

# Traceability and food safety: public choice and private incentives

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## Abstract

In this article we strive to develop some basic “economics” of traceability in order to demonstrate that beyond its major use as a food safety tool, mandatory traceability strongly affects the organization of food system, as well as its structures and strategies. In some cases organizational effects can even overwhelm the safety assurance effects.

The general effect of traceability on the organization of the food systems is to drive even more national brands towards procurement policies based on the outsourcing.

Traceability can heavily affect the nature of relationships along the food supply chain, replacing contractual relationships strongly relied on trust, with highly engineered technological links based on formal short-period contracts

Keywords: traceability, processed tomato industry, organizational forms, firms’ strategies.

## Introduction

In this article we strive to develop some basic “economics” of traceability in order to demonstrate that beyond its major use as a food safety tool, mandatory traceability strongly affects the organization of food system, as well as its structures and strategies. In some cases organizational effects can even overwhelm the safety assurance effects.

In the first section we analyze the effectiveness of traceability in achieving its food safety goals in different institutional and economic environments. We also compare traceability with other public and private food safety tools.

In the second section we represent traceability as a process of information production. This allows us to draw up a plain list of private costs and benefits of traceability, as well as to analyze their distribution among the different actors in the food chain.

In the third section we test the general statements stated in the previous sections using a case study on the Italian processed tomato sector. Stemming from the information gathered through directly interviewing manufactory firms, we estimate the relationships between structural variables and different firms’ responses to traceability.

In the concluding section we highlight how the achieved results call for a wider and multidimensional approach to the study of traceability. In particular the role of traceability in driving organizational strategies in the food sector, raises complex institutional questions.

### 1. Traceability as a food safety tool: effectiveness and comparison with other tools

The study of the literature about food safety reveals the main tools available to the policy makers. This tools show different effectiveness in reducing the harmful events probability and have a different impact on the social actors (Antle J. M. 1996).

The information is mainly directed towards the consumers and it usually has a low distorting level on the market. The main function of the information is that of educating the consumer choice.

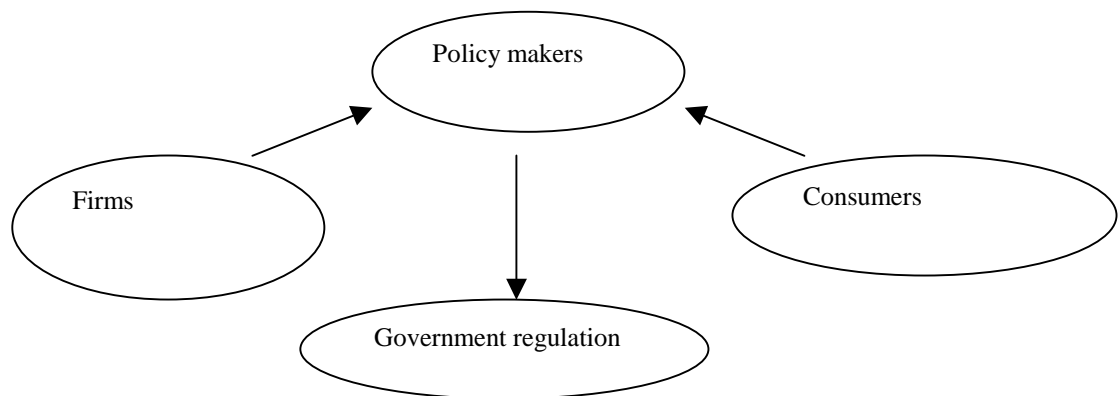
Standards are mainly directed to the firms and can be ignored by the consumers They can modify markets equilibria increasing the level of medium quality.

Licensing is adopted to select firms and has no interaction on the product or on the production process: The listing of the selected firms make the control system more efficient. It also points to the liability of the producer and shorten the time of recalling.

Bans and moratoria can negatively affect the market equilibria but, on the other hand can be the only tool which removes the source of damage. During the recent scares due to BSE emergency, bans and moratoria has been largely used in Europe.

Also mandatory traceability can be considered as a food safety tools. In particular it raises the information flow and makes it available to all the different actors along the food chain. It also shows the capability of facilitating the risk management above all when damage is evident. Nevertheless it must be applied jointly with at least one of the other tools.

Effectiveness of traceability strictly depends on the interaction among social actors: firms, consumers and policy makers. Social actions can be explain as the result of deliberate intentions by individuals or social actors to promote their interests (Rupert L., Hobbes J. E. 1999). Social groups and institutions experience some interaction if the interest of one group conflict with the interest of another group and they will mobilize political actions for accomplishing a predefined goal.



Looking at this interaction process, the effectiveness of mandatory traceability could be affected by three different factors.

First of all must be exist an efficient monitoring system of the whole distribution network that quickly allows to proceed to the effective recalling whenever a risky situation is present. The existence of such a monitoring system and its efficiency level represents an element only partially linked to the productive system. It is also affected by political choices and by the capability of the public operator to implement the system.

The second factor is represented by the capability of the policy makers to identify responsibilities and to choose the better sanction. From this point of view traceability tends to mitigate some managerial aspects which is possible to observe in complex food chain. In this context it is possible to generate a routinization process and a diffusion of liabilities which negatively impact risk manager results. Such controlling system failure is mainly due to a massive diffusion of internal and external controlling forms (Perrow, 1984). For example a technological risk situation, which includes organizational factors such as complacency of operators or inadequate control, may produce a much higher risk for public. Nevertheless, when the political process to implement norms is perceived as inadequate by society; and the capability of persecute a responsible is low, traceability systems could raise the probability of errors.

The third factor has to be found in the incentives generated by traceability system for the firms in order to invest in quality control systems and to prevent any risk. In this case the

main elements to take into account could be the different level of risk which characterize any productive process and the potential damage for the firm brand reputation in case of harmful event. When the food chain is characterized by a low level of risk along all the process stages, firms may be not incentive to invest in quality control, trusting on minor perception of risk that the existence of mandatory traceability system induce in the consumers.

Also when brand reputation does not represents a value to defend, the benefits stemming from the implementation of traceability systems could produce a reduction of the inner activities if quality control and risk preventions.

## **2. Traceability and private incentives: firms' strategic response to mandatory traceability**

To analyse the economic effects of traceability on the food sector it is useful to look at traceability as a process of information production. In that way we can distinguish the analysis of costs from that of benefits and from that of coordination problems associated with the fact that the whole production process is managed by subjects operating in separate stages of the food chain.

Costs will depend primarily on the available technology that can favour some sectors or some firms with easier access, while it can disadvantage other sectors or firms. In some sectors specific investments are needed in order to adapt current plants to traceability systems, by creating for example additional production lines in order to distinguish among different sources of raw materials. Some firms may already have the physical and cognitive resources required for the implementation of traceability systems, while others may not have any. Costs will also depend on firms' size. Usually processes of information production exhibit high fixed costs and a typical u-shaped average variable cost curve. This means that medium size firms are more likely to optimize their costs, while small firms have cost disadvantages, and large firms can experience diseconomies of scale. Furthermore high fixed costs can be barriers to entry, with negative effects on competition.

Benefits of traceability depends on different factors: 1) the quantity of information produced; 2) the quality of information (i.e. information must be consistent with the needs and expectations of the involved subjects, firms, consumers and, the public agencies responsible for control and certification); 3) its peculiar nature of shared information. In the case of mandatory traceability there is a required minimum of quantity and quality of the information, nevertheless some firms may decide to extend the traceability system, reaching higher standards. The choice of quantity and quality concerning the minimum standard of mandatory traceability is a political more than an economic issue. This study focuses on the effects that the mandatory traceability standard has on the firms' behavior.

A larger amount of information facilitates exchanges along the supply chain, lowering transaction costs associated with search activities, and improving operational efficiency within the firms.

Shared information corrects distortions generated by asymmetric information, lowering transaction costs in those relationships affected by moral hazard and adverse selection problems.

The main direct effect of a traceability system is that of improving efficiency in the supply chain management, as a consequence of the transaction costs reduction. Associated with this direct effect there are two important indirect effects: the asymmetric capability of different actors in the chain in the appropriation of the efficiency gain, and the changes in the exchange governance structures induced by the new levels of transaction costs associated with each organizational form.

There are at least three kinds of firms which will exploit the maximum benefit:

1. Firms for which the produced information is valid but do not possess enough resources and incentives to produce it by themselves. Retailers selling private label products fall into this type. They are responsible for the integrity of their suppliers, due to the tort liability rule or to the due diligence clause (Buzby, Frenzen, 1999). A system of mandatory traceability can be a less expensive way of assurance, compared with the current supplier retailer assurance quality systems (Holleran et al., 1999). It shifts even more food safety costs away from the retailers to the suppliers.
2. Firms which already produce information can save resources in case of traceability, because they do not need to cover themselves against partners' opportunistic behaviors in presence of asymmetric information, and because they shift the information production activity to other actors in the chain.
3. Firms which possess material and immaterial resources such as managerial skills, that allow them to get the maximum benefit from the public good, i.e. information, generated by the traceability system. A multinational firm with procurement activities basically based on outsourcing can use the low cost of origin certification assured by traceability to engage in brand proliferation policies coupled with price discrimination practices.

The general effect of traceability on governance structures in the food chain is that of turning vertical integration and long-term contracts in arm's length relationships.

In the food supply chain procurement activities usually have not a high strategic value due to the low specificity of assets involved in exchanges, but they are very important for the efficiency of logistic functions. Furthermore moderate problems of asymmetric information exist and take both the form of moral hazard and adverse selection. These elements have driven the system towards hybrid forms of organization, such as wide firms' networks whose structure is made up of relationships based upon the use of information technology and informal norms at a high use of social capital (we use the Coleman's (1990) concept of social capital, which refers to the resources an actor can mobilize through the structure of the social networks). Strategic alliances, cooperatives and, other forms of firms' associations built up to achieve different goals, from the use of a collective brand to the implementation of an efficient supply chain management and to the launch of new products. These associations rely primarily on trust for their success (Sporlerder, 2000; Sodano, 2002). When relationships are mediated by trust networks' structures (following the approach of network social analysis) they are likely to be more flexible and resilient, generating a larger set of strategic opportunities for the actors at the nodes of the network.

When a traceability system is implemented, the reduction of asymmetric information and the larger amount of public information available can reduce firms' incentives to consolidate their relationships through informal agreements and to coordinate their efforts in the supply chain management. The focus is shifted on the routines and technical coordination for the implementation of the tracing process. The substitution of rigid routines with the previous "weak ties" shaping the networks' structures, cuts down the strategic opportunities for the firms and weakens the whole evolutionary strength of the system. In one sense traceability can destroy social capital, and wastes strategic resources unconsciously spared by a society.

### **3. The case study from the Italian processed tomato sector: firms' traceability perception as an institutional constraint or as a strategic opportunity**

The processed tomato industry is characterized by mature technology, low added value and a low safety risk. Italy is the second world supplier and inside the country the industry is concentrated on two areas (a region in the north and two regions in the south) which we will refer to as "north-area" and "south-area". Due to the economies of localization affecting the procurement activity of the raw agricultural product, the industry exhibits a local network

organizational form such as the industrial district type. Districts in the two areas differs in many aspects that might affect the implementation of traceability systems as well as its costs and benefits. In the sector there is little room for vertical differentiation strategies, while there is moderate room for horizontal differentiation and cost reducing policies. Late innovations have regarded cost reducing process innovation and the relaunch of regional niche products (Gorgitano, Sodano, 2002)

In the north, both agricultural and manufacturer sectors, are highly concentrated with the prevalence of medium-large size firms. The production is specialized in tomato concentrate and pulp and is mostly sold without its own brand to international big buyers. The relationships between farmers and manufacturers is strongly collaborative with procurement long-term contracts and a collective bargaining process which defines the price at the beginning of each production cycle.

In the south there is a less degree of concentration with the prevalence of small and medium firms, especially at the farm level. Production is less specialized, due to the presence of peeled tomato and niche products such as “corbarino” and “san marzano”. The procurement of raw material makes use of poor contracts. The price is determined by a bargaining process based on the competitive game between the two most powerful actors in the chain, farmers’ associations and processors. A supply chain management based on competitive behaviours rather than on cooperative ones, is the most distinguishing feature of the south-area compared with the north one.

Traceability is likely to solve the different problems due to asymmetric information in the two districts.

In the north-area traceability lowers the transaction costs resulting from the moral hazard problem. Customers, which are mainly big buyers and own a massive brand equity, force processor to frequent auditing visits and require rigorous standard of production. Traceability makes suppliers more reliables to the buyers, which also relieve themselves of the responsibility for possible defects and contamination of the product. At the same time traceability makes previous network links unnecessary and it lowers incentives of the partners investing in trust. In this way traceability weakens the social network structure and lowers the available social capital.

Traceability, as referred to the moral hazard problem, works in an opposite way in the south area. Here the lack of trust has traditionally limited the interest of major international customers. Traceability reduces social liability (social liability occurs when the structure of a social network prohibits and obstructs action (Leenders, Gabbay, 1999)), and creates new commercial opportunities for the suppliers. In the South, traceability also corrects the adverse selection problem associated with the signaling of credence attributes of niche products. The success on the international markets of regional product such as corbarino and san marzano, is hampered by the poor managerial and financial resources invested in marketing activities (Sodano, 2001). Traceability can partially make up for insufficient investments in marketing and reputation and can open new markets for these products.

We analyzed the impact of traceability on the processed tomato sector by directly interviewing processors in the two areas. These interviews are part of a larger research project on the tomato industry.

The main results are presented in the tables showed below. First of all we have pointed out the different ways in which the two districts manage traceability. The variables originated by the questionnaires have been tested according to the Chi square. This test shows linear and non linear links between variables. The test is also very general and therefore does not show the direction of the relationship. This direction is then analyzed with the contingent tables. In general the statistical elaboration can be summarized by the following statements.

33% of the interviewed firms is implementing experimental traceability systems. Looking at the regional data, the experimentation involves most of the firms from the North and only 25% in the South.

All firms recognize the function of traceability as a food safety tool and recognize a better warranty for the consumers as one of the advantage of traceability itself.

The firms from the North recognize also the strictly economic advantages of traceability. Particularly they also recognize two economic advantages: the efficiency of supply chain management and, the potential competitive advantages. The competitive advantages come from their better capability to speedily comply with the new legal issues as referred to that of emergency competitors. Furthermore the firms' capability in exploiting benefits from traceability is positively related to their size.

Firms in the south-area do not quote any disadvantage due to the mandatory traceability because they are still not trying to implement traceability and cannot actually measure its cost. Firms in the north-area underline the high incidence of traceability on production cost and complain for the absence of any added value associated with traceability. In fact their buyers are most likely to appropriate themselves of the savings in transaction costs, without offering any premium price to the suppliers.

### **Concluding remarks**

In the paper we studied firms' strategic responses to traceability in order to assess its effectiveness as food safety tool and, its role in driving the evolution of structures and strategies within the food system.

Mandatory traceability can lower firms' incentives to invest in private labelling and certification system as well as in internal quality control systems. This because traceability 1) reduces problems of asymmetric information and therefore the need of certification, 2) lowers the consumers' safety risk perception and therefore their demand of assurance, 3) weakens the power of other legal tools, such as tort liability, of creating incentive for firms to reduce food safety problems.

The effect on the structure and the strategies of the food system have been analyzed using the case study of the Italian processed tomato industry. Here traceability produces at least three kinds of effects: on the structure of the procurement market, on the competitive strategies at the final market, on the general organizational asset of the chain.

At the level of procurement market traceability primarily pushes out of the market those small marginal firms which do not possess enough managerial and financial resources to make the investments required to comply with the new rules. Furthermore it creates barriers to entry towards competitors of the new producing countries (mostly Cina) which must afford higher cost to implement traceability systems.

At the level of final market, traceability gives private label a competitive advantage with respect to national brands. Private label, in fact, can exploit the larger benefits from the "transaction-cost reduction effect" of traceability. Due to the drop in consumers' demand of insurance, national brand are more likely to invest in horizontal than in vertical differentiation. Small-medium firms specialized in niche products take advantages from the effect of traceability of reducing signaling costs of quality. The result will be a higher market share of private label, a brand proliferation, and a lower investment in those quality control systems and process innovation useful for vertical differentiation strategies.

The general effect of traceability on the organization of the food systems is to drive even more national brands towards procurement policies based on the outsourcing.

Traceability can heavily affect the nature of relationships along the food supply chain, replacing contractual relationships strongly relied on trust, with highly engineered technological links based on formal short-period contracts. Through the lens of the social network analysis, changing network's links means changing the structure of the network and the behavior of actors embedded in the structure. The final hint is that in order to assess the actual role of traceability in the food sector, institutional and organizational aspects must be taken in account with the same care as the technological and economical ones.

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Tab 1 - Chi square test

	Pearson Chi square	Sig. asint
Perceived advantages vs district	19,190	0,002
Perceived disadvantages vs district	20,180	0,000
Traceability experimentations vs district	5,240	0,073
Firms' size vs perceived advantages	24,013	0,000

Tab 2 - Perceived advantages due to traceability

	Food safety improvement	Reduction of transaction costs	
North area	14.8 40.0	100.0 60.0	100.0
South area	85.2 100.0	0.0 0.0	100.0
	100.0	100.0	

Tab 3 - Perceived disadvantages due to traceability

	No disadvantage	Rise of production costs	Not additional Added Value	
North area	15.0 30.0	90.0 50.0	100.0 20.0	100.0
South area	85.0 97.0	3.0 3.0	0.0 0.0	100.0
	100.0	100.0	100.0	

Tab 4 - Traceability experimentations

	No traceability experiments	Carring out traceability experiments	
North area	14.8 40.0	100.0 60.0	100.0
South area	85.2 100.0	0.0 0.0	100.0
	100.0	100.0	

Tab 5 - Firms' size and perceived advantages due to traceability

	Food safety improvement	Reduction of transaction costs	
Small firms	85.0 100.0	0.0 0.0	100.0
Medium firms	10.0 30.0	45.0 70.0	100.0
Large firms	5.0 20.0	55.0 80.0	100.0
	100.0	100.0	