

An Analysis of Food Safety Private Investments Drivers in the Italian Meat Sector

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1 Introduction

The general focus of this study is to investigate the decision to invest in food safety as a field of connection between public and private strategies. The objective of the study is to investigate how the legislation pressure influence the decision to invest in food safety systems. The basic idea is to conceptualize the allocation of the decision right to invest among the transaction party, counterparty and regulator as a source of drivers of investments. While the allocation of the decision rights is recognized as the key factor in coping with uncertainty (Gibbons, 2005), it is also here held as term of the micro-foundations of the organizational arrangements (Grandori, Furnari, 2008).

Food companies and agricultural farms pay a great and necessary attention to technologies and economic relationships and arrangements aimed at enhancing and ensuring the due degree of products safety. In all the chain stages, adequate technologies are needed in order to carry out the productive process according to the best prerequisites identified by health and food sciences. Policy interventions intended to prevent food safety crisis have shaped the institutional environment of food systems channelling the companies strategies and have induced, with the technological requirements, the raise of complex organizational forms (Hobbs, 2002; Mènard and Valceschini, 2005). The food chain actors elaborate complex strategies in which technological and organizational choices and institutional commitments assure the food safety level demanded by public and private safety regulations and strategies.

Although the process depicted has been widely investigated under economic and organizational views, a lack of knowledge still remains about the determinants of the investment in food safety strategic choices. There are several drivers of food safety oriented investments.

In the empirical investigation we consider the influence of the law and economic drivers separately for the following food safety risks management systems: HACCP, certification, geographical indications and brand. The knowledge of such an influence provides a better comprehension of the micro-level motivations of food safety strategies adopted and help to understand specific characteristics of the Agri-food governance modes and could favour the elaboration of policy intervention.

The paper is organized as follows: in the second section we introduce the analytical framework. The data analysis approach and the empirical results are presented and discussed in the sections three. The last paragraph is dedicated to conclusions.

2 Analytical framework

2.1 Coordination and information issues and uncertainty

The choice of the efficient governance structure allows the agents to carry out the planned transaction (Williamson, 1985, 1991). Namely the transaction parties seek to align the attributes of the transaction – asset specificity, uncertainty and frequency – to the characteristics of the governance structure (Williamson, 1991, Masten, 2000; Mènard, 2005). Normally, quality and safety strategies in Agri-Food Chains require to make highly specific investments and to deal with uncertainty. Uncertainty exacerbates the effect of asset specificity in choosing more centralized governance structure (Williamson, 1991) and determine the necessity to adapt the governance mode (Mènard, 2004) to unforeseen contingencies (Williamson, 1991, Gibbons, 2005; Gibbon *et al.*, 2013). As a consequence hybrid governance modes became largely diffused (Mènard, Valceschini, 2005; Martino, Perugini, 2005).

Coordination issues influence the safety performance of the food systems. The safety level of food products supplied depends on the behaviour of all agents involved in the food chain. This is because the source of accidents - chemical, physical, microbiological, etc. - may occur at any stage of the system and because remedies and precautions intentionally implemented may fail due to technological flaws or human errors. Thus the safe foods provision involves the choice of appropriate forms of governance able to guarantee the expected objectives. The safety level is an outcome of the coordination designed by the chain agents (Martino, Perugini, 2006; Lupien, 2005; Charlier, Valceschini, 2008; Hammoudi *et al.*, 2009).

The most of the safety characteristics are credence in nature (Hobbs, 2002) therefore an unavoidable information asymmetry arises among the chains partners. The market failure determined by the information asymmetry is an important cause of public intervention (Unnehever, Jensen, 1999). Public intervention takes different forms characterized by various specific objectives and intensity (Garcia-Martinez *et al.*, 2007; Henson, Holt, 2000). Likewise, the information asymmetry is a further important issue to be taken into consideration. Furthermore the unequal distribution of information about food products characteristics requires the agents to design and to implement mechanisms to gather and to channel information and to carry out dedicated activities.

Coordination and information issues motivate the critical importance of the organization arrangements for the supply of safe food. To design effective coordination arrangements requires to cope with uncertainty (Mènard, 2005). Information asymmetries exacerbates the influence of uncertainty (Williamson, 1991).

In sum, on the one hand effective food safety provision systems (Haccp, Certification, Traceability, Certification etc) are based upon or provide organizational solutions of both coordination and information issues; on the other hand, technological and behavioural uncertainty require the agents to allocate resources to food safety systems intended to channel information along the chain and to favour the coordination among the agents (Hammaudi *et al.*, 2009; Hirschauer, Zwoell, 2008; Hobbs, 2004; Mènard, Valceschini, 2005; Dosman *et al.*, 2001; Unnehever, Jensen, 1999). We then consider the investments in food safety systems both as economic instruments to implement safety strategy and as elements related to organizational choices. In the following we elaborate on these points by focusing on the allocation of decision rights as critical step in building up effective safety provision systems.

2.3 Public intervention and allocation of decision rights

The necessity of coping with risks emerging in food chain determined the building up of complex regulatory frameworks (Majone, 2010; Szajkowska, 2009). During the recent decades an intensive change of the institutional framework has been implemented at both national and international level in order to enhance and to ensure the degree of safety of the food products (Fulponi, 2006; Lupien, 2005; Yapp, Fairman, 2006; Garcia-Martinez *et al.*, 2007; Henson, Holt, 2000). The agri-food chain coordination patterns progressively change under the inducements of the co-regulation approaches (Garcia-Martinez *et al.*, 2007) as well as the increasing influence of the food standards' adoption (Swinnen, Vandermoortele, 2009; Hammoudi *et al.*, 2009; Trienekes, Zuurbider, 2008). The implementation of safety oriented activities is associated with monitoring and controlling while signalling to consumers and

chain partners the degree of safety of the products delivered is a critical strategic tool (Elbash, Riggs, 2003; Golan *et al.*, 2001). Beyond the compliance with the law, agents have identified specific objectives that concern private standards (Hobbs *et al.*, 2002; Trail, Koenig, 2010; Hammoudi *et al.*, 2009; Henson, Reardon, 2006; Trienekens, Zuurbier, 2008), complex information management systems (Charlier, Valceschini, 2008; Heyder *et al.*, 2012) and signalling devices (Hatanaka *et al.*, 2005; Golan, 2003; Konefal, Hatanaka, 2011).

The alignment of the behaviour of the agents, is a critical instrument to cope with technological and behavioural uncertainty (Hirschauer, Mussoff, 2006). Our approach elaborates on the idea that the allocation of the decision rights is the tool to sustain the achievements of safety requisites. Theory states that in order to cope with uncertainty the parties negotiate *ex ante* the allocation of the critical decision rights to the party who is expected to maximize the total surplus (Gibbons, 2005; Gibbns *et al.* 2013). Although the parties could not anticipate at the time of the contract outset all the future specific necessities which may rise due to inherent uncertainty of food safety, they may decide how to face these necessities by allocating the critical decision rights at the time of the negotiation of the governance structure. Drawing from Gibbons (2005) we contend that the coordination pattern among two parties in the chain may follow the following timing:

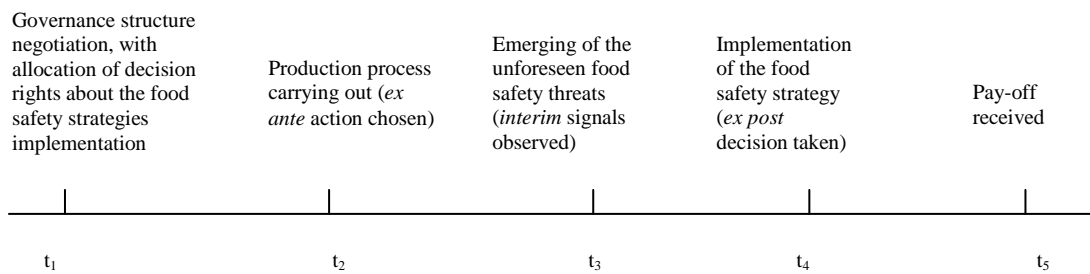


Figure 1. Allocation of decision rights about food safety private strategy and timing of implementation

The figure 1 indicates that the choice of the governance mode allows the parties to coordinate themselves to the purpose of safety provision. The allocation of the decision rights is aimed at allowing the parties to achieve the largest surplus, provided the uncertainty influence (Gibbons, 2005; Williamson, 1991). We contend that the relevant rights set includes also the right to decide the investments required to design and implement the investments needed to set up the safety provision systems.

Many factors inducing the adoption of food safety standards can have an effect on the allocation of the decision rights. In general, the compliance with law (Henson, Holt, 2000) limits the freedom of contract of the parties and modifies their degree of freedom in the decision making process. The external pressure caused by the chain partners or final consumers (Trienekens, Zuurbider, 2008) has a similar impact. The size of the firm can influence the adoption of standards (Trienekens, Zuurbider, 2008) and can interfere on the allocation of the decision rights because of its relation with the capability of the firm to implement safety system (Yapp, Fairman, 2006). These factor interact with the internal motivation of the firm, the objective to strengthen the market position (Zaiber, Bredhal, 1997), the search for a premium price (Zhou *et al.*, 2011) and for scale economies (Trienekens, Zuurbider, 2008, p. 120), and the reduction of the transaction costs (Henson, Northern, 1998; Loader, Hobbs, 1999).

Public intervention and private strategies set up a complex network of rules and incentives aimed at achieving an enhanced degree of food safety (Garcia Martinez *et al.*, 2007). Food safety rules have influence upon the decision rights concerning the process implementation, the enforcement, and the monitoring and controlling activities as well as the design of entire food safety systems. The parties to a transaction may agree upon a given allocation of decision rights in order to achieve the higher efficiency possible in coping with uncertainty. Nonetheless, based on the comparison of benefits and costs of effective safety strategies (Antle, 1999; Garcia Martinez *et al.*, 2007), the policy intervention may

delimitate the right to decide the allocation of decision rights and may also force the parties to adopt a given allocation.

2.4 Food safety investments drivers

To the purposes of our analysis, we distinguish the *right to decide the allocation of the decision right to invest* from the *decision right to invest*. If the public regulation prohibits to carry out a given productive operation, then none of the parties to a transaction can carry out that operation: none of the party will invest to the purpose of that operation. If the public regulation constrains a party to carry out the given operation, then the party has to invest and none can decide how to allocate the decision right to carry out the operation. Therefore it seems that public prohibitions and prescriptions share a common general trait, actually both of them deprive the parties of the right to decide the allocation of decision rights related to the objective of the public intervention.

In terms of decision rights, then, the first effect of the public intervention we consider is to deprive or not the private agents to decide the allocation of decision rights. The figure 2 illustrates the investments drivers we identified.

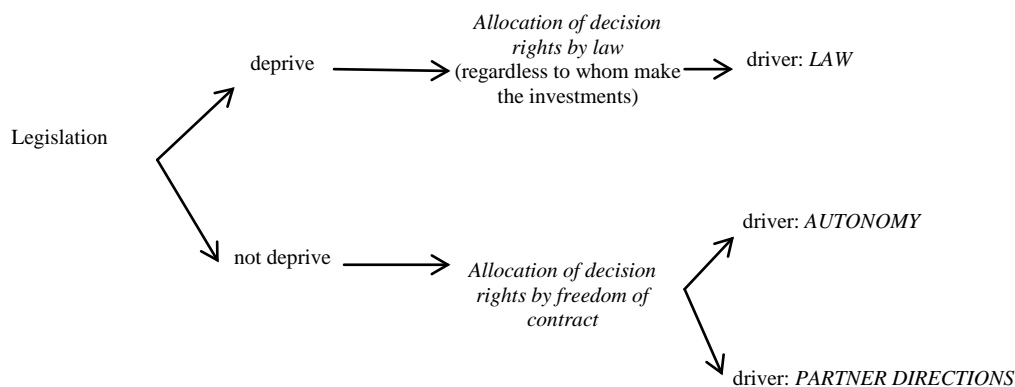


Figure 2. Identification of the investments drivers

In the first case, the critical decision could be made by public officers or by private agents but strictly according to public prescriptions or prohibitions. As a consequence the investment decision would be made by the force of the law. This is the field of compliance with the legislation. The second case is that grounded upon the freedom of contract: the parties will behave according to the model depicted in Figure 1. On the other hand, buyers and consumers expectations could induce companies to invest in order to ensure and to enhance the degree of safety of the products. In other words, if the law does not deprive the parties of the right to decide the allocation of the decision right to invest, then free decisions can be made. The parties have thus the freedom to make investments to the purposes of safety performance and surplus maximization. The party to a transaction could decide to maintain the decision right to invest as she expect to maximize the total surplus of the transaction. The *autonomy* – that is the capacity and willingness to act by herself - is thus an additional investments driver often crucial in the implementation of marketing plan based on safety and quality (Martino, Perugini, 2006, Fulponi, 2006). Moreover, to deal with the coordination and information food safety management issue, a party may decide to allocate to the counterparty the right to invest, in such a case the investment will be made under the *directions of the partners* which is then the third driver we identify.

If the decision about the allocation of the decision right to invest can be freely made according to the complete freedom of the private agents, the parties will choose the efficient allocation of the decision rights to invest (Gibbons, 2005). Therefore, under the point of view of a transaction party, we distinguish two cases: a) the decision rights is fully exerted according to the liberty of the transaction party, we label “Autonomy” this case; b) the decision right is allocated to the transaction counterparty (“Partner directions”). We operationalize this conceptual approach by two steps (par. 2.3): we firstly

introduce a selection hypothesis intended to capture the influence of the policy interventions on the decision patterns and then we identify the types of investments drivers.

3 Empirical study

According to Loader and Hobbs (1999) food safety investments are expected to be made in all the critical areas of firm activities. We considered a wide definition of food safety system, namely we consider all the system based on the qualification of the production processes or the product paying explicit attention to safety.

We consider five basic organizational systems that have been developed to achieve food safety and food quality objectives: *Haccp system*, which provides the basic possibilities to implement the right technology; *Certification*, which integrates the search for signalling objectives and the organizational innovation (Unnevehr and Jenson, 1999; Crespi & Marette, 2001); *Geographic Indications*, which require the producers on the supply side to comply with specific rules and, on the demand side, are able to channel adequate information toward consumers (Louriero, Umberger, 2007); *Brand*, which are used to signal of quality and safety characteristics even though consumers seem to prefer public labelling (Roosen *et al.*, 2003); *Traceability* which facilitates the management of supply chain by the possibility of identifying liabilities by enhancing the efficiency of control activities (Heyder *et al.*, 2012; Starbird, Amanor-Boadu, 2006; Hobbs *et al.*, 2005; Hobbs, 2004) and supporting transparency (Beulens *et al.* 2005).

3.1 Method of analysis

How does the relationship between the allocation of the decision right to invest work in the context of a strong legislation pressure? Consider the case in which paradoxically any legislation existed on food safety, the parties to a transaction would have the convenience to decide the allocation of the decision right to invest in order to cope with uncertainty and coordinate themselves. Of course we cannot observe the allocation of decision rights impact in the case of absence of legislation, because it is not real. We only can observe farms and companies which are under the legislation pressure as the safety is a pre-requisite of the food. Therefore, observing the real farms and companies we may not be able to capture completely the relation between the allocation of the decision rights and the investment decision concerning the necessity to cope with uncertainty in food safety context. In other words, we are observing a “decision making space” in which both law and free willingness could operate as determinants of the allocation of decision right to invest. Asking agents to declare what are the drivers of the investments they made, we are sampling decisions in that “decision making space” and the decisions sampled may be not representative, if the logical possibility exists that the decision to allocate the decision right is made regardless to law (this is for example the case of the supply of meat-food for kids). Actually the investment decision right could have been allocated without law pressure, but as we can only observe decision made in law pressure context, it makes sense to make the hypothesis of selection.

Furthermore, the food safety investments may span from the simply change of the way to carry out an unique productive operation to the set up of complex traceability or certification systems. Asking agents to declare if they have invested exploring this very large field would provide answers not fully comparable. A focus on system is needed, in order to capture comparable behaviors. Unfortunately, the system view, includes several possible motivation including the competing quality and safety aims.

Both the two reasons illustrated motivates a selection bias. In order to test for the selection hypothesis discussed above, the method of data analysis is based on the estimation of a bivariate probit model with sample selection (Greene, 2008). The model includes a selection equation and an outcome equation. The selection equation accounts for the decision based on the utility of undertaking the *change* under the inducements of the legislation pressure. The change process indicates that the farm/company of the respondent reacted to the food safety legislation pressure. In this context, decisions to invest could have been made which are of the interest in the present study. In other words,

$$(1) \quad Y_1^* = \alpha_1 X_1 + \varepsilon_1$$

where:

Y_1^* is a latent variable which refers to the utility to undertake the change, mainly related to the compliance with the law (Hirschauer, Zwoll, 2011);

α is a vector of unknown parameters;

X_1 is a vector of exogenous variables;

ε_1 is the error terms.

The outcome equation expresses the decision based on the utility of making the investments, having undertaken the change under the inducements of the general law pressure:

$$(2) \quad Y_2^* = \beta_2 X_2 + \varepsilon_2$$

where:

Y_2^* is a latent variable which refers to the utility to undertake the change;

β is a vector of unknown parameters;

X_2 is a vector of exogenous variables;

ε_2 is the error terms.

The decision patterns summarized by the equation (1) and (2) can be depicted as follows (see also Signorino, 2002):

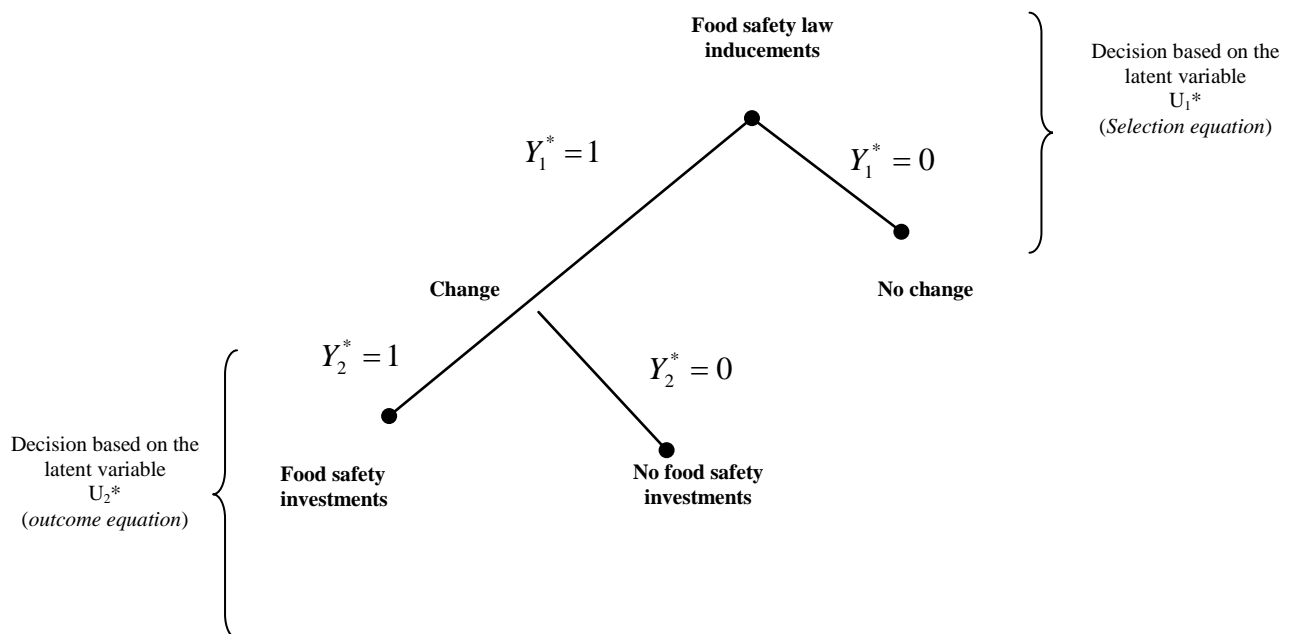


Figure 3. Investments decision pattern

Of course, we only can observe the decisions made when the latent variables are larger than 0.

Our approach to empirical analysis focuses on how the three drivers considered influence the probability to invest. Each of the drivers considered may have the same (positive, negative) or a different impact on that probability for all the types of investments taken into account. If the impacts on the three types of investments have the same (different) sign, then we conclude that inducements of each driver (Law, Autonomy, Partner directions) converge (diverge) toward the same effect, increasing (decreasing) of the probability to invest. Our method of data analysis focuses on association. The convergence (divergence) in terms of types of investments regards how the impact of each driver is

associated to each type of investments. The convergence (divergence) in terms of drivers concerns with how for each investments the drivers associate themselves. The types of association of the drivers, with respect to each investments highlights instead how public interventions and private strategy combine themselves.

3.2 *Data*

The empirical analysis was carried out gathering data by using the data base built on in 2005-2006 by through a postal questionnaire submitted to 2036 Italian companies. The postal address were achieved from Posteitaliane – the company managing mail services at national level – and the selection of the companies was carried out by the unique criterion of “Field of activity”. The companies selected were active in the field of animal products supply and were engaged in various stages of food chains (i.e., agricultural, processing and just trading activities).

The Italian meat sector includes several branches of activities spanning from farm stages production to distribution activities. The sector is based upon a variety of organizational forms strongly influenced by the quality and safety policies and a large diffusion of certified products. The main branches of activities are the bovine, the pork and the poultry (see Table 1 for details). The policy intervention strongly influenced the organization of the sector. Changes occurred in order to face the BSE crisis and the avian flu. Nevertheless, the sector is characterize by the prevalence of vertical integration in poultry industry and by the diffusion of contractual relationships (among farmers and processors, and processors and retailers) in bovine and pork industry. These variety motivates a different approach in dealing with safety strategies.

The instrument used in our inquiry includes three sections: a) general information about the company, including the date of establishing, the size and the field of activities (production, trade); b) the relationships with other enterprises in the chains, the section focus of the type of contract (verbal, written, brief term, long terms) and related decision (procurement, selling, duration), the information related are not presented here, but are part of a further investigation; c) the activities undertaken in the field of food safety: the information concern with the typo of systems implemented (Haccp, Certification, Brand, Geographical Indication, Traceability, none) and the investments made in order to support the system built on (physical resources, human resources, additional costs); further information concern with: the sources of information on safety, the implementation of specific hygiene practices and the internal safety

Table 1.
Some characteristics of the Italian meat sector

		u.m.	2008	2009	2010
Bovine					
	N. of farms	(000)	93	93	93
	Head slaughtered	(000)	1869	1882	1890
	Meat supply	(Mil Euros)	1057	1049	1069
	Sales	(Mil Euros)	5900	5900	5900
	Import	(Mil Euros)	3122	3138	3336
Pork					
	N. of farms	(000)	-	-	26
	Head slaughtered	(000)	-	-	-
	Meat supply	(Mil Euros)	1606	1628	1673
	Sales	(Mil Euros)	7578	7601	7928
	Import	(Mil Euros)	1839	1765	1972
Poultry					
	N. of farms	(000)	-	-	11117
	Head slaughtered	(000)	-	-	-
	Meat supply	(Mil Euros)	1237	1247	1319
	Sales	(Mil Euros)	5300	5320	5300
	Import	(Mil Euros)	146	131	163

Source: Ismea (2012)

3.3 Variables

There are many studies considering different aspects of the organisational systems of food safety management in various settings. Karaman *et al.* (2012) investigated the managers' opinions about Haccp in Turkish dairy. The additional costs and the lack of adequate physical conditions were ranked at the first position among the barriers limiting the diffusion of Haccp system. Economic incentives and the necessity to comply with the law are identified as the main goals to be achieved through the implementation of Haccp. Wilcock *et al.* (2011) propose similar motivation for the adoption of food safety systems, including Haccp. According to the received literature (Acemoglu, 1996; Lepak and Snell, 2002) the human resources are recognized as the main requirement for the implementation of an effective food safety system (Wilcock *et al.*, 2011, pp. 29 ff.). By an extensive analysis Herath and Henson (2010) found out that the main obstacle to diffusion of Haccp would be the financial constraints while confirming that the consumers' requests act as the great inducement to adopt. Notably they pointed out that the size of the company appears to be not influent.

Collins and Burt (2006) show that brand strategy requires both the parties to a dyad relationship to make specific investments (but they do not emphasize the allocation of decision rights). Quetier *et al.*

(2005) found out that typical cheese producers modified the land use and the genotypes improvements strategies in order to enhance their compliance with Geographical Indication production rules. Heyder *et al.* (2012) provide a comprehensive analysis of the traceability implementing and management in the lens of the technology acceptance model. Their results showed that the costs caused by the management of the traceability systems negatively influence the choice to adopt them, while the intention to invest has a positive role in the diffusion of these systems. Further scholars underlined the necessity to face increased costs caused by the adoption of the food safety systems (Seggerson, 1999; Henson, Reordan, 2001; Antle; 2000). In this context, although the investments in food safety may consist in material resources, human resources and in organisational activities, scholars recognize that human resources, staff skills and training and information technologies are the most prominent resources sustaining food safety systems. This circumstance implies that human resources and additional costs are expected to be more diffused investments made in order to support food safety strategies. Nevertheless, physical resources appear to maintain a role, even though associated to the technological and management changes (Herat *et al.* 2011; Heyder *et al.*, 2012).

To the purpose of the empirical analysis we therefore considered three types of investment mentioned for each system: a) physical resources; b) human resources; c) additional costs of the internal organizational activities. The variables utilized in the analysis are illustrated in Table 2

The code (0,1) indicates as usual the presence/absence of the variable. Thus in the case of investments the value 1 indicates that the respondents declared she invested. In the case of the driver, the value 1 indicates that the respondent recognized the influence of that driver.

The *Beliefs* variables capture the influence upon behaviours (decision to invest) that accounts for the general views of the respondents about the food safety strategies. According to literature, we identified three prominent beliefs: the compliance with law (Loader, Hobbs, 1999; Henson, Holt, 2000; Antle, 2000; Trienekens, Zuurbider, 2008); the expectations about the profitability in terms of number of clients and sales (Trienekens, Zuurbider, 2008; Segerson, 1999; Gorris, 2005; Zhou *et al.*, 2012); and of premium price for the certainty of the safety degree (Loader, Hobs, 1999; Trienekens, Zuurbider, 2008; Fares, Rouviere, 2010).

Table 2.
Variables description and coding

Variable	Symbol	Code
<i>Investments</i>		
Physical Resources (Haccp, Certification, Geographical Indications, Private Brands, Traceability)	PR (Haccp, Cert, Brand, Trace) Gi,	0, 1
Human Resources (Haccp, Certification, Geographical Indications, Private Brands, Traceability)	HU (Haccp, Cert, Brand, Trace) Gi,	0, 1
Additional Costs (Haccp, Certification, Geographical Indications, Private Brands, Traceability)	CO (Haccp, Cert, Brand, Trace) Gi,	0,1
<i>Investment Drivers</i>		
Law	Law	0, 1
Autonomy	Auton	0, 1
Partner directions	Partndir	0,1
<i>Beliefs</i>		
	Law_duty	<i>I completely disagree</i> -2 <i>I disagree</i> -1 <i>I do not know</i> 0 <i>I agree</i> 1 <i>I completely disagree</i> 2 <i>I completely disagree</i> -2 <i>I disagree</i> -1
To ensure food safety is a law duty		
	Custom	<i>I do not know</i> 0 <i>I agree</i> 1 <i>I completely disagree</i> 2 <i>I completely disagree</i> -2 <i>I disagree</i> -1
To ensure food safety increases the number of clients and the sales		
	Price	<i>I disagree</i> -1 <i>I do not know</i> 0 <i>I agree</i> 1 <i>I completely disagree</i> 2
To ensure food safety increases the prices of the products		
<i>Sources of information</i>		
Technicians	Tech	0, 1
Public Health officials	Asl	0, 1
Advertsing	Publ	0, 1
Other entrepreneurs	Enterpr	0, 1
<i>Control variables</i>		
Number of high level managers, as index of the capability to cope with technological uncertainty;	Ndir	Number
Year of experience of the top manager, as index of the capability to cope with technological uncertainty;	Exper	< 5 years 6 – 15 years 16-25 years < 25 years
Volume of sales as an index of the size of the firm;	Sales	0-100.000 Eur/year 101.000-500.000 Eur/year 501.000-1.000.000 Eur/year 1001.000-5.000.000 Eur/year more than 5.000.000 Eur/year
Dichotomous variable, indicating the stage of activity of the firm (production = 1; distribution = 0).	Prod	0, 1

Each *source of information* has a specific effect. *Technicians* are here intended to be associated with the chain relationships (the connection between poultry companies and farmers under contract, for example, is normally guaranteed by the company's technicians network), therefore we expect that this variable strengthen the role of *Partnreq* in explaining the investments decisions. Analogously, we expect that *Asl* is associated with *Law*, being the public Health related to legislation. *Adv* is here intended as a free source of information, vehiculating a zero cost information. With *Other entrepreneur* we thus capture the horizontal exchange of information, mainly channelled in the networks relationships (Omta *et al.*, 2001). The information considered here concerns with the technology and the related risks. A positive effect of these variables would indicate that the source influences the probability to invest.

With *Control* variables we account for variable which may be supposed to influence the decision to invest, but that are not related to the decision to allocate the decision right to invest. Shaosheng *et al.* (2008), Yapp and Fairman (2006), Fulponi (2006) emphasize the importance of the experience of the entrepreneurs and managers to the end of adopting food safety systems. Both *Ndir* and *Experience* are intended to account for the capability – based upon tacit knowledge - to cope with technological uncertainty and then to invest.

Scholars underlines the role of the size of the business in adopting food safety systems. Loader and Hobbs (1999) argue that the legislation can charge small firm of larger costs because of the lack of economies of scale. Trienekens and Zuurbider (2008) underlines the difficulties of small firms to comply. Scale is also invoked to account for different impact and technological risks and well as difference in the class of operations. These differences would be so marked to require different approaches at the various scale of business (Delind and Howard, 2008). We therefore introduced the variable *Sales* in order to account for the influence of scale. The variable *Prod*, finally, is considered to account for the potentially different behaviour in units specialized in trade with respect to those engaged in production or also in production.

3.4 Empirical results

177 questionnaires were filled and returned back (response rate: 8.89%). Among these questionnaires, 117 provided the data used in the present study. The remaining were incomplete and lacking some of the variables needed. The Table 3 illustrates the characteristics of the sample data.

Table 3.
General characteristics of the sample

Variables		
Managers (n. units)		409
Technicians (n. units)		818
Employers (n. units)		77
Skilled workers (n. units)		1988
Generic workers (n. units)		9923
Age of top manager (years)		
	≤ 30	9
	31-50	81
	> 50	89
Education of the top manager		
	Elementary school	20
	Junior High School	52
	High School	93
	University Degree	13
Job experience of the top manager (years)		
	≤ 5	9
	6-15	21
	16-25	49
	>25	99
Branch of activity (n.units)		
	Production	47
	Trade	97
	Production and trade	33

Source: the Authors

The sample is characterized by a small presence of skilled workers and technicians. The age of the top managers is of medium or high level. There is a really small percentage of managers with an University degree. This fact could appear to be compensated by the prevalence of large work experience. The 26.6% of the units investigated is specialized in production, the 18.6% in production and trade, whereas the 54% is specialized in trading activities.

In the following we briefly illustrates and discuss the results concerning the selection hypothesis (sample selection bivariate probit models).

Table 4 summarizes distribution of the drivers resulting from the questionnaires. The legislation pressure is the most influential drivers in Haccp and Traceability, but it maintains an important role also in Certification and Geographical Indications. Autonomy and Partners directions are prominent in Certification, Geographical indications and Brand, with an evident role for the allocation of decision rights to the transaction counterparties.

Table 4.
Distribution of drivers by safety systems

System	Law	Autonomy	Partner directions
Haccp	72.7	25.0	2.3
Certification	22.5	69.0	8.5
Geographical Indications	27.3	63.6	9.1
Brand	14.0	76.7	9.3
Trace	57.4	39.0	3.7

Source: *the Authors*

Table 5 (Part I).
Bivariate sample election models

	HACCP			Certification			Geographical Indications		Private Brand		Traceability		
	PR_Haccp	HR_Haccp	CO_Haccp	PR_Cert	HR_Cert	CO_Cert	HR_Gi	CO_Gi	HR_Brand	CO_Brand	PR_Trace	HR_Trace	CO_Trace
<hr/>													
MAIN													
Law_Haccp	1.037***	0.727***	0.276										
Auton_Haccp	0.211	0.0451	-0.202										
Partndir_Haccp	8.117	-8.669	10.55										
Law_Cert				12.184***	-6.220***	1.102**							
Auton_Cert				6.627***	0.833***	0.564**							
Partndir_Cert				6.6753***	0.613***	1.046*							
Law_Gi							-4.169	7.418					
Auton_Gi							0.511	0.693*					
Partndir_Gi							-	-3.785					
Law_Brand									-1.914***	0.666			
Auton_Brand									0.48	0.354**	*		
Partndir_Brand									-2.176**	0.615			
Law_Trace											0.786*	0.437***	-3.745
Auton_Trace											0.163	0.442***	0.0542
Partndir_Trace											8.460	-4915***	-4.294
_cons			0.634***	-5.822***	-1.518***						-1.285**		0.962
<hr/>													
Change													
Law	-0.311	0.241	-0.0631	0.191	0.0703	0.217	-0.1083627	-0.208	-0.143	-0.274	-0.0892	-0.214	0.0558
Custom	-0.315*	-0.136	-0.452***	-0.232	-0.171	-0.184	-0.3853***	-0.315*	-0.352***	-0.427**	* -0.425**	-0.174	-0.392**

Table 5 (part II).
Bivariate sample election models

	HACCP			Certification			Geographical Indications		Private Brand		Traceability		
	PR_Haccp	HR_Haccp	CO_Haccp	PR_Cert	HR_Cert	CO_Cert	HR_Gi	CO_Gi	HR_Brand	CO_Brand	PR_Trace	HR_Trace	CO_Trace
Price	0.266*	0.0902	0.302**	0.214*	0.244	0.197	0.26117**	0.283*	0.276***	0.380**	0.222	0.102	0.248*
Tech	0.0771	0.251	-0.0694	0.339	0.452	0.563	0.1593706	0.0958	0.0604	0.024	-0.0646	-0.111	0.367
Asl	0.709	0.992	0.37	1.049**	1.303***	1.050	0.3638364	0.756	0.298	0.475	0.494	0.641*	0.896
PublAdv	0.0868	0.364*	0.0932	0.134	0.0376	-0.0759	0.1298488	0.0162	0.24	0.0877	-0.0163	0.183	0.218
Enterpr	0.349	0.423	0.676*	0.348	0.372	0.672*	0.2991006	0.404	0.159	0.482	0.618*	0.661***	0.649*
Ndir	-0.0107	-0.00473	-0.00281	-0.00878	-0.0125*	-0.00539	0.011106**	-0.0094	-0.0108*	-0.0104	-0.0052	-0.009***	-0.0057
Sales	0.0000051	-1.51E-06	-2.71E-07	-7.32E-07	-5.54E-06	-2.38E-06	-4.33E-06	-5.55E-06	-10.24	-5.22E-07	-2.72E-06	-7.39-06**	-2.74E-06
Exper	0.000328	0.00744	-0.00374	0.0131**	0.0152	0.00933	0.0011764	-0.00415	0.00115	0.00267	-0.00292	-0.0026	0.098
_cons		-2.398*		-2.324*	-2.568**	-2.554*							-1.840
N	112	112	112	112	112	112	112	112	112	112	112	112	112
Wald	19.03	5.13+e12	1989.77	.	1.6+e11	19.97	1.97	3.6	2.39	199.39	6.82	112860.46	0.8
Prob >	0.0003	0.0000	0.0000	.	0.0000	0.0020	0.3700	0.3000	0.4900	0.0000	0.0800	0.0000	0.8500
	-0.793	-1.000	-1.000	-1.000	1.000	1.000	0.935	-0.939	-0.883	-1.000	1.000	-1.000	-0.696
	4.17	0.19	5.42	165.55	6.67	40.53	106.43	29.34	10.67	35.46	8.55	7.86	0.5
Prob >	0.0410	0.6700	0.0200	0.0000	0.0098	0.0000	0.0000	0.0000	0.0000	0.0000	0.0035	0.0050	0.4770

* p<0.05, * * p<0.01, ** * p<0.001

The Table 5 illustrate the estimates for the sample selection bivariate probit model.

The selection hypothesis holds for all the systems considered except than in the case of investment in Human resources for Haccp (*HR_Haccp*) and in Additional costs for traceability (*CO_Trace*). In the following we provide details about the statistical results paying attention to the selection hypothesis, the statistical significance of the coefficients estimated.

Haccp

The driver *Law_Haccp* is explains the investments decisions both for Physical and Human Resources. Among the *beliefs* variables, only the duty to comply with the law (*Law*) and the expectations about the increase of clients and sales (*Custom*) have an explaining capacity in the case of *CO_Haccp*, while only *Adv* is significant in the case of *HR_Haccp*. *Enterpr* explains the investments in *Additional Costs* emphasizing the importance of horizontal relationships. The influence of legislation is evident and it is associated with the expectations having a clear private economic sense. This results reflects the literature achievements (Trienekens, Zuurbider, 2008; Loader, Hobbs, 1999; Gorris; 2005; Lupien, 2005).

Certification

All the drivers considered contributes to explain the investments decisions. The *change* equation estimates provide a more articulated picture. Price expectations, health authority information (*Asl*) and the experience of the managers (*Exper*) are significant in the case of the investments in Physical resources. *Asl* and *Ndir* are influential in the

case of the Human resources, but only the coefficient of *Enterpr* is statistically significant in the case of the investments in Additional Costs.

Geographical Indications

Only the coefficient of *Auton-Gi* is statistically significant for the Geographical indications system in the case of investments in Additional Costs. Among the *beliefs* considered *Law* and *Price* have significant coefficient for the investment in Human Resources and Additional Costs for Geographical indications. The control variable *Ndir* is significant in the model for *HR_Gi*.

Brand

While *Law* and *Partners* directions have significant coefficients in the case of *HR_Brand*, the driver *Autonomy* is significant in the case of *CO_brand*. The belief *Custom* and *Price* are influential in both the two models, but only the control variable *Ndir* has a significant coefficient and only for *HR_Brand*.

Traceability

The driver is significant in the case of the Physical resources, while all the three drivers are significant in the case of the Human resources investments. For the *change* equation, the expectation *custom* and the information from the other entrepreneurs (*Entepr*) have significant coefficient for Physical resources, Human resources and Additional Costs. Among the control variables *Ndir* and *Sales* have significant coefficient in the case of Human resources investments.

The results delineate a complex picture of the influence of the allocation of the decision right to invest. Certification is a clear case of common influence of the three drivers, in such a case the public intervention and the private strategies combine themselves in a convergent manner for physical resources. In the case of Human resources the legislation pressure has a negative, divergent influence. This indicates that the presence is directed toward physical resources and additional costs. Although the Human resources are relevant to safety outcomes, the legislation pressure has a positive influence because investments are usually idiosyncratic (Williamson, 1985) and this strengthen the coordination (Martino, Perugini, 2006). Notably *Autonomy* and *partner directions* are positive and convergent for all the three types of investments. The legislation influence is of particular importance in Haccp, the mostly diffused system (Yapp, Fairman, 2006; Henson, Holt, 2000). The explaining capacity of the *Beliefs* is mostly evident in the remaining four systems, in which the free choice of the partion is normally more pronounced. The explaining contribution of the source of information is not evident. Notably the horizontal relationships are important in the case of Traceability, which rests on the contact among the

chain stages. The *Ndir* confirms the importance of knowledge to design and to implement food safety strategy. We have to point out that there is not an evidence for the role of size, despite the indications of literature. In synthesis our results indicates a large explaining capacity of an approach based upon the analysis of the allocation of the decision right to invest.

After having delineated the patterns of explanation, a natural step is to examine the impact of the drivers on the decision to invest (Greene, 2008). The Table 6 summarizes the average marginal effects (AMEs) estimated for the drivers of the outcome equation: the AMEs indicate how change the probability to invest under the inducement of the driver considered. They are estimated for all the units of the sample and then the average value is calculated.

Table 6.
Sample selection bivariate probit models - Average Marginal Effects by systems

Drive rs	HACCP			Certificati on			Gegraphical Indication			Brand			Traceab ility		
	PR_HACC P	HR_HACC P	CO_HACC P	PR_CER T	HR_CERT	CO_CERT	PR_ GI	HR_GI	CO_GI	PR_BR AND	HR_BR AND	CO_BRAN D	PR_TRAC E	HR_TRA CE	CO_TRAC E
Law	0.330841 1*** (2.46)	0.258092 8*** (16.68)	0.213173 8 (1.38)	0.17676 17 (1.73)	- 0.148679 2 -(0.02)	0.300714 9*** (5.73)	-	0.267 * (0,10)	0.477906 4*** (0.03)	-	0.490* ** (0.00)	0.233377 4*** (0.01)	0.224593 2** (2.11)	0.15057 24 (0.00)	0.104500 8 -(0.68)
Auto n	0.050485 9 (0.39)	0.014062 6 (0.10)	0.054774 (0.40)	0.26677 22* (1.13)	0.162783 6** (1.94)	0.190323 *** (3.34)	-	0,083 *** (0.00)	0.238485 3 (1.91)	-	0.189 (0.12)	0.134996 7*** (0.01)	0.050196 2 (0.43)	0.14596 76 (0.00)	0.015767 7 (0.11)
Partn dir	0.203054 6 (1.51)	- 0.717861 7*** -(8.92)	0.306265 4*** (2.28)		0.143411 2*** (18.40)	0.271460 8*** (3.43)	-	0-375 (0.015)	0.504545 1 -(0.16)	-	-0.496 (0.00)	0.216565 3*** (0.01)	0.371002 6*** (21.31)	0.68128 65 (0.00)	0.764594 5*** -(2.80)

Haccp

In the model regarding the Haccp system the driver *Law* has a positive impact on the investment on Physical, Human resources and Additional costs. The probability of investing in physical resources supporting Haccp increases by 0.339, and the probability of investing in Human resources also increase but only by 0.254. The increasing is small than in the case of *CO_Haccp* (0.080). The *Partners directions* act as a drivers increasing the probability to invest in Physical resource by 0.552 and by 0.303 the probability in the case of Additional Costs, and reducing by -0.718 the probability of investing in Human resources. Therefore we point out that while *Law* has a similar influence on both physical and human resources, the *Partner direction* has a different influence on the investment in Physical resources, Human resources and Additional costs. The emerging picture indicates that no autonomous decisions drive the invest in Haccp system.

Certification

All the three drivers have an impact on all the types of investments in the case of the certification system. The *Law* increase the probability to invest in physical resources by 0.787 and by 0.301 in additional costs, but it reduces the probability to invest in the case of Human resource (-0.208). The impact of *Auton* on physical resources is positive and smaller than that of law and Partner directions for Physical resources and additional Costs, but larger for Human resources. The probability to invest in human resource is reduce by the *Law* (-0.208) whereas both the *Autonomy* and *Partners directions* increase it. The impact of *Law* on the investment in additional costs is larger of the autonomous decisions and about equal to that of the decisions made by the chain partners. Therefore the certification system involves a complex allocation of the decision rights along the chain. The first reason for that is the mandatory and voluntary certification schemes co-exist in the sector examined. The can also be explained by the evidence that certification requires a strict monitoring of the production process entailing then the combination of autonomous and partners decisions. Furthermore we note that, while the decisions of parties tend to increase the probabilities of all the types of investments, the *Law* does not promote the investment in human resources. This point is relevant because, while it reflects the policy inducement to increase costs (Henson, Reordan, 2000), it clearly contradicts the necessity of sustaining safety strategies with adequate skills and human competences (Yapp, Fairman, 2006; Fulponi, 2006; Gorris, 2005).

Geographical indications

The discussion of the case of Geographical indication can just concerns the model for invest in the Human resource (-0.552) and additional costs investments (0.601). Notably, we see that the driver *Law* reduces the probability to invest in Human resources but increases the probability if investing in additional costs. This would suggest that the legal framework tends to charge specific additional costs on the participants to the systems, confirming the existing evidence (Belletti et al...). On the other hand also the *Autonomy* decision has a similar effect on Additional costs even though it is weaker.

Brand

The probability to invest in Human resources increases under *Law* inducements but strongly decreases with *Partndir* in the case of Brand system, suggesting a prevalence of the legal framework which limits the importance of Brand opportunistic relations.

Traceability

The AME of *Law* is 0.235 in the case of traceability system. The allocation of the decision rights to the transaction counterparty also reduces the probability to invest in additional costs, indicating that the chain relationships may entail efficient approaches to that safety system.

4 Final remarks

The study addressed the question of how much law compliance and economic and organizational goals determine food safety investments. We focus on inducements to invest due to the necessity to comply with the law, to the individual free economic convenience and particularly on the allocation of critical decision rights to the party who is expected to be able to maximize the relationship total surplus. The decision to allocate the decision rights appear to be able to influence the choice of the investments as well as the remaining two drivers. The evidence indicates that the decision rights perspective is meaningful in order to investigate how public and private activities combine themselves in food safety provision. Furthermore, the role of public regulation (law) is concentrated in terms of food systems and types of resources. The allocation of decision right to the counterparty is evident, thus there is also a confirm of this organizational solution, as predicted by theory, This evidence contributes to shed light on the strength of the coordination devices associated by safety strategies.

The study presents two main limits. First, the association among the drivers entails both substitution and complementarity among the investments, but our method does not allow for discriminating these facts. A specific approach should be carried out (REF). The second limits derives from the fact the our questionnaires did not provide any information about the allocation of decision rights to collective bodies, which instead play a role in many of the systems considered.

The knowledge of the pattern of influence may contribute to design public and private policies aimed at increasing the degree of product safety.

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