowledge and physical assets are required. Based on this solution, the hold-up problem is present because adoption of a particular (private) quality certification reduces the number of potential buyers who require a specific product for a specific market (Holmes *et al.*, 2006), which could cause quasi-rent expropriation and mal-adaptation hazards.

To mitigate the contractual hazards, a particular governance structure can be adopted. Noorderhaven (1994) and Geyskens *et al.* (2006) have found that high asset specificity leads to a preference for relational governance over market governance. Reducing contractual hazards engaging in collaborative exchanges (*i.e.*, relational governance) is a viable alternative to hierarchy. Relational governance modes are sustained by relationship characteristics such as expectation of continuity, commitment, and information exchange (Lusch & Brown, 1996). The following hypothesis is proposed:

Hypothesis 1: *As asset specificity increases, relational governance becomes preferred over market governance*

The problem of behavioral uncertainty is related to performance evaluation, and two different problems are identified: monitoring costs and enforcement costs (Leiblein, 2003). Monitoring costs refer to the costs associated with monitoring whether or not the partner is complying with the agreement (Dyer, 1997). Enforcement and verification costs refer to the costs associated with *ex post* bargaining and with sanctioning a trading partner who does not perform according to the contract. Williamson (1991) has argued that relational governance addresses behavioral uncertainty less effectively than does market governance when asset specificity is absent. This leads to the following hypothesis:

Hypothesis 2: *As behavioral uncertainty increases, market governance becomes preferred over relational governance*

Environmental uncertainty refers to unanticipated changes in circumstances surrounding an exchange that influences coordination costs (Noordewier *et al.*, 1990) and negotiation costs (Hobbs, 1997). Environmental uncertainty has been measured in terms of demand uncertainty, volume uncertainty, and price uncertainty. Demand uncertainty is the supplier's inability to predict variations in the quantity and timing of demand. Without this information, the supplier will be hesitant to invest in production capacity for fear that s/he will be stuck with costly excess if the projected sales do not materialize (Anderson, 1985). Volume uncertainty is defined as uncertainty in production or distribution of the product (Noordewier *et al.*, 1990), and this uncertainty can occur as result of quality and production process problems, unreliable lead-time, and inflexibility (Davis, 1993). Suppliers cannot access accurate information on the quality attributes of the product and buyers must deal with heterogeneous inputs of variable qualities while at the same time, being able to deliver a uniform and stable final product to consumer markets (Raynaud *et al.*, 2005). Price uncertainty occurs when producers and buyers cannot access accurate information about the quality attributes of the product; thus, rather than reflecting the opportunity costs of production, the final price may simply reflect the relative strength of bargaining (Fafchamps *et al.*, 2008; Kyeyamwa *et al.*, 2008).

Williamson (1985) has argued that in the case of environmental uncertainty and absent asset specificity, market governance is preferred because of its low cost and strong performance incentives. The following hypothesis is proposed:

Hypothesis 3: *As environmental uncertainty increases, market governance becomes preferred over relational governance*

Relationship characteristics

Under relational governance, different characteristics of the supplier-buyer relationship are identified to

mitigate exchange hazards. Lusch & Brown (1996), having distinguished between relational and market governance, concluded that a significant and positive relation exists between relational governance and each of the variables: expectation of continuity, information exchange, and buyer commitment. Gulati *et al.* (2005) and Geyskens *et al.* (2006) have explained that the expectation of continuity has an important role in aligning interests in relational governance, and therefore, in safeguarding the level of transaction-specific investments incurred by the supplier with the main buyer. Noordewier *et al.* (1990) have indicated that information provided to suppliers clearly contributes to buyer adaptability, and Dyer (1996; 1997) has added that information is shared only when parties are under relational governance. Therefore, the following hypotheses are proposed:

Hypothesis 4: *A high level of expectation of continuity is more prevalent under relational governance than under market governance*

Hypothesis 5: *A high level of buyer commitment is more prevalent under relational governance than under market governance*

Hypothesis 6: *A high level of information exchange is more prevalent under relational governance than under market governance*

Quality certifications and governance structure

Raynaud *et al.* (2005) define a quality standard as a list of product specifications that translates into constraints in the production/transformation process and on the final quality. While suppliers may need to invest or finely design their production process in order to meet the quality certification, these requirements entail increasing specific assets (Raynaud *et al.*, 2005). Distinguishing between public and private quality certifications, Raynaud *et al.* (2005) have mentioned that public and private quality certifications rest on different enforcement mechanisms, and therefore, are associated to different governance structures. Public quality standards are market oriented because of lower levels of asset specificity and lower costs of monitoring, in-

formation, and negotiation than with private quality certifications (Ménard & Valceschini, 2005; Raynaud *et al.*, 2005). Particularly, Raynaud *et al.* (2005) have identified that suppliers need to invest or re-design their production process in order to meet private quality certifications, thus, increasing the physical specificity of the assets invested. This condition gives rise to relational governance, reducing observability and traceability problems (Foss, 1996), so as to have more ability to exercise decision control (Heide, 1994), as well as to safeguard the asset specificity (Williamson, 1991).

The following hypothesis is proposed:

Hypothesis 7: *Relational governance is positively related to the adoption of private quality certifications*

Material and methods

Research design

Relevance of the avocado industry in Mexico

Mexico is the world leader in production, consumption, and export of fresh avocados (Sánchez, 2007). The Mexican avocado industry has undergone numerous changes in configuration since the non-tariff barriers prohibiting Mexican fresh avocado exports to the US market were eliminated[2] and phytosanitary regulations were introduced (Ortiz, 2007; Sánchez, 2007: 67). In 2008, Mexican avocado producers exported 30% of their domestic avocado production, with the main export market being the USA (importing more than half of Mexican avocado exports).

Michoacan is the main avocado region in Mexico, annually generating a harvested product value of more than US$ 700 million, and providing 42,000 permanent and 31,000 temporal jobs (Ramos, 2007). In terms of production, Michoacan produces more than 800,000 tons annually, on more than 75,800 ha, by approximately 11,700 avocado producers (Sánchez, 2007). Seventy-two percent of the cultivated area and 66% of all avocado producers are found in five municipalities: Nuevo Parangaricutiro, Periban, Tancitaro, Uruapan, and Ziracuaretiro. Producers in the aforementioned places have between 5.2 and 10 ha of land, and yield 10 tons ha^{-1}.

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[2] On February 5, 1997, the ban on Mexican avocado imports into the USA was lifted. To allow exports of Mexican avocado into the USA, the USDA requires verification of compliance for phytosanitary conditions, which is inspected by the Animal and Plant Health Inspection Services (APHIS). In addition, Mexican producers must follow a continual program of pest control (Sánchez, 2007: 49).

The packer is the most important buyer for international market destinations. The packers sector is more concentrated than the producer sector, as it consists of approximately 382 packaging houses located in Michoacan. Only 60 of these firms export avocados and only 26 of them export to the USA (Sánchez, 2007). The 26 large packaging houses are characterized by advanced technology and the use of quality systems (*i.e.*, good manufacturing practices). Each large firm sells more than 8,000 tons of avocados per year, and is supplied by, on average, 50 producers. In total, these packaging houses process about one fourth of the Mexican avocado production.

Avocado activity, quality certifications and contractual arrangements

In Mexico, avocado is a commercially valuable fruit and is cultivated as a single crop. Mexican authorities implement strict phytosanitary regulations so that the Mexican avocado may be exported to different US markets. In addition, these regulations establish the legal base for a system of regional phytosanitary control, requiring every avocado producer to enter the state pest control program and obtain certification for his orchards if the intention is to market his fruit at regional packinghouses (Dorantes *et al.*, 2004).

Mexican avocado producers have adopted public and private quality certifications (Sánchez, 2007). Public quality certification, that is also named Public quality standard, is mandatory by the Mexican phytosanitary legislation (066-FITO-2002) for avocado producers selling product to packaging houses. The Public quality standard entails a number of phytosanitary requirements[3] and producers entering a state phytosanitary program are required to comply with technical recommendations at least one year prior to export in order to receive the certification. Although the public quality standards require a relatively complex implementation, technical assistance, monitoring, and certification activities are carried out by personnel of the Local Plant Health Boards (JLSVs), a public-private partnership of local producers and federal authorities (SAGARPA). Costs for technical assistance and monitoring are supported by the state through the JLSVs, whereas costs for certification are paid by the producer.

Private quality certification is voluntary, and it is an additional step to Public quality standard. Thus, producers must comply with private quality certifications if they wish to enter or remain within markets which demand regulations such as US and European certifications on food safety and good agricultural practices (US-GAP and Global-GAP), along with organic produce certification. Private quality certifications are more complex than public quality standards[4]. Producers not only face high costs, but are also required to have constant interaction with the packer to resolve technical issues. The packing house puts great effort in providing technical advice to its partner-suppliers to keep them in compliance with current and future quality requirements for both the product and the process.

Producers are subject to the harvesting and payment conditions that are determined by the packer. In contrast to other agrifood products, harvesting in the Mexican avocado industry is done by the packer, which has caused both advantages and disadvantages for the producer. While the packer, who directly gathers the fruit, has reduced problems with quality of the product, producers have cited damage to the avocado trees that is caused by incorrect harvesting practices (Sánchez, 2007). Payment is another concern for avocado producers. The producer and the packer frequently establish the payment conditions (*i.e.*, price, ripeness and amount, payment date) one day before harvesting. Based on these conditions, payment is done on-site or during the following two weeks after harvesting. Therefore, producers may face non-fulfillment or deferment of payment, or non-fulfillment of the agreed price.

Producers use two types of arrangements; simple contractual arrangements and verbal contractual arrangements (Stanford, 1998; Sánchez, 2007). Non-legal terms are established to make the transactions for both.

Simple contractual arrangements or spot market transactions are efficiently used by producers who have

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[3] The product must come from certified orchards; the packing houses must have a registration; and each avocado shipment must carry a document stating that it originates from a registered orchard or packing house (Dorantes *et al.*, 2004)

[4] Producers must first purchase certification services, then incur compliance costs and undergo regular and repeated testing and certification. In total, the producer must implement eleven practices related to soil and substrata management; fertilizer use; irrigation system; crop protection; harvesting; produce handling; waste and pollution management; worker health, safety and welfare; environmental issues; and complaint form. In addition, information from the packer such as size, weight, ripeness, and color must be registered (Dorantes *et al*., 2004).

adopted public quality standards, and in which amount, price and date are specified. Approximately 5,250 producers commercialize their products under this type of arrangement (Ramos, 2007). Thus, when producers or buyers do not comply with agreed product quality or purchasing conditions and harvesting activity has not been met, both parties can easily find another trading partner. However, even with the transaction being made, there is not guarantee that the packer will fulfill his payment obligations; hence there is constant uncertainty for the producer. In this context, producers have mentioned that a written arrangement does not offer assurance payment because of the time, cost, and effort that is needed to enforce the legal terms of the arrangement.

Verbal arrangements based on commitment of technical assistance, input, credit, or expectation of continuity about future benefits have been used by producers who have adopted private quality certifications as a means to influence the fulfillment of the arrangement. Under private quality certifications, the non-complaint buyers would reduce their supplying sources because the availability of alternative producers would decrease, and thereby affect their contracts with customers further down the supply chain.

Survey

The information required for testing the hypotheses was collected through a survey of 122 Mexican avocado producers. To estimate the sample size, the following parameters were used; the level of precision is 5%, the level of confidence is 90%, and the estimated proportion regarding the type of quality certification adopted is 0.10. As result, the sample size was 130. However, eight questionnaires presented inconsistencies, and therefore, 122 questionnaires were finally used. The avocado producers were randomly selected based on multistage cluster sampling from the most important avocado municipalities in the State of Michoacan: Uruapan, Nuevo Parangaricutiro, Periban, Tancitaro, and Ziracuaretiro. Unlike the final four municipalities, avocado producers located in Uruapan present condi-

tions that facilitate avocado commercialization. Based on these five municipalities, two sources were used to select the producers. The first source comes from JLSVs. In each municipality, the boards have a record of producer characteristics such as name, property size, and fulfillment of phytosanitary norms (*e.g.*, non-registered, registered, certified producer[5]). Thus, from 11,727 producers included in the source, producers that have been certified and are located in one of the five municipalities listed were selected. As a result, 3,851 producers fulfilled with the previous two characteristics. The second source comes from the avocado producers association that also registers every member per municipality. In this latter source, we can find avocado producer characteristics such as the private quality certification adopted (*i.e.*, US-GAP, Global-GAP or Organic certification), name, and property size. In this case, 385 producers adopting private quality certifications are located in the five previously mentioned municipalities (Sánchez, 2007). A list was made including the final number of producers from the two sources. Later, producers were randomly selected by municipality[6]. By mean of JLSVs, avocado producers were contacted and personalized interviews were requested. From these 122 avocado producers, 94 are phytosanitary standard adopter producers and 28 private quality certification adopter producers (see Table 1).

The survey was conducted from February to April 2008 by trained enumerators that were supervised by the first author, using a structured questionnaire. The questionnaire covered specific information on producer characteristics, adoption of quality certifications, type of arrangement, transaction characteristics, relationship characteristics, and external and internal incentives.

Estimation procedure

To test the hypotheses, a bivariate probit model was used. Previous studies about contractual arrangements (Fernández-Olmos *et al.*, 2009) and quality certifications (Goodhue *et al.*, 2003) have used univariate models. However, Raynaud *et al.* (2005) have explained that

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[5] According to Phytosanitary Program, Local Plant Health Boards classify the avocado producers in three categories, non-registered, registered, and certified producers. Non-registered producers don't apply any phytosanitary requirement and they cannot sell their product to the packaging houses. Registered producers are included in the Phytosanitary Program list, and they apply pest control practices in their orchard during one year or more. Certified producers are included in the Phytosanitary Program list, and because they have fulfilled with phytosanitary requirements, by one year or more, their orchard are certified as "pest free". In this case, the producers can sell their product to any packaging house.
[6] Producers for municipality are: 64 in Uruapan, 28 in Nuevo Parangaricutiro, 12 in Periban, 10 in Tancitaro, and 10 in Ziracuaretiro.

Table 1. Summary of variables

Independent variable	Type of variable	Type of quality standard					
		Public standard		Private standard		Total	
		M	SD	M	SD	M	SD
Observations		94		28		122	
Asset_sp	Ordinal	4.14	1.79	5.75	1.74	4.51	1.90
BU_payment	Ordinal	2.97	1.99	3.18	2.52	3.02	2.12
BU_damage	Ordinal	3.27	2.26	3.75	2.27	3.38	2.26
EU_price	Ordinal	5.01	2.04	5.11	1.97	5.03	2.02
EU_demand	Ordinal	2.86	1.70	13.18	1.83	2.93	1.72
EU_volume	Ordinal	4.15	1.73	4.46	1.88	4.22	1.76
Gender (female = 1, male = 0)	Nominal	0.19	0.40	0.07	0.26	0.16	0.37
Education (primary school = 1, higher education = 0)	Nominal	0.59	0.50	0.18	0.39	0.49	0.50
Experience (producer experience in years)	Interval	20.57	12.18	19.29	10.89	20.28	11.86
Family size (members)	Interval	5.06	2.59	5.61	2.23	5.19	2.52
Association member (yes = 1, not = 0)	Nominal	0.38	0.49	0.57	0.50	0.50	0.43
Channel (export = 1, otherwise = 0)	Nominal	0.40	0.49	0.54	0.51	0.43	0.50
Location (location of property, Uruapan = 1, otherwise = 0)	Nominal	0.62	0.49	0.21	0.42	0.52	0.50
Packer (certified packer = 1, otherwise = 0)	Nominal	0.61	0.49	0.86	0.36	0.66	0.47
Price (average price in pesos kg^{-1})	Interval	10.81	3.46	13.48	3.6	11.42	3.64
Sales (thousand pesos year^{-1})	Interval	1,206	3,329	2,604	2,407	1,527	3,187
Yield (tons ha^{-1})	Interval	8.56	3.68	11.07	4.16	9.14	3.93

Independent variable	Type of variable	Type of arrangement					
		Simple arrangement		Relational arrangement		Total	
		M	SD	M	SD	M	SD
Observations		30		92		122	
Asset_sp	Ordinal	3.42	1.76	4.87	1.81	4.51	1.90
BU_payment	Ordinal	3.27	1.95	2.93	2.17	3.02	2.12
BU_damage	Ordinal	2.87	2.10	3.54	2.30	3.38	2.26
EU_price	Ordinal	6.13	1.17	4.67	2.11	5.03	2.02
EU_demand	Ordinal	2.00	1.11	3.24	1.78	2.93	1.72
EU_volume	Ordinal	4.00	1.91	4.29	1.71	4.22	1.76
Information	Ordinal	1.53	1.58	2.81	2.21	2.50	2.14
Buyer_commitment	Ordinal	1.31	1.29	1.88	1.82	1.74	1.72
Continuity	Ordinal	0.94	1.00	1.62	1.54	1.45	1.45
Gender (female = 1, male = 0)	Nominal	0.23	0.43	0.14	0.35	0.16	0.37
Education (primary school = 1, higher education = 0)	Nominal	0.60	0.50	0.46	0.50	0.49	0.50
Experience (producer experience in years)	Interval	21.93	12.07	19.74	11.81	20.28	11.86
Family size (members)	Interval	5.93	2.80	4.95	2.38	5.19	2.52

M: mean. SD: standard deviation. *Source:* Author's survey.

the decision to adopt a specific quality certification was based on an aligned decision with a particular type of governance choice. Based on the bivariate probit model, it is analyzed whether transaction costs and relationship characteristics, as independent variables, were related to the type of contractual arrangement, and whether transaction costs and external and internal incentives were related to the type of quality certifica-

tion adopted. Studies about agrifood quality certifications refer to transaction costs (Holleran *et al.*, 1999) and external and internal incentives (Holleran *et al.*, 1999; Fouayzi *et al.*, 2006) as explanatory variables for deciding on a specific type of quality certification.

Because transaction costs and relationship characteristics are not readily measurable (Hobbs, 1996), previous studies used proxy dimensional constructs, as variables, integrating several items (Noordewier *et al.*, 1990; Heide & John, 1992; Dahlstrom *et al.*, 1996; Lusch & Brown, 1996). Therefore, Factor Analysis is used to evaluate the significance of each construct in terms of individual item reliability, internal consistency, and discriminant validity [see a more detailed explanation on Suppl. Table 1 (pdf)]. In case of no-significance, items regarding their construct are separately included as independent variables in the bivariate probit model. The rest of the independent variables, external and internal incentives, and producer characteristics, are singly included. Thus, all independent variables of their respective dependent variable are considered in the first block (full model) to determine their significance, and afterwards, a step down procedure is used to fit the model.

Bivariate probit model

Because the producer must make two decisions, type of arrangement[7] (*Arrangement*) and type of quality certification (*Quality*), a bivariate probit model[8] was used, *i.e.*, two separate binary dependent variables are modeled. The type of arrangement (*Arrangement*) is explained by a vector of independent variables[9] (x_{1i}): transaction characteristics, relationship characteristics, and producer characteristics. The type of quality certification (*Quality*) is modeled by a vector of independent variables (x_{2i}): transaction characteristics, external and internal incentives, and producer characteristics.

The specification for the two equation model is:

$$Arrangement^* = \gamma'_1 x_{1i} - u_1 \qquad [1]$$

$$Quality^* = \gamma'_2 x_{2i} - u_2 \qquad [2]$$

where: *Arrangement** and *Quality** are latent variables, and *Arrangement* and *Quality* are dichotomous variables with the following rules:

Arrangement = 1 if *Arrangement** > 0, 0 otherwise

Quality = 1 if *Quality** > 0, 0 otherwise

The error terms are assumed to be independently and identically distributed as bivariate normal:

$$E(u_1/x_{1i}, Arrangement, x_{2i}) = E(u_2/x_{1i}, Arrangement, x_{2i}) = 0$$

$$Var(u_1/x_{1i}, Arrangement, x_{2i}) = Var(u_2/x_{1i}, Arrangement, x_{2i}) = 1$$

$$Cov(u_1/u_2, Arrangement, x_{2i}) = \rho$$

where ρ is the correlation between the error terms in the equations. In other words, ρ measures the correlation between the outcomes after the influence of the included variables is accounted for.

Data preparation

Dependent variables

The type of arrangement (*Arrangement*) refers to the product sale between producer and buyer, and has two outcomes. A relational arrangement (*Arrangement[R]*) will be chosen by the producers if a verbal transaction is made, and a simple market arrangement (*Arrangement[S]*) will be chosen if a spot market transaction is established. A dummy variable will be used, with 1 for relational arrangement and 0 for simple arrangement.

The avocado producer was directly asked about his choice of adopted quality certification (Quality); and four quality certifications were identified: organic certification, Global-GAP, US-GAP and phytosanitary standard. The first three are considered as private quality certifications, and it is assumed that they result in higher transaction costs than does the phytosanitary quality standard, which is considered to be a public quality standard. A dummy variable will be used, with the value of 1 for private quality and with a value of 0 for public standard.

Independent variables

Asset specificity (*Asset_sp*) was initially measured by three items (description of the items is presented in Table 2), *Asset_sp_knowledge, Asset_sp_ investment,*

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[7] In the present research, market governance is viewed as a simple arrangement, and relational governance as a relational arrangement.

[8] As noted by Maddala (1983) and Greene (2003), a bivariate probit model enables us to simultaneously model the process, and potential selection bias can be corrected by assuming a joint normal error distribution using a two-step procedure.

[9] Constructs of independent variables such as asset specificity, buyer commitment, expectation of continuity, and information exchange are indicated in Table 2.

Table 2. Constructs and items used in the bivariate probit model

Constructs	Loading
Asset specificity (α = 0.74)	
Asset_sp _knowledge We have made significant investments in training of workers and in equipment specific for our main buyer	0.90
Asset_sp _investment We have made significant investments in fulfillment of production requirements for our main buyer	0.93
Behavioral uncertainty (α = 0.58)	
BU_payment We are uncertain whether our buyer will stick to the payment arrangement	0.99
BU_damage We are uncertain whether our buyer will damage the orchard	0.52
Environmental uncertainty (α = 0.34)	
EU_price The price for my product varies significantly over the seasons	0.90
EU_demand The demand for my product varies significantly over the seasons	0.62
EU_volume The harvested volume per hectare varies significantly	0.31
Information exchange (α = 0.85)	
Information_planning needs We receive information to help us plan according to his/her needs	0.74
Information_frequency We are frequently informed of his/her product requirements	0.87
Information_forecasting We are provided with long-range forecasts of supply requirements	0.68
Information_in advance We are informed in advance of impeding changes in preferences and requirements	0.80
Buyer commitment (α = 0.85)	
Buyer commitment _helping Our main buyer tries to help us when we incur problems	0.70
Buyer commitment _sharing Our main buyer shares in the problems that arise in the course of dealing	0.74
Buyer commitment _improving Our main buyer is committed to improvements that benefit our relationship	0.68
Buyer commitment _assistance Our main buyer has supported us with technical assistance and inputs	0.84
Expectation of continuity (α = 0.67)	
Continuity_long time We expect our relationship to continue a long time	0.85
Continuity_renewal Renewal of the relationship is virtually automatic	0.73

and *Asset_sp_buyer* (Dahlstrom *et al.*, 1996). However, *Asset_sp_buyer* (*i.e.*, producer loses part of his investment when he switches to another buyer) was not a significant item in the construct; hence the final two were used. The items were measured using a seven-point Likert scale ranging from "not agree at all" to "totally agree".

Behavioral uncertainty was initially measured by two items: *BU_payment* and *BU_damage* (see Table 2). However, because individual item reliability (loadings)

for *BU_damage* was lower than 0.7[10] (Table 2), items were included separately in the model. Again, a seven-point Likert scale was used.

Environmental uncertainty was initially measured by three items (Table 2): *EU_price*, *EU_demand*, *EU_volume*. However, because individual item reliability (loadings) for *EU_demand* and *EU_volume* were lower than 0.7, and the composite reliability for the environmental uncertainty construct was lower than 0.7 [see Suppl. Table 2 (pdf)], items were separately included in the model. A seven-point Likert scale was used.

Buyer commitment (*Buyer commitment*) refers to the willingness of the buyer to work together to create a positive exchange relationship and improve the performance of alliances (Heide & John, 1992). Four items measured by a seven-point Likert scale are considered for its construction (Table 2). This construct was included as a variable.

Expectation of continuity (*continuity*) indicates the degree to which the supplier is dependent on the buyer (Lusch & Brown, 1996). Two items were used to measure this construct (Table 2), each one using a seven-point Likert scale. This construct was included as a variable in the model.

Information exchange (*information*) refers to long-term forecasting, structural planning information, including future product design information, and production planning- schedules (Noordewier *et al.*, 1990). Four items were used to measure this construct (Table 2), each one using a seven-point Likert. This construct was included as a variable in the model.

External incentives (association member, channel, location, and type of packer) suggest that firms adopt quality certifications imposed by major customers, whereas internal incentives (price, sales, and yield) show that firms adopt quality certifications to increase their benefits or efficiency (Holleran *et al.*, 1999; Fouayzi *et al.*, 2006). Regarding external incentives, Holleran *et al.* (1999) affirm that buyers play a main role defining the product quality requirements. Wollni & Zeller (2007) found that producers participating as members of a cooperative increase the probability of participation in specialized markets. In terms of location, Raynaud *et al.* (2005) have mentioned that if producers have alternative processing companies with whom they can do business and an equal distant apart,

the bilateral dependency is limited; therefore, a significant positive relationship is expected between a location where a high number of packaging firms are located, and there is adoption of public quality standards. According to the survey, four dummy independent variables regarding location were introduced in the model. For each dummy independent variable, two mutually exclusive choices were considered; 1 = Uruapan and 0 = otherwise, 1 = Periban and 0 = otherwise, 1 = Tancitaro and 0 = otherwise, and 1 = Ziracuaretiro and 0 = otherwise. In terms of internal incentives, a price premium (price) is a necessary condition to cover the extra costs associated with the higher quality of the product; the producer has an incentive to attain the expected high quality (Klein & Leffler, 1981; Fouayzi *et al.*, 2006). Price, sales, and yield are interval variables, and they indicate the average value during the season 2007.

Characteristics of the producer such as education, experience, family size, and gender are expected to influence the adoption of quality certifications. The variables education and gender are nominal variables while experience and family size are interval variables. Wollni & Zeller (2007) found that education and experience are associated to marketing channels that require higher quality certifications.

A summary of the variables included in the two equations is given in Table 1. The table shows that price uncertainty (*EU_price)* has a high mean value compared to the other environmental uncertainty variables. The avocado producers involved in both types of quality certifications have indicated that price is a relevant variable in the transaction with the packers. Price is negotiated daily and large-scale avocado producers are preferred by international packaging firms.

The following presents the producer characteristics belonging to the sample. On average, the 122 avocado producers had around twenty years of farming experience, but this is slightly higher for producers who adopted public quality standards. The average family size consisted of five. Fifty percent of the surveyed producers participated in the most important avocado association in Mexico, and their participation was slightly higher when there was adoption of private quality certifications. Price uncertainty was higher and asset specificity was lower for producers using simple arrangements than for producers using relational arrange-

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[10] According to Yurdugül (2008), individual reliability, as assessment measure of a dimensional construct integrating several items, is acceptable if the value is grater or close to 0.7, when the sample size is equal to or larger than 100 observations.

ments. In terms of the three relationship characteristics used in the present research, there was a higher average of producers using relational arrangements.

In terms of correlation, the variables did not exhibit great correlation of 0.45. Based on the low correlations among the measures, the possibility of criterion contamination can be more or less ruled out.

Results

Results of the bivariate probit regression model are presented in Table 3. Mc Fadden's Adj R^2 value was 0.26 indicating a good model fit (Greene, 2003). As an additional measure of goodness of fit, the percentage of correct predictions of the bivariate probit model was 68%.

In the first decision of the model, type of arrangement, asset specificity (*Asset_sp*) had a significant positive relation with the type of relational governance, thus supporting hypothesis 1. The coefficients for the

two items reflecting behavioral uncertainty, *BU_payment* and *BU_damage*, were not significant in explaining the type of arrangement; and thus, hypothesis 2 is not supported.

In terms of environmental uncertainty, *EU_price* had a significant negative relation with relational governance, which is consistent with hypothesis 3. However, *EU_demand* had a significant positive impact on relational governance, which is not consistent with hypothesis 3. *EU_volume* was not a significant variable. Thus, *EU_price* is the only variable that corresponds to the transaction costs findings. *i.e.*, a lower level of price uncertainty is present when producers use relational governance as opposed to when producers use market governance.

The variable expectation of continuity (continuity) had a significant positive effect on the adoption of relational arrangement, and therefore, hypothesis 4 is supported. The coefficients of the variables buyer commitment and level of information were not significant, and therefore, hypotheses 5 and 6 are not supported.

Table 3. Determinants of type of arrangement and adoption of quality standards (Seemingly unrelated bivariate probit model)

Variables[a]	Coefficients	*p*-values[b]	
		Coefficients	Marginal effects[c]
Dependent variable = arrangement			
Asset_sp	0.6900012	0.001	0.001
EU_price	−0.2868706	0.005	0.003
EU_demand	0.2810726	0.007	0.005
Continuity	0.5881243	0.015	0.015
Constant	1.6715170	0.013	
Dependent variable = quality standard			
Asset_sp	0.7063186	0.001	0.001
Location	−1.1089480	0.001	0.001
Price	0.1059356	0.020	0.015
Education	−0.7560213	0.024	0.016
Constant	−1.4582090	0.017	
Wald test of rho = 0:		$\chi^2(1) = 5.54291$	Prob $> \chi^2 = 0.019$
Observations			122
Log likehood (only the constant)			−128.12
Log likehood (constant and explanatory variables)			−86.29
Mc Fadden's R^2			0.33
Mc Fadden's Adj R^2			0.26

[a] Variables EU_volume, BU_payment, BU_damage, information, Buyer_commitment, experience, education, family size and gender were included to explain Arrangement; however, they were not significant at 10%; and variables EU_price, EU_demand, EU_volume, BU_payment, BU_damage, experience, family size, gender, association member, channel, packer, yield and sales were included to explain quality standard; however, they were not significant at 10%. [b] All the variables are significant at $p < 0.05$. [c] Marginal change in probabilities at the sample means.

In terms of correlations, the Wald test reveals that the null hypothesis = 0 was rejected at 5%, which means that the errors of the two separate probit equations are related, and a significant positive correlation exists between type of arrangement and type of quality certification (thus supporting hypothesis 7). Therefore, the bivariate probit model generates consistent estimates using standard maximum likelihood (see Table 3).

The second decision of the model, adoption of quality certification, was explained by such variables as asset specificity, price (internal incentive), location (external incentive), and education. Whereas asset specificity and price have a significant positive effect on the choice of private quality certification, location and education had a significant negative effect. Location is a nominal variable with two categories. Producers with orchards in Uruapan prefer to adopt phytosanitary standards, whereas producers with orchards in municipalities such as Nuevo Parangaricutiro, Periban, Tancitaro, and Ziracuaretiro adopt private quality certifications. Education is a nominal variable with two categories. Producers with an education level no higher than primary school adopt public quality standards, whereas producers with an education level higher than primary school adopt private quality certifications. Other independent variables measuring the transaction costs, known as behavioral uncertainty (*BU_payment* and *BU_damage*) and environmental uncertainty (*EU_price, EU_demand, and EU_volume*), were not significant to explain the dependent variable quality. It was shown that transaction costs did not influence the decision about what quality certification was adopted. The rest of independent variables, sales, yield, association member, channel, type of packer, and producer characteristics (experience, family size, and gender) were also included to explain the dependent variable quality; however, none of them resulted significant.

Discussion

Type of arrangement

Empirical results from the study support the main TCE argument that asset specificity is related with the type of governance structure. When producers make specialized investments, they tend to safeguard these investments by relying on relational governance as shown by the expectation of continuity, which will be discussed later on. Although previous studies on transaction costs support the notion that specific governance such as written arrangements are efficient at safeguarding specific investments, this type of arrangement presents limitations (Mesquita & Brush, 2008). Mexican avocado producers have expressed that it is expensive and time consuming to enforce written arrangements. On the contrary, relational arrangements in which parties have frequently agreed upon transactions have been an efficient strategy in safeguarding specific investments.

Demand uncertainty has a significant positive relation with relational governance, while the relation between price uncertainty and relational governance is negative. Results regarding the relationship between environmental uncertainty and governance structure have been mixed in prior research (Walker & Weber, 1984; Heide & John, 1990). The significant positive relationship between demand uncertainty and relational governance was also obtained by Fynes *et al.* (2004), who showed that a high level of demand uncertainty is associated with a tighter relationship between supply chain members. High level of demand uncertainty can lead either to excesses or shortages in inventory, both of which will be more easily prevented through relational governance structure than through market governance.

In regards to price uncertainty, the study showed a significant negative relation to the adoption of relational governance proving Dwyer & Welsh (1985) and Heide & John (1990) who also found a significant negative relationship. Williamson (1996, p. 116) argued that although there is efficacy in relational governance, adaptations of it cannot be made unilaterally (as with market governance) or by fiat (as with hierarchy), but rather, require mutual consent. In other words, to continue the relationship, different aspects may be negotiated, and rely on incentive provisions to encourage motivation (Artz & Brush, 2000). Whereas Mexican avocado producers using relational arrangements have gained more price certainty, buyers have been hesitant to commit to purchasing a specified quantity of product. Therefore, buyers support their producer's relationship by paying prices according to the product quality, and at the same time, they leave open the quantity and timing of orders to manage their exposure to demand changes.

In the present research, behavioral uncertainty, which was analyzed using two variables, was not significant in explaining the type of governance structure. Two possible reasons can explain this result. First, obser-

vations with higher values for measures of behavioral uncertainty were not large enough to contrast with the rest of the data, and therefore, the measures were not statistically significant (Greene, 2008). Second, the two measures of behavioral uncertainty were not serious problems for the producers.

In terms of relationship characteristics, the expectation of continuity has a significant positive relation with the adoption of relational governance, the same conclusion that was obtained by Lusch & Brown (1996). Avocado producers adopting relational governance have a high expectation of sustained benefits, and they expect to continue selling their product to the same buyer even in a context of abundant supply. The rest of the relationship characteristics, information exchange and commitment were not significant. Therefore, the efficient mechanism through which avocado producers mitigate exchange hazards is through the expectation of sustained benefits, not a repeated exchange based on information or commitment between partners to support the relationship (Geyskens *et al.*, 2006). Remaining independent variables, gender, producer experience, family size, and education were included to explain the dependent variable arrangement; however, none resulted significant.

Quality certification

Asset specificity also had a significant positive relation to private quality certifications. Producers adopting organic quality certification, US-GAP, or Global-GAP invest in the training of workers and specific equipment, along with the fulfillment of production requirements for their buyer. In this context, because of few alternative buyers (Raynaud *et al.*, 2005), the producers could face opportunism and receive a price that does not correspond to the product quality. This can explain why relational governance had a significant positive correlation with the adoption of private quality certifications. Raynaud *et al.* (2005) have explained that private quality certifications require a more complex governance structure than do public quality standards because of higher asset specificity and higher transaction cost resulting from monitoring and certifying. Particularly in the Mexican avocado industry, simple contractual arrangements are used by producers when they adopt public quality standards. Under simple contractual arrangements, a standardized product is supplied and producers sell their product looking for the best

price. Under these circumstances, producers fulfill public quality standards (phytosanitary requirements) and do not make specific knowledge or investment to commercialize their avocado. By contrast, verbal contractual arrangements are used when producers adopt private quality certifications such as organic quality certification, US-GAP, and Global-GAP. Verbal arrangements can guarantee producers that the buyers will continue with the business relationship.

In addition, price, location, and education are significant variables explaining the adoption of a quality certification. Price is positively related to the adoption of private quality certifications. A negotiated premium has been the main incentive in covering the extra costs associated with the higher quality of the product. Avocado producers adopting private quality certifications, such as organic quality certification, US-GAP, and Global-GAP, have received a higher price than avocado producers who have only adopted phytosanitary standards (Sánchez, 2007). Unfortunately, the present questionnaire only considers prices measured in 2007. Even so, if these prices are used as an independent variable, it could show a simple relationship with the type of quality certification adopted. Location is negatively related to adoption of private quality certifications. It means that producers in Uruapan prefer to adopt public standards, whereas producers located in Nuevo Parangaricutiro, Periban, Tancitaro or Ziracuaretiro are better to adopt private quality certifications. As a possible explanation, Sánchez (2007) refers to the number of alternative buyers that producers have to market their product. Producers located in Uruapan have a significant number of packaging houses and other buyers requiring avocado certified with phytosanitary standards, compared to producers located in Nuevo Parangaricutiro, Periban, Tancitaro, and Ziracuaretiro. In the last four municipalities, producers with few alternative buyers have marketed their product with packers demanding an avocado certified with private quality certifications. In terms of education, avocado producers with higher education (*i.e.*, more than primary school) adopt private quality certifications. The reason is that producers with higher education have more experience in dealing with agricultural tasks and recognizing potential economic benefits through adoption of private quality certifications.

The present study provides insights about the impact of transaction costs and relationship characteristics on the joint choice of contractual arrangements and quality certifications. Unlike previous studies which used uni-

variate models to show how transaction costs influence the vertical coordination when quality issues are considered, the present analysis uses a bivariate probit model to show explicitly how the transaction costs can impact the joint choice of contractual arrangements and quality certifications. In addition, because transaction costs and relationship characteristics are not readily measurable, proxy dimensional constructs are used as variables integrating several items. Thus, in order to gain access to US and other western markets, Mexican avocado producers have followed two investment strategies that are related to specific types of quality certifications and types of arrangements. Whereas avocado producers adopting private quality certifications invest in a high level of specific assets and use relational arrangements, avocado producers adopting phytosanitary quality standards do not invest or rather, invest little in specific assets and use spot market transactions. Theoretical explanations are found in transaction cost economics, which predicts that the need for safeguarding transaction-specific investments is an important driver for governance structure choice. Thus, Mexican avocado producers using relational arrangement support their relationship with packers on expectation of continuity to reduce price uncertainty, along with safeguarding specific investments. Unlike other studies that analyze how formal written arrangements safeguard specific assets, the present study focuses on relational arrangements to explain how expectation of continuity is an important relationship characteristic reducing opportunism. In addition, relational arrangements allow avocado producers to have more price certainty according to the quality attributes of the product, whereas buyers have more freedom determining the product demand. The present study also shows that price, education, and location are relevant characteristics that determine whether avocado producers adopt a particular quality certification. Thus, whereas price is an important incentive, education gives avocado producers the experience to facilitate the adoption of private quality certifications. Regarding location, avocado producers located in municipalities with few alternatives for processing companies, have more incentives to adopt private quality certifications as a strategy to get a price that corresponds to the quality of the product.

Finally, implications of this research should be evaluated in light of the following limitation. Although the sample of producers used was large enough to evaluate and obtain significant results in most hypotheses, it presents limitations in terms of the representati-

veness of the data. Although the sample of producers included respondents from different property sizes and different municipalities, most respondents came from the central avocado production region in Mexico, which has a network of supporting institutions, many potential buyers, and close proximity to export packaging firms. Therefore, the results are more representative for the avocado industry in that region.

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