Voluntary traceability standards: which is the role of risk?

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Abstract

In the last decades a growth of food standards has been revealed in the EU market. Several of these standards concern the management of supply chain relationships and represent alternative modes of transactions organization. In addition to mandatory traceability rules, voluntary regulation offers food firms a wide range of traceability systems. Current literature on drivers of inter-firm transaction governance has stressed the key role of risk. The role of risk could be crucial also in the choice of alternative governance forms, like traceability standards. The aim of the study is to investigate the influence of relational and performance risks on the different voluntary traceability systems adopted by the firms within the food supply chains. A survey was conducted in the Italian population of 216 firms which have implemented voluntary traceability rules based on the standard ISO 22005:2007. An ordinal regression model was used in the analysis. Policy and managerial implications are derived form results.

1. Introduction

In recent years, the impact of repeated food safety incidents on public concern and businesses has raised the interest of governments and private initiatives in the elaboration of mandatory and voluntary standards aimed at evaluating and managing efficiently food safety risks within firms and along food supply chains. Traceability is one of the most important normative interventions aimed at avoiding the safety failures for food products (Charlebois et al., 2014).

The proliferation of traceability standards and systems sheds light on the perspective of food traceability and on the understanding of the mechanisms leading agri-food firms to choose among different kind of rules and methods for their implementation.

The paper tries to contribute to this research question by considering traceability standards as alternative modes of the supply chain organization affecting vertical relationships (Banterle and Stranieri 2008). The effects on vertical coordination will depend on the type of standard and system applied, leading to a set of different situations from a low to a strong coordination (Canavari, 2010; Trienekens and Zuurbier, 2008).

Current literature on drivers of inter-firms transaction governance has stressed the key role of risk (Billitteri et al. 2013; Pilbean et al., 2012; Hagigi and Sivakumar, 2009). On one side, rapid changes in the macroeconomic context; like price volatility, production costs, legal context etc., can push food firms to adopt strategies oriented to dynamic and flexible forms of supply chain organization. On the other side, the need to maintain firm market reputation and the efficiently manage supply chains can address firms towards standards which imply a more stringent supply chain organization. The role of risk could be crucial also in the choice of alternative governance forms, like traceability standards. In specific, the risk can be analyzed in terms of relational risk connected to opportunistic behavior of supply chain partners, and performance risk related to the changes in the economic environment (Das and Teng, 2001).

The paper focuses on the standards ISO 22005:2007. We consider such traceability standard as organization form which implies different level of vertical coordination on the basis of the system adopted. The aim of the study is to investigate the influence of relational and performance risks on the system adopted by the firms within the food supply chains. A survey was conducted in the Italian population of 216 firms which have implemented voluntary traceability rules An ordinal regression model was used in the analysis.

The paper is organized as follows: the conceptual framework and the economics of traceability are presented in sections 2. The survey conducted and the methodological issues are examined in section 3. Results and concluding remarks are analyzed in section 4.

2. Conceptual framework

Within the context of economic determinants leading firms to choose among different kind of traceability standards, we consider traceability as an institution that can affect the vertical coordination of food supply chains (Banterle and Stranieri, 2008). North (1991, 1994) defines institution as 'humanly devised constraints that structure political, economic and social interaction. They consist of both informal constraints and formal rules'. In this sense traceability standards are considered as a set of procedures and rules which can affect the organization of transactions within the supply chain, thus alternative modes of supply chain organization (Banterle and Stranieri, 2008). The kind of coordination mechanisms associated to traceability rules will depend on the rules applied to implement them.

Contributions on transaction governance have deeply investigated the drivers concerning the choice of different kind of existing transactions' organization. Empirical literature on Transaction Cost Economics (TCE) has focused especially on the role of asset specificity and uncertainty to explain the choice of different forms of vertical coordination. Asset specificity relays on investments conducted by transaction parties leading to bilateral dependency among them. Such transaction attribute exposes the economic subjects to a risk of opportunistic behavior dealing with the risk that the counterparty could renegotiate the terms of arrangements once investments are made (Leiblein, 2003). Uncertainty relates to the risks associated to a transaction which can obstacle the positive resolution of transactions. TCE refers to transaction uncertainty in terms of level of performance difficulty and level of uncertainty (Williamson, 1991; Gulati and Singh, 1998). The performance difficulty refers to the risk of opportunistic behavior of transacting parties which occurs when transactions are affected by information asymmetry. This exposes the uninformed economic agent to the risk of shirking behavior. The level of uncertainty refers to the risk of maladaptation of transacting parties due to unanticipated changes in the environment (Wever et al., 2012).

Hierarchical modes of organizations suit well in case of risks associated to opportunistic behavior thanks to the introduction of safeguards condition which allow the firms to monitor the correct execution of transactions. The role of opportunistic behavior coming from transaction asset specificity on the governance of vertical relationships has been largely acknowledged (David and Han, 2004). On the contrary, the role of uncertainty on the choice of governance forms is still part of the scientific debate. TCE have mainly studied the organizational consequences associated to the risks of opportunistic behavior, even if there are other kind of risks associated to transaction uncertainty. When making arrangements decisions economic agents have to take into account all the risks surrounding a transaction, like the environment uncertainty (Artz and Brush, 2000). Starting from this background, the paper tries to contribute to a better understanding of the role of risk in

adopting different kinds of traceability rules. In the analysis the kind of vertical coordination mechanisms related to different traceability rules is based on the classification introduced by Golan et al. (2004) who point out that traceability can differ in terms of the amount of information recorded, the tracking unit used, and the sectors of the supply chains involved. The level of information recorded refers to the breadth of traceability, the tracking unit used deals with the degree of product identification (precision of traceability system), and the sectors of the supply chain involved are connected with the depth of the traceability system implemented. A higher traceability breadth, precision and depth involves more complex rules and relates to a higher level of vertical coordination. On the contrary, few rules associated to the implementation of voluntary traceability imply a lower level of vertical coordination.

3. Methodological issues

In accordance with recent economic literature concerning the influence of risk in the choice of organizational mechanisms in inter-firm relationships (Bilitteri et al., 2013; Lo Nigro and Abbate, 2011; Judge and Dooley, 2006; Das and Teng, 2001), we hypothesize the following functional relationship among the groups of variables:

$$VTR_i = f\ (S_i, IS_i, PA_{gi}, T_{mi}, CP_{zi}, SP_i) \qquad [1]$$

with i = 1,.....,146; g = 1,....,3; m = 1,....,3; z = 1, 2.

VTR_i expresses the kind of voluntary traceability adopted by food firms using an ordinal variable (scale 1-3).

Among the independent variables we considered firms' size (S_i). Firm's size is expressed by a scale from 1 to 6 on the base of the income level. Moreover, the independent variables have been selected in accordance to the economic literature with the aim to use proxies of the factors explaining the relational and performance risks. Relational risk variables are: investment specificity (IS_i), partners' asymmetry along the supply chain (PA_{ig}), and trust among the supply chain agents (T_{im}). Performance risk variables are expressed by consumers preferences for specific food attributes that push firms to implement voluntary traceability (CP_{iz}) and the geographical proximity of suppliers (SP_i).

To investigate the investment specificity (IS_i) we asked firms whether they conducted physical investments together with suppliers. Answers were in a dichotomous scale.

Partners' asymmetry along the supply chain (PA_{gi}) was measured through three variables. The first investigates the presence of contractual power asymmetry between firms implementing voluntary traceability and suppliers (scale 1-4). The second relates to the asymmetry in liabilities among the agents of the supply chain (scale 1-4) and the third variable investigates the presence of transaction information asymmetry (scale 1-4).

The level of trust was measured by other three variables. The first measures the level of non-confidence in suppliers (scale 1-4). The second deals with the reputation of main suppliers (scale 1-4) and the last one refers to the length of time of inter-firm relationships (scale 1-4).

The consumer preferences that push firms to implement voluntary traceability (CP_{zi}) were expressed by two variables: changes in consumer food safety perception (scale 1-4) and changes in consumer preferences towards food quality differentiation (scale 1-4). The geographical distance of the main suppliers (SP_i) was measured by a rating scale (scale 1-4).

We conducted an ordinal regression model to test whether variables associated with relational risk and performance risk play a statistically significant role to explain the different kind of voluntary traceability adopted by food firms along the supply chains.

Before running the ordinal regression we carried out a correlation analysis among the independent variables in order to exclude those variables with a significant level of correlation. We removed from the ordinal regression model the variables with a high level of correlation. The model was developed under SPSS software package (version 22). We used the Logit as link function because it assured the best fitting of the model.

4. Results and implications

With regard to general firms characteristics the 38% of the sample is composed by firms with less than 20 employees, the 22% with a number of employees between 20 and 50, the 14% is represented by businesses with a number of workers between 50 and 100, the 10% between 100 and 150 and the 16% with more than 150 units. Moreover, 9% of the interviewed show an income of less than one million euro, the 36% state a turnover between 1 and 10 million euro, the 23% between 10 and 25 million, the 13% declare a turnover between 25 and 50 million euro, the 3% between 50 and 100 million and the 15% more than 100 million euro. The structural features of the present sample reflect the structural characteristics of the Italian and European food industry which is composed by both small and big firms which compete on the same market.

The sectors more represented within the sample were: fresh and processed meat (22%), processed fruits and vegetables (21%), diary, including milk, butter and cheese (26%), and wine (13%). The

other sectors involved were represented by processed fish (2%), olive oil and fat of vegetable origin (4%), processed cereals (3%), bread and pastry (2%), sugar and sweetener (5%) and others (2%).

Before running regression we conducted correlation analysis in order to remove those variables which were highly correlated. Table 1 shows in bold the correlation values of those variables with a p-value < 0.01. We removed the variables 'Income' (S_i) 'Liability' (PA_{2i}), 'Suppliers confidence (T_{1i}) and 'Suppliers distance' (SD_i) from the analysis.

The results of the ordinal regression model are reported in table 3. The overall model test reveals adequate fitting information. The difference between the two log-likelihoods – the chi-square – has an observed significance level of less than 0.0005. Moreover, the Cox and Snell R^2 is 0.488, the Nagelkerke's R^2 is 0.565 and the McFadden R^2 is 0.335, indicating strength of association between the dependent variable and the predictor variables. For the ordinal regression we chose the logit link function.

The variables related to relational and performance risks considered in the ordinal regression are significant. The variable 'Investment specificity' is significant and its coefficient is positive. This is in accordance with TCE literature which demonstrated a positive relationships between the level of vertical coordination and transaction asset specificity. Also the variable 'Suppliers/buyers power' is significant and positively related to the dependent variable. When the risk of opportunistic behavior of economic agents due to an asymmetric distribution of contractual power is high, the probability of choosing a standard entailing higher coordination mechanisms increases. Moreover, the variable 'Inter-firm relationship length' is negatively related to the level of traceability chosen by food firms, revealing that suppliers knowledge increase the level of trust in transactions and decreases the risk of opportunistic behavior and the adoption of a more hierarchical form of transaction organization.

The variables 'Food safety' and 'Food quality' connected to firm performance risk are significant and negatively related to the dependent variable.

Results highlight that risks associated to supply chain relationships and business environment can help to explain firms mechanisms for the adoption of different traceability rules. Both relational and performance risk can be considered as a key driver for shaping different kind of voluntary traceability systems. Such results support the literature on the role of risk in governance of vertical relationships and Transaction Cost Economics. In specific, a positive link between the relational risk and the kind of voluntary standard system adopted is revealed; indeed a higher risk leads to the introduction of more complex traceability rules. Also the variables associated with the performance risk result to be significant in explaining the kind of traceability standard adopted. Nevertheless, it is negative related to the dependent variable, according to the existing economic literature on the relationships between performance risks and transaction governance. In this case, performance risk

seems to lead to the implementation of a system which does not imply a strong coordination. The use of a more flexible standard rules could be related to the fact that firms prefer to minimize the risk of firms maladaptation in those situations where the risks of change in consumer preferences. The difficulty to communicate standards to consumers and the risk to be perceived as insufficient or meaningless bring firms to adopt more flexible voluntary traceability systems.

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Tables and figures

Table 1. Correlation analysis

	Income	Investment specificity	Suppliers/buyers power	Liability	Information asymmetry	Trust	Inter-firm relationship experience	Reputation	Food safety	Food quality	Suppliers distance
Income	1	-,224**	0,01	-0,06	0,01	-0,05	0,18	0,12	0,04	0,10	-0,19
Investment specificity	-,224**	1	0,17	0,16	-0,14	,384**	-0,19	-0,05	-0,09	-0,17	,276**
Suppliers/buyers power	0,01	0,17	1	0,20	0,08	0,17	-0,02	0,07	-0,14	-0,07	,280**
Liability	-0,06	0,16	0,20	1	0,00	,286**	0,05	0,09	-0,07	-,282**	0,20
Information asymmetry	0,01	-0,14	0,08	0,00	1	-0,02	0,08	0,16	0,17	0,04	0,00
Trust	-0,05	,384**	0,17	,286**	-0,02	1	-0,21	0,05	0,03	-,219**	,225**
Inter-firm relationship experience	0,18	-0,19	-0,02	0,05	0,08	-0,21	1	-0,06	0,14	0,07	-0,17
Reputation	0,12	-0,05	0,07	0,09	0,16	0,05	-0,06	1	0,08	0,19	0,00
Food safety	0,04	-0,09	-0,14	-0,07	0,17	0,03	0,14	0,08	1	0,08	-0,19
Food quality	0,10	-0,17	-0,07	-,282**	0,04	-,219**	0,07	0,19	0,08	1	-0,09
Suppliers distance	-0,19	,276**	,280**	0,20	0,00	,225**	-0,17	0,00	-0,19	-0,09	1

**: Sig. 0.01

Table 2. Regression results

	Estim.	Srd. Error	Wald	df	Sig.	95% Confidence interval	
						Lower bound	Upper bound
Threshold							
VTRi = 1	-2,633	1,445	3,321	1	0,068	-5,464	0,199
VTRi = 2	1,658	1,453	1,302	1	0,254	-1,190	4,505
Location							
Investment specificity	2,140	0,451	22,547	1	0,000	1,257	3,024
Suppliers power	0,554	0,188	8,678	1	0,003	0,185	0,923
Information asymmetry	0,352	0,232	2,302	1	0,129	-0,103	0,807
Inter-firm relationship lenght	-0,931	0,215	18,701	1	0,000	-1,353	-0,509
Reputation	-0,134	0,197	0,466	1	0,495	-0,519	0,251
Food safety	-0,475	0,186	6,528	1	0,011	-0,840	-0,111
Food quality	-0,744	0,182	16,744	1	0,000	-1,101	-0,388

Link function: Logit.

Pseudo R^2: Cox and Snell 0,488; Nagelkerke 0,565; McFadden 0,335