Food Control 80 (2017) 187–196

Contents lists available at ScienceDirect

Food Control

journal homepage: www.elsevier.com/locate/foodcont

# Do motivations affect different voluntary traceability schemes? An empirical analysis among food manufacturers

Stefanella Stranieri, Alessia Cavaliere*, Alessandro Banterle

*Department of Environmental Science and Policy, Università degli Studi di Milano, Via Celoria, 2, 20133, Milan, Italy*

ARTICLE INFO

*Article history:*
Received 3 January 2017
Received in revised form
12 April 2017
Accepted 30 April 2017
Available online 4 May 2017

*Keywords:*
Traceability schemes
Economic firm motivations
Sustainability certifications
Food supply chain
Structural model
Survey

ABSTRACT

The purpose of this study was to explore the links between the motivations leading firms to adopt quality certifications and the kinds of voluntary traceability implemented to comply with such requirements. Specifically, our analysis focuses on the voluntary traceability implemented to accomplish certification requirements addressing environmental and social sustainability. To reach our goal, we conducted a survey through an ad hoc questionnaire on a sample of 131 Italian food firms. Structural equation modeling with Partial Least Squares was used to analyze the relationships between the motivations of sustainability certification adoption and the kind of traceability implemented. The results show that most of the motivations related to the adoption of sustainability certifications are statistically linked to the level of traceability complexity implemented. More precisely, confidence-related and supply chain motivations are positively related to the level of traceability complexity, whereas profitability-related motivations are negatively associated.



## 1. Introduction

The number of quality certifications adopted by food firms is growing constantly (Beatty, 2006; Karipidis, Athanassiadis, Aggelopoulos, & Giompliakis, 2009). Such certifications are used to improve the quality and safety of products (Manning & Baines, 2004) and to enhance collaboration among supply chain partners. Indeed, they are considered as important firm strategic elements because they entail an efficient reorganization of chain relationships and enhanced food quality and safety management (Trienekens & Zuurbier, 2008). The other aims of these certifications are linked to the improvement of environmentally friendly and socially responsible practices. The feasibility of a certification is directly related to the adoption of specific traceability schemes capable of increasing and guaranteeing the transparency of the supply chain. Traceability, therefore, plays a crucial role because it represents a fundamental tool for certification adoption.

Nevertheless, there are different kinds of traceability schemes. In the EU, food traceability is mandatory. Regulation 178/2002 obliges all firms to trace suppliers, customers and the quantity of product exchanged. Such traceability is simple and entails a low level of transparency and precision (Charlebois, Sterling, Haratifar, & Naing, 2014). The EU requires more severe rules for the traceability of meat products through Regulations 1760/2000 and 1337/2013. This scheme entails the unique identification of goods and makes it possible to reconstruct the complete history of meat products. In between these mandatory rules, economic agents are also free to choose among a wide range of voluntary traceability schemes that can be adopted to guarantee both the safety and/or quality characteristics of food products. More precisely, voluntary traceability can refer to different levels of complexity, i.e., from simple rules to complex procedures.

The adoption of different certifications requires the implementation of specific traceability schemes. Nevertheless, there is a certain degree of freedom for firms in the choice of different levels of traceability complexity to implement certification requirements. More precisely, the choice of the level of traceability depends on a number of factors, such as the type of product category, the supply chain considered and the cost of implementation (Shamsuzzoha, Ehrs, Addo-Tenkorang, Nguyen, & Helo, 2013). Moreover, Karlsen, Dreyer, Olsen, and Elvevoll (2013) noted the relevance of a firm's strategy in its willingness to invest in different kinds of traceability. Following this consideration, certification represents a strategic choice of the firm that is linked to a set of motivations (Hooker & Caswell, 1999; Karlsen, Donnelly, & Olsen, 2011). Our hypothesis

* Corresponding author.
*E-mail addresses:* stefanella.stranieri@unimi.it (S. Stranieri), alessia.cavaliere@unimi.it (A. Cavaliere), alessandro.banterle@unimi.it (A. Banterle).

http://dx.doi.org/10.1016/j.foodcont.2017.04.047
0956-7135/

is that the level of the traceability complexity depends on the motivations that lead firms to adopt specific certifications (Fig. 1).

Many studies have revealed the presence of different motivations affecting firms' decision to implement quality certifications (Karipidis et al., 2009). To the best of our knowledge, no study has investigated the relations between the motivations for quality certification adoption and the level of voluntary traceability complexity adopted to fulfill the certification requirements. This paper aims to fill this knowledge gap through an analysis of the links between the motivations leading firms to adopt quality certifications and the kinds of voluntary traceability implemented to comply with such requirements. Specifically, our analysis focuses on the voluntary traceability implemented to accomplish certification requirements addressing environmental and social sustainability.

To reach our goal, we conducted a survey through an ad hoc questionnaire in 2015. The sample was composed of 131 firms. Structural equation modeling (SEM) with Partial Least Squares (PLS) was used to analyze the relationships between the motivations of sustainability certification adoption and the kind of traceability implemented.

## 2. Traceability and sustainability certifications

### 2.1. Food traceability definitions

Traceability refers to the ability to trace products (Karlsen et al., 2013). This concept has been largely adopted at a regulatory level to strengthen food safety after the occurrence of repeated food scandals. European legislation on food traceability is one of the most complete normative framework (Charlebois et al., 2014). Regulation 178/2002 introduced a mandatory traceability based on the principle of 'one step back'–'one step forward', which obliges food firms to be able to identify from whom a food product is supplied and to whom it is sold (Karlsen et al., 2011). This regulation allows a degree of flexibility for business operators in the implementation of traceability schemes because it specifies the information to be traced without suggesting the way to comply. The meat sector has been regulated in a stricter way due to frequent safety scandals and frauds that have characterized this sector, such as the BSE scandal, the avian flu, and the recent horsemeat scandal. The mandatory Regulation 1760/2000 obliges operators to implement traceability able to identify the product flows within the bovine meat supply chain and within the firms' part. This kind of traceability allows us to reconstruct the complete history of meat products. This kind of traceability has been extended to most meat products by Regulation 1337/2013.

At an international level, it is also possible to find different definitions of traceability. The International Standard organization (ISO) in 1994 defined traceability as the ' … ability to trace the history, application, or location of an entity by means of recorded identifications' (ISO., 1994). ISO-22005:2007 refers to traceability as the 'ability to follow the movement of a feed or food through specified stage(s) of production, processing and distribution'. In addition, the definition of traceability is highly debated in the literature. Opara and Mazaud (2001) describe it as 'the collection, documentation, maintenance, and application of information related to all processes in the supply chain in a manner that provides a guarantee to the consumer on the origin and life history of a product'. Tavernier (2004) describes traceability as a 'process that requires the documentation of information within the supply chain'. Bollen, Riden, and Opara (2006) define it as 'means by which the information is provided'. From these definitions, it is possible to identify some common key features. First, the aim of traceability is to record information flows within supply chains. Second, traceability refers to the systems that allow firms to identify the supply chain operators.

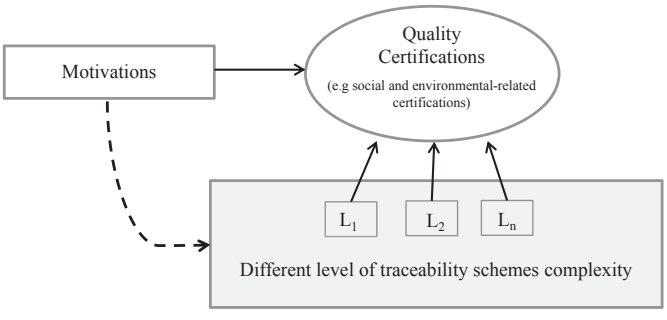


**Fig. 1.** Motivations and level of traceability complexity.

In the literature, traceability is also conceptualized on the basis of some dimensions that can help to explain the differences among existing schemes. Moe (1998) distinguishes two kinds of traceability: supply chain and internal traceability. The first one relates to the identification of the external links that connect the various sectors of the supply chain. The second type of traceability refers to the transparency inside a firm. Golan et al. (2004) introduced three different dimensions to identify differences among existing traceability schemes, i.e., the breadth, the depth, and the precision of traceability. The breadth refers to the amount of information traced, the depth refers to the sectors traced, and the precision is associated with the degree of assurance with which the traceability can pinpoint a particular product's movement or characteristics (Bosona & Gebresenbet, 2013; Ruiz-Garcia, Steinberger, & Rothmund, 2010).

In the European food sector, the minimum level of traceability breadth is that required by Regulation 178/2002. In addition to the mandatory information, food operators can choose to add voluntary information, such as information on harvests, processing methods, the scientific and commercial names of the species traced, and additional supplier details (Asioli, Boecker, & Canavari, 2014). The depth of traceability can range from internal traceability to the recording of all the sectors of the traced supply chain, i.e., the input sector, agriculture, the food industry and retailer. The precision of traceability refers to the dimension of the tracking unit used to implement traceability. The smaller the tracking unit, the higher the probability is of reconstructing the complete history of a single product within the supply chain and the lower the costs are in the case of food safety recalls. McEntire et al. (2010) introduced another dimension to describe traceability, i.e., the traceability speed. This relates to the effectiveness of traceability in transferring the information traced (Badia-Melis, Mishra, & Ruiz-García, 2015). In general, the higher the breadth, depth, precision and speed of traceability, the more complex the related implemented scheme is in terms of rules and procedures applied. On the other side, the lower the breadth, depth, precision and speed of traceability, the more flexible the traceability is because only a few rules and procedures are applied.

Complex traceability leads to high supply transparency, an improved ability to guarantee the truthfulness of information certified, and the possibility to prevent or manage food quality and safety failures (Golan et al., 2004). However, the adoption of complex traceability faces some barriers associated with the costs of its implementation and the difficulty of applying stringent rules to certain food products and to certain supply chains (Canavari, Centonze, Hingley, & Spadoni, 2010a; Chiesa et al., 2011).