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Objectiveness in the Market for Third-Party Certification: Does market structure matter?

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Summary

The globalization of trade in high quality foods is stimulating the development of international food standards and certification systems. Third-party certification has evolved as a means of ensuring that product information and signals on quality and safety attributes are sound and reliable. Certification can only provide credible market signals if it operates objectively and independently. This paper investigates the potential trade-off between certifiers' objectivity and the level of competition in the rapidly expanding market for third-party certification of quality foods. Based on a theoretical supply chain framework a nested panel analysis is applied to a set of accredited certifiers for the EurepGAP fruits and vegetables standard. Our results indicate that increasing economies of scale and market share in certification do matter.

KEYWORDS: Third-party certification, objectiveness, market structure, nested panel analysis, EurepGAP

1. Introduction

Markets for high-quality foods have changed dramatically in recent decades and especially in the advent of the new millennium, creating an increasingly complex global food system. A multiplication of food-safety outbreaks diminished consumers' confidence and trust in the ability of the agro-food industry and governmental authorities to assure the provision of safe and high quality foods. Increasing vertical coordination in food supply chains has triggered a shift in structures from single firm to multi-stakeholder supply-chain configurations (Barkema and Drabenstott 1995). A particularly critical issue of this new paradigm of food supply is the emergence of opportunistic behaviour associated with information asymmetries between contracting parties.

Credible quality signalling evolves as a pivotal element facilitating transactions among agents in the food chain. Reliable product information becomes even more important when firms' differentiating strategy involves credence attributes such as food safety, organic farming or fair trade. Shifts in governmental consumer protection strategies and stricter private food quality and safety standards impose greater responsibility on food operators, especially retailers, which are being forced to assume a "gatekeeper's" role as guarantors of food quality and safety. This is certainly the case in the UK, where the Food Safety Act of 1990 requires a stricter control of production and processing along the supply chain and forces retailers to assume their share of responsibility on the provision of food safety (Henson and Northen 1998). Across Europe retailers are adapting to the new market agenda developing imposing quality assurance systems on supplier's to assure the safety and quality of their products and to mitigate product liability (Hatanaka, Bain and Busch 2005)

In the European Union private and public authorities have defined and specified a number of new quality assurance and labelling systems relying on control and certification schemes provided by independent and impartial agents. These control systems reassure partners in

the food chain and consumers' of the quality and safety of products. In recent years several new control and certification bodies have been created and compete to offer its services to firms seeking certification from good farming practices to processor specifications in various standards. Thus, new markets emerged where firms compete to provide food quality and safety certification services for different private or public food standards.

This paper focuses on the recently created certification services market. The main goal is to analyse how the structure of the international market for third-party certification of high quality foods influences the objectiveness of third-party certifiers and thus the credibility of the certification process.

Third-party certifiers (TPC) have evolved as independent and credible institutions designed to ensure quality and safety standards across food markets. Third-party certification is one way to assess and to monitor firm's compliance with standards, practices, principles, and/or legal requirements, where 'certification' is the voluntary assessment of and approval by an accredited party and an accredited standard (Meuwissen et al. 2003). Product and/or process certification may reduce uncertainties and lower overall transaction costs that arise from information asymmetries between producers and retailers in vertical supply chains [Caswell et al, 1998; Tanner 2000; Deaton 2004; Manning and Baines 2004].

As the demand for private third-party certification of quality assurance schemes increases so does the level of competition among accredited certifiers as additional TPCs enter the market. Busch et al. (2005) and Tanner (2000) point out that the credibility of third-party certification critically depends on the objectiveness and independence of the certifier. As the competitive structure in the TPC market is shifting there may be a trade-off between the objectiveness of third-party certifiers and market structure as shown by Lizzeri (1999). If this is the case, the role of third-party certifiers as an efficient and signalling institution has to be questioned [Carriquiry, Babcock and Carbone 2003; McCluskey 2000].

The paper is organized as follows: Section two provides an overview of the economics of third-party certification with an emphasis on recent work and its implications on food markets. Section three proposes an analytical framework relating the structure of the TPC market to the objectivity of the certification process. The fourth section presents an empirical case study using panel data on the Euro-Retailer Produce Working Group (EUREP) Good agricultural practices (GAP) quality assurance system in the international fruits and vegetables market. Finally conclusions are drawn.

2. The Emergence of Third-Party Certifiers and Their Role in Food Chains

According to the traditional neo-classical economic model both suppliers and buyers in the market are fully informed about the homogenous commodity that is exchanged. In fact, today's global food system is rather characterised by highly diversified products and far reaching information deficits on both side of the market (Jahn, Schramm and Spiller 2005). Empirical studies on food markets suggest that third-party certifiers may in fact facilitate the mitigation of market failure due to information asymmetries between market participants. Caswell et al. (1998) argue that third-party certification may reduce transactions costs where uncertainty about product attributes exists. Henson and Reardon (2005) and Fulponi (2006) analyse the impact and use of third-party certifiers to mitigate uncertainty and reduce information asymmetry between producers and retailers in vertical food-supply chains. Carriquiry, Babcock and Carbone (2003) investigate the relation between the stringency of third-party certifiers and optimal quality systems in terms of agricultural output. Only if these organisations are successful in establishing a positive reputation will their certificates be accepted as credible signals in the market place.

The above studies emphasise the benefits of independent signalling and certification institutions. However, none of them considers the fact that nowadays most certification systems are privately organized. While public certification authorities enforce standards

through laws and fines, private certification institutions constitute economic agents that typically follow some form of economic profit-maximisation rule. Therefore, as Jahn, Schramm and Spiller (2005) state the analysis of third-party certification systems has to acknowledge the existence of opportunistic behaviour rather than assuming that private certifiers will always be capable of carrying out certification in the most efficient and effective manner.

In his seminal paper Tirole (1986) analyses the relationship between three agents (principal, agent and supervisor) in an organization viewed as a network of intertwined contracts. Tirole (1986) offers important insight into the importance of independence of the third party in transaction processes. He shows that with a dependent third party, coalitions may emerge between market partners (supervisors and principals or supervisors and agents). If coalitions emerge, the process of revealing information is hindered.

Using a game theory approach Lizzeri (1999) looks at the impact of the certification's market structure on gathering and revealing information. He shows that if the third-party certifier is a monopolist, it will reveal only part of the information gathered which creates a monopoly rent and decreases social welfare. Contrarily, under a perfectly competitive third-party certification market, all private information is revealed and social welfare is optimal. Therefore, market structure needs to be considered when analysing the market mechanism for third-party certification.

Tanner (2000) provides an insiders view to the nature of a third-party certifiers. He notes that TPCs need to be experienced organizations and demonstrate expertise in certification procedures. While Tanner claims that a critical point to the role of TPCs is their true independence, he also suggests that "the third-party's relationship with the first-party, the client food company, is also more supportive and "arm around the shoulder" than the relationship between the company and the regulator" (p. 415). Tanner reveals an ambiguity in the role of TPCs. Being supportive to the certified firm may imply a relaxation of the certification process and expose a conflict of interests between the TPC's independence and the need to act cooperatively with the certified firm. Baumman (2001) and Giannakas (2002) provide empirical evidence of opportunistic behaviour in the organic control schemes, estimating that frauds in organic labelling were about 10% in Germany and varied between 15 and 40% in southern EU member states. Evidence of imperfect certification enforcement and fraud is also supported by Anania and Nistico (2003) and McCluskey (2000).

Manning and Baines (2004) stress the importance of certifier accreditation through accreditation institutions to assess and ensure independence and objectiveness of certification process. They claim that accredited TPCs offer more guarantees of independence, impartiality, competence and sustainable performance to consumers or other stakeholders. However, accreditation is a largely formal process that does not include the actual monitoring of the working process. So far, researchers have a limited understanding of the quality and thoroughness of control procedures that may prevent opportunistic behaviour but also may create barriers to market entry. Jahn, Schramm and Spiller (2005) criticise that the lack of supervision is the reason behind the introduction of 'control-of-control' mechanisms in many of today's private agrifood certification systems. In fact, incumbent providers of certification may have strong incentives to prevent market entry of new competitors in a rapidly growing certification market and evolving regulations. Moreover, TPCs established in one food industry may find it easier to achieve accreditation for another industry, than it is for a newcomer in the market.

Deaton (2004) analyses the role of third-party certifiers using an information economics framework. Along with the assumption of independence of third party certifiers, Deaton further assumes certification will only provide effective signalling service if low quality producers have higher certification costs than suppliers of high quality products. Thus independence of TPCs is related to the ability and willingness to discriminate between low and high quality producers. Given the competitive pressure that is common to many

retailer-led food supply chains, suppliers might view certification of their product as an externally imposed regulation in order to protect market shares. Hence, suppliers may have low interests in thorough and costly inspection procedures and third-party certifiers may have an incentive to reduce certification costs (Jahn, Schramm and Spiller 2005).

Following Tanner (2000), Deaton argues that accreditation agencies play a crucial role ensuring TPCs remain independent from their clients. Jahn, Schramm and Spiller (2005) also discuss the implications of imperfect certification markets by drawing on the existing financial auditing literature and new institutional economics.

Henson and Reardon (2005) argue that as many food markets are shifting from a price-based to a quality-based competition third-party certifiers will become an increasingly important and powerful player in many high-quality food markets. This trend may create larger and more powerful TPCs over time whose profit-maximizing self interest may affect the quality of the certification service. This justifies a closer scrutiny on both the structure of certification markets and their role as signalling credible institutions. A critical question is whether increasing competitive pressure in the certification market will affect the outcome and hence the reliability of the certification process?

3. Analytical Framework

The theoretical economic literature investigates the role of market intermediaries, auditors and certifiers in different contexts and markets. In here the aim is to propose a framework to analyse how market structure impacts the provision of credible by third party certifiers. Jahn, Schramm and Spiller 2005, analyse the reliability of certification focusing on the relationship between a standard owner and certifying bodies. In turn, here the focus is on transactions between third party certifiers and firms seeking certification. More specifically the aim is to investigate whether competition between certifiers impacts the quality of certification.

Previous work has analysed the role of intermediaries as agents disclosing otherwise private information and at the impact of the market structure on its effectiveness. Three main findings are relevant for our analysis: First, Tirole (1986) shows that increasing competition between third-party certifiers and either buyers or sellers of food products may lead to noisy signals and hinder the objectiveness of the certification process. Second, the number of third party certifiers in the market may affect the amount of information revealed (Lizzeri 1999). Third, Deaton (2004) suggests that the role of TPC as signalling institutions decreasing information asymmetries critically depends on their objectiveness.

Other factors affecting performance of third party certifiers found in the literature are the institutional setting in which the certification body operates; the effectiveness of monitoring by a “control-of-the-control” agent; or the public or private nature of the certification body (Jahn, Schramm and Spiller 2005).

The framework proposed here illustrates the structure of a private, business to business certification, such is the EUREPGAP standard or those emerging from the ISO 9000. With the underlying assumption of a private standard owner Figure 1 illustrates the institutional structure of a third-party certification system where the owner of the voluntary standard establishes accreditation system to guarantee and streamline the flow of certified product up to the retail.

[Figure 1]

Assuming a leading position of the retail sector in the supply chain, the suppliers provide certificates to signal standard compliance with the retail standard. The certificate is issued by a certifier based on an establish standard that is laid down and overviewed by the standard owner. Certifiers in turn have to prove their eligibility to conduct inspections through ISO 65/EN 45011 standard accreditation. Finally, the standard owner is

responsible for the development and ultimate monitoring of the specific standards and its control procedures.

As the majority of private food safety and quality schemes are based on ISO 9000 standards, third-party certification providers are offering market based inspection and certification services. Depending on the nature and scope of the standard the costs of certification and associated inspection routines might be high (Nadvi and Waeltring 2002). Moreover, leading accredited third-party certification bodies, like SGS, DNV (Det Norske Veritas) Moody's and Integra BVBA that provide certification services internationally might sub-contract national standard organisation. While the standard owner aims at the highest possible level of compliance, the competitive structure of the certification market may affect this goal. In fact, individual certifiers that are sub-contracted to become agents of larger certification companies may pursue different stringency levels and certify products or processes that otherwise do not meet standard requirements. Hence, changes in the competitive structure of the certification market may have significant implication for both certifiers and associated suppliers.

A credible certification scheme is one where high quality products have higher chances of being certified, than low quality products ones (Carriquiry, Babcock and Carbone 2003). If a TPC is truly objective, independent and competent it will not only be able to minimize both type I and II certification errors but also will resist any pressure to relax its procedures. Off course objectivity and competence is costly and these costs will raise the more detailed and accurate is the certification process. Assuming that the level of objectiveness increases with firm size and reputation asset, then multinational certifiers may not only have better chances of being accredited but also of getting more contracts to provide certification. Reputation asset itself is dependent on the level of experience a certifier has in the market. Increasing competition may either increase the level of stringency or reduced it. An increased competition may prevent reputed firms from relaxing their level of monitoring, especially if the control of the controllers is effective. However, it may also occur that higher pressure from other firms competing to provide certification hinders objectivity in certification and thus has a negative impact.

To get accreditation certifiers must demonstrate their independence and objectivity, but once this stage is overcome, these firms have to sell their services of certification and compete with other accredited firms for a fixed number of firms seeking certification of products or processes. There may be a difference between the procedures justifying the accreditation and their use in practice, such that the reality of the certification process is quite distinct from what was intended and announced to obtain accreditation. The argument tested empirically in the next section is that increasing competition will increase the gap between the intended level of quality certification and what is actually observed. Overall two seemingly important issues will be analysed. First, it is necessary to treat the objectivity of TPCs in relative, rather than absolute terms. This is because if TPCs compete in the provision of certification services there will be inevitably differences in the level of service provided. Second, given a fast growing market for third-party certification it is worthwhile to investigate what factors determine TPCs objectiveness and how they impact the ability to provide credible signals to the market.

4. Data, Empirical Model and Results

To illustrate the hypothetical relationship between competition and the objectiveness of third-party certifiers a case study is constructed based on the international certification market for the EurepGAP standard in the fruit and vegetables industry. We select the fruit and vegetable industry because it is the origin of the EurepGAP standard system. A particularly interesting feature of this pre-farm-gate-standard for good agricultural practices is its limitation as a business to business label that cannot be promoted to consumers. To enter the certification market for EurepGAP, third party certification bodies have to be

accredited according to the EN 45011 or ISO65 norm. These norms state that third-party certifiers should be independent, impartial, and confidential and have integrity (EurepGAP 2006). Currently EurepGAP recognizes over 100 control bodies in more than 70 countries. These compete to certify producers seeking contracts with retailers. By analyzing data available through the EurepGAP web site it is apparent that large multi-national certifiers compete against smaller national certifiers that only operate in single countries. The system allows for sub-contracting of certification services for EurepGAP in the fruit and vegetable sector. This makes a particularly interesting case study for the competitive environment in the market for third party certification.

4.1 Data Set

The empirical data used in this analysis is partly obtained directly from the EurepGAP web site (EurepGAP 2006). EurepGAP publishes and updates comprehensive information relating to the approval of TPCs for EurepGAP's quality assurance system certification, that have applied for accreditation under EN 45011 or ISO65 norms. This information includes a list of currently approved and operating certification bodies in over 100 countries. EurepGAP publishes detailed firm information together with dates of firm's application and final approval of EurepGAP accreditation (EurepGAP 2006). Other relevant information on the specifics of fruit and vegetables markets in countries where EurepGAP is active was obtained from public statistical sources (FAO 2007).

4.2 Empirical Model

A nested panel-model approach is used to analyse the impact of current market structures in the market for EurepGAP certified fruits and vegetables on the level of competition in a cross-section of over 100 TPCs in 28 countries and in the year 2006. The number of accredited TPCs in the certification market of country i is regressed on the date of accreditation of a TPC (2000 - 2007), and the timelag between a TPC's application and accreditation under EurepGAP. Other explanatory variables are the number of countries for which a TPC is approved under EurepGAP, and its individual share in the market for certified fruits and vegetables in a country i . The degree of country i 's export orientation is measured as the relation of its total value of agricultural and food exports and the quantities of fruits or vegetables produced. Finally, geographical specifics of TPC markets in different world regions are introduced through dummy variables.

The following nested panel model is specified:

$$\begin{aligned} Comp_Cert_{it}^j = & \alpha_0 + \alpha_1 (Time_of_Entry_{it}) + \alpha_2 (Activity_{it}) + \alpha_3 (SHARE_VEGGIE_{it}) \\ & + \alpha_4 (SHARE_FRUITS_{it}) + \alpha_5 (EXP_AGRI_{it}) + \alpha_6 (EXP_FOOD_{it}) + \alpha_7 (SGS) \\ & + \alpha_8 (AMERICAS) + \alpha_9 (EUROPE) + \varepsilon_{it} \end{aligned}$$

$Comp_Cert$ is our dependant variable and denotes the number of competitors of TPC j in country i and in the particular year 2006. The error ε_{it} is assumed to be normally distributed with mean zero. Table 1 presents definitions and descriptive statistics of the dependent and independent variables.

$Time_of_Entry$ represents the month and year of entry of a TPC into the EurepGAP system. Note that there is an increasing number of TPC around the world has applied for accreditation under EurepGAP system. We hypothesize that a later entry into the system entails higher competitive pressure as the number of incumbent certifiers increases.

$Activity$ is a proxy of a TPC's scale of operation providing information on the number of countries in which the company certifies fruits and vegetables for EurepGAP. As can be seen from Table 1 the average TPC certifies produce in around 13 countries. However, the standard deviation indicates a large band with. From the dataset we can identify TPC's

active in only a single country and global players – like SGS – that certify produce for EurepGAP in over 35 countries.

[Table 1]

Large-scale TPC's will thus have a competitive advantage over smaller and more "national" certifiers within EurepGAP, due to significant differences mainly in cost structures and reputation assets. Moreover, larger companies that are diversified across many markets will be less affected by increased competitive pressure in a single market. Hence, we hypothesize a negative impact of *Activity* on the level of competition.

Share_Veggie and *Share_Fruit* describe the TPC *i*'s share in country *j*'s market for certified vegetable and fruits, respectively. With increasing market shares of individual certifiers in a market we assume lower levels of competition, as the underlying market structure deviates toward more oligopolistic structures and a monopoly when a single certifier covers the entire quota of certified produce.

Exp_Agri and *Exp_Food* are proxies for export orientation of a relevant country with respect to its overall exports of agricultural and food products, relative to the size of its fruit and vegetable sector. We assume that an increasing involvement in international fruit and vegetable trade positively affects a country's importance within the global EurepGAP system. Hence, we hypothesize positive signs for these variables. The variable *SGS* equals one for countries in which this global player in the market for third-party certification is present and is zero in all other countries. TPC's like SGS are global market leaders in certification and quality assurance for foods. Markets in which these players are present will attract market entry of smaller TPC's and therefore increase the level of inter-TPC competition.

Americas and *Europe* are geographical dummy variables. Our data set identifies South America and Europe – the origin of EurepGAP – as areas of major activity. Hence, we hypothesize that these two geographical regions show greater levels of competition among producer contracts and amounts of produce to be certified.

Table 2 presents the panel model estimates. Among several model specifications Exact-Maximum Likelihood Estimators (ExactML) corrected for first-order serial autocorrelation revealed the best results based on the Schwarz-Bayesian Information Criterion (SBIC). Statistically insignificant F-tests could not reject the null hypothesis of equivalence of ExactML and fixed-effects models at the 95-percent level. The estimates of the nested panel model are generally well behaved.

[Table 2]

4.3 Empirical Results

Our results reveal a relative competitive advantage of larger and more diversified TPC's. As indicated by the variables *Activity* and *Share_Fruit* increasing diversification of activity, in terms of the number of markets a TPC certifies product and an increasing market share result in lower levels of competitive pressure from competitors. This result is significant with regard to the market for EurepGAP certified fruit. The variable *Share_Veggie* also shows the expected negative sign but is insignificant.

The variable *Year_of_Entry* provides valuable insight on the relation between market entry and the level of competition. The EurepGAP certification and quality assurance system has gained increasing recognition and importance in international food trade since its inauguration in 1997. The positive sign indicates that over time, increased entry due to rising numbers of accredited TPC's has significantly increased the level of competition among certification bodies and across countries.

The internationalization of trade in foods and agricultural products in recent years has been a driving factor of increased importance of international standardization and certification systems as is EurepGAP. Increasing uncertainty about product characteristics such as product quality and food safety levels are inherent attributes of today's global food trade. For many countries, in particular developing countries that supply fruit and vegetables to European and North American high-value markets, reliable certification of produce are vital. Our model results reveal that rising levels of export orientation in food production, relative to the country's size of vegetable and fruit production have a positive impact on the number of competing TPC's. Interestingly, the exact opposite result is obtained with respect to a countries export orientation in agricultural trade. Increasing levels of agricultural or commodity exports have a significant negative effect on the penetration of this market by TPC's for EurepGAP.

Another variable that provides important insight into the specifics of the EurepGAP system is captured in the variable SGS. As hypothesized earlier we assume a significant effect of reputation assets and economies of scale on the competitiveness of certification bodies within the global EurepGAP system. The dummy variable shows that the presence SGS as one of the market leaders accredited under EurepGAP has a positive effect on certifier competition. Unfortunately, the variable is insignificant.

Finally, the model shows results on the impact of geographical market location on competition. Our data set reveals that EurepGAP plays a major role the fruit and vegetable sectors of many South American countries. Another focus of EurepGAP, of course, is within Europe. Against the hypothesized impact, both variables show negative sign. For TPC's operating from South American countries we observe a significant and negative impact on the level of competition among quantities of fruits and vegetables produced under EurepGAP. The same effect can be seen for Europe, but remains insignificant.

5. Concluding remarks

Third-party certifiers are playing an increasing role in international quality food markets, as consumers increasingly demand clear and credible signals when they purchase high quality and safe food. Global food procurement and trade entail increasing uncertainty and information asymmetries. Competition in food markets is shifting from a firm and price based to a supply chain and credence attributes based configuration, where private third-party certifiers emerge as important signalling institution.

Previous research has addressed the importance of third-party certifiers in food market as a credible signalling institution that facilitates the reduction of uncertainties related to information asymmetries in credence food quality and safety attributes. The main argument is that to properly fulfil their role TPCs must be independent and objective (Tanner 2000, Deaton 2004, and Busch et al 2005). This paper maintains that the objectiveness of private third-party certifiers may be affected by the competitive structure of the certification market. Namely, with an increasing number of certifiers in a market, objectiveness may be hindered.

Based on panel data of the EurepGAP standard in the international fruits and vegetables market our empirical analysis provides first empirical evidence and valuable insight into the competitive structures within the international EurepGAP standard and certification system. Moreover, the results are intended to stimulate the ongoing discussion on the role of third-party certification in food product as important means to assure quality and safety of consumer foods.

However, the study and in particular our empirical analysis also reveals the need for more detailed market data to investigate the differences between market segments of certified produce and residual commodity market qualities. Such information is vital to the analysis and better understanding of the implications international food standard system such as EurepGAP and others have on the performance of many food market.

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Tables

Table 1: Definitions of Variables and Sample Statistics Table

Variables	Variable Description	Mean	Standard Deviation
Dependent Variable			
<i>Comp_Cert</i>		8.58	5.87
Explanatory Variables			
<i>Time_of_Entry</i>	Month and year of EurepGAP accreditation	8.27	4.67
<i>Timelag</i>	Time gap between a TPC's application and EurepGAP approval	2003.64	1.57
<i>Activity</i>	Number of countries <i>i</i> in which TPC <i>j</i> certifies product	12.87	11.53
<i>Share_Veggie</i>	TPC <i>j</i> 's share in the market for certified vegetables in country <i>i</i> (tons)	821.15	3230.50
<i>Share_Fruits</i>	TPC <i>j</i> 's share in the market for certified fruits in country <i>i</i> (tons)	0.24	0.27
<i>Exp_Agri</i>	Country <i>i</i> 's value of agricultural exports per ton of vegetable and fruit produced in 2006	15694	16960.18
<i>Exp_Food</i>	Country <i>i</i> 's value of food exports per ton of vegetable and fruit produced in 2006	13645	14559.73
<i>SGS</i>	Presence of global TPC player SGS in country <i>i</i>	0.73	0.44
<i>Americas</i>	Geographical dummy variable North and South American countries	0.13	0.33
<i>Europe</i>	Geographical dummy variable European countries	0.72	0.44

Table 2: Explaining Inter-TPC Competition in the International EurepGAP System for Fruits and Vegetables^a

Variables	Estimate^b
Year of Entry	0.006*** (0.00) 8.43
Activity	-0.208*** (0.03) -5.99
Market Share Vegetables	0.0001 (0.00) -0.97
Market Share Fruit	-0.003*** (0.00) -2.86
Export Orientation Agricultural Products	-0.093*** (0.03) -3.60
Export Orientation Foods	0.094*** (0.02) 3.62
Presence of SGS	0.724 (1.03) 0.70
South America	-4.057*** (1.54) -2.62
Europe	-0.801 (1.39) -0.57
Rho	0.12
Test Statisticis:	LogL:-864.05 DW: 1.34 R2: 0.496

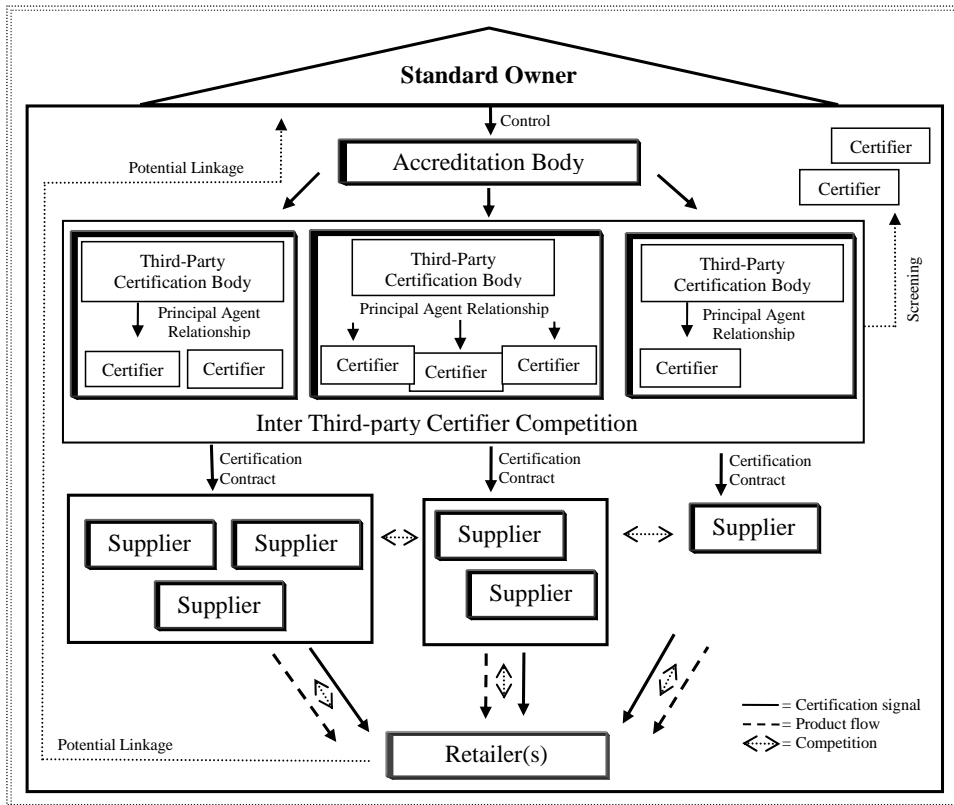
^a Dependent variable: Number of competing TPC's in country i.

^b ExactML random effect estimates of elasticities corrected for serial correlation. t-statistics and standard errors (in parentheses) computed with White's heteroscedasticity-consistent standard errors.

***, ** and * statistically significant at the 99%-, 95%-and 90%-level, respectively.

Figures

Figure 1. Schematic Structure and Competitive Relationships of the Certification Market



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