

# An analysis of food safety private investments drivers in the Italian meat sector

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**Abstract:** Food safety systems that implement Hazard Analysis and Critical Control Points (HACCP), certification, traceability, brands as well as in geographical indications and private branding require dedicated investments in physical resources, human resources and in re-organising the production processes and control activities. Investment decisions can be made according to legal requirements or based on voluntary decisions. In this study, we address the two following research questions: do the inducements due to the regulatory framework influence the decision to invest in the implementation of food safety strategies and what is the size of this potential influence? Does the allocation of the decision right to invest influence the investment decision and does this potential influence vary across food safety systems? We carried out an empirical investigation on investment decisions in the Italian meat sector, comparing systems dedicated to safety and marketing strategies. The knowledge of such an influence provides a better understanding of the micro-level motivations of food safety investments in a critical area and contribute to the design of regulatory strategies.

**Keywords:** decision rights; food safety; investment; law; transaction costs

In recent decades, policy interventions intended to prevent food safety crises have shaped the institutional environment of food systems and influenced company strategies (Knowles et al. 2007). Multiple regulatory bodies have been established, while network governance is increasingly challenged by the need to manage a complex body of information. Correspondingly, a systematic enhancement of safety-oriented technology and production techniques is required (Heyder et al. 2012).

Food safety systems that implement Hazard Analysis and Critical Control Points (HACCP), certification, traceability, brands as well as in geographical

indications and private branding require dedicated investments in physical resources, human resources and in re-organising the production processes and control activities (Unnevehr and Jensen 1996; Segerson 1999). The decision to invest is made not only according to legal requirements but also according to voluntary decisions. Laws support the regulation of food safety driving corporate activities toward society and consumer expectations (Lupien 2005; Knowles et al. 2007). Private motivations, however, also have an important role in motivating investment in food safety; Hammoudi et al. 2009; Herath and Henson 2010; Wilcock et al. 2011). A comprehensive

explanation of how regulatory intervention and private strategies interact with each other is still lacking. This study aims to contribute to this area by adopting an organisational perspective. Namely, we focus on the decision to invest and analyse whether and how the allocation of the corresponding decision rights among the transacting parties influences the investment decisions (Ménard 2013, 2017). From this perspective, we address two research questions concerning whether or not the legislation and the allocation of the decision rights to invest influence the decision to invest in the implementation of food safety strategies.

To answer to these research questions, we carried out an empirical investigation on investment decisions in the Italian meat sector, comparing systems dedicated to safety strategies (HACCP, traceability and certification) and systems in which food safety is critically relevant to marketing strategies (geographical indications, private branding). The knowledge of such an influence provides a better understanding of the micro-level motivations of food safety investments and help in unravelling specific characteristics of the different meat supply governance modes.

## MATERIAL AND METHODS

This study first elaborated on the existing literature by formulating a conceptual framework aimed at identifying the drivers of food safety investments in both legislation and private strategies. Two research questions were drawn from the conceptual framework. Then, according to the conceptual framework proposed, we recognised that both changes induced by legislation and the allocation of the decision rights to invest influence the decision to invest in the food safety field. We modelled the relationship between the drivers and the decision to invest using a bivariate probit model (Greene 2008):

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

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

$$Y_1^* = 1 \text{ if } Y_1^* > 0, 0 \text{ otherwise,}$$

$$Y_2^* = 1 \text{ if } Y_2^* > 0, 0 \text{ otherwise,}$$

where  $Y_1^*$  is a latent variable which refers to the utility to undertake food safety law-oriented change;  $\alpha$  is a vector of unknown parameters;  $X_1$  is a vector of exogenous variables, among these we included

market and regulation variables;  $\varepsilon_1$  represents the error terms;  $Y_2^*$  is a latent variable which refers to the utility to make investments;  $\beta$  is a vector of unknown parameters;  $X_2$  is a vector of exogenous variables among which is considered the allocation of the decision right to invest;  $\varepsilon_2$  represents the error terms.

We adopted bivariate modelling for two reasons. Firstly, policy intervention is usually aimed at encouraging farmers and food companies to adopt the correct and safe technology. This aim often requires the agents to improve the technology in use – at least in some productive task – and can also elicit positive changes in the organisation and the management of information. Therefore, undertaking change at the farm or company level because of the low inducements and making investments are expected to be two correlated decisions in the food safety field. Secondly, the model chosen is suitable because the variables we are dealing with are categorical in nature (e.g. to have or to have not made an investment).

We expected that: (i) the equations are related and that the change induced by regulation influences the decision to invest and (ii) the allocation of the decision right to invest explains the patterns of decisions observed. This point is better explained in the subsequent section.

The empirical analysis was carried out through a postal questionnaire submitted to a convenience sample including 2 036 Italian companies. The companies selected were engaged in the supply of animal products and were active in various stages of food chains (i.e. agricultural, processing and just trading activities).

The instrument used in our inquiry included three sections (details on the variables are provided below): (i) general information about the company, including the date of establishment, the size and the field of activities (production, trade); (ii) the relationships with other enterprises in the chains: this section focuses on the type of contract (verbal, written, short-term, long-term) and related decision (procurement, selling, duration). The related information is not presented here but is part of a further investigation; (iii) the activities undertaken in the field of food safety: the information concerning the type of systems implemented (HACCP, certification, brand, geographical indication, traceability, none) and the investments made in order to support the system (physical resources, human resources, additional costs); further information was concerned with sources of information on safety, the implementation of specific hygiene practices and internal safety.

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## RESULTS AND DISCUSSION

### Conceptual framework

#### *Coordination, information issues and uncertainty*

In this study, we adopted a transaction cost (TCE) perspective. The agents organise their transactions by choosing governance structures that minimise the transaction costs (Williamson 1985). These costs depend in turn on the characteristics of the transaction, asset specificity, uncertainty and frequency (Williamson 1985).

Quality and safety strategies in agri-food chains require high levels of investments. These investments are often dedicated to a given transaction (Ménard and Valceschini 2005), e.g. paid to a laboratory for quality analysis with the aim of facilitating the exchange between a producer and a retailer, components of traceability systems or HACCP systems. These kinds of investments are specific in the sense that their value depends upon the possibility for the investor to continue the exchange relationship: outside the given transaction the investment would lose part or all of its value.

Uncertainty has different sources. It may be caused by the behaviour of the transaction counterparty (Williamson 1985), who may hide some negative characteristics of the food product. However, uncertainty may also be caused by the difficulty to predict the future changes in technology or the market. In the meat sector, technological uncertainties are inherently associated with safety as the chain organisation of the production process may fail in coping with unforeseen technological contingencies and human mistakes (Lupien 2005).

Along with a food chain, the agent has to coordinate among themselves in order to align the production plans and provide the product to the final consumer. Coordination issues influence the safety performance of the food systems. The safety level of supplied food products depends on the behaviour of all agents involved in the food chain. This is because accidents – be they chemical, physical, microbiological – may occur at any stage of the system and because intentionally implemented remedies and precautions may fail due to technological flaws or human errors.

Most of the food safety characteristics cannot be observed by the consumer and then they are usually held as credence attributes of the food (Hobbs et al. 2002), causing the emerging of information asymmetry among the chains partners. Furthermore, the

asymmetric information about food products characteristics requires the agents to design and implement mechanisms to gather and channel information and to carry out dedicated activities. To cope with information asymmetry is then a necessary objective in designing organisational arrangements ensuring the agents' coordination.

Both the specificity of the investment and the hazards mentioned induce the parties to choose a governance structure that minimises the transaction costs and efficiently solves coordination and information issues (Ménard and Valceschini 2005; Martino and Perugini 2006).

#### *Food safety investments drivers*

Transactions between two parties along the meat chain (e.g. a farmer and a slaughterhouse company) have to be organised in order to guarantee the required level of safety (Martino and Perugini 2006). The transactions are organised in an institutional environment (Williamson 2005) characterised by the food safety regulatory framework (Coglianese and Lazar 2003; Lupien 2005; Knowles et al. 2007). The coordination and information problems require solutions at the transaction level. The solutions consist of the choice of the governance structure that guarantees the expected performance (Martino and Perugini 2006). While the regulation framework determines changes in the basic parameters of the institutional environment surrounding the transaction (Hobbs et al. 2002; Williamson 2005), the market demand also pushes companies to adopt the best technologies and organisational arrangements in order to guarantee the safety of the supplied food.

Figure 1 summarises previous analyses and highlights the fact that both representation and market inducements influence the organisational solutions to the coordination and information problems.

Coase (1959) stated that one of the purposes of the legal system is to establish a clear delimitation of rights by which the transfer and the recombination of the rights can take place through the market. One of the cases in which a specific regulation is preferable is that, in which the transfer of rights would require that the market transaction is carried out among many participants. In such cases, the negotiation may be extremely costly and may make the transaction impossible; moreover, in such a situation, it might also be impossible for a court to enforce the rights (Coase 1959). The coordination of all the agents for safety purposes would require all the chain agents to negotiate

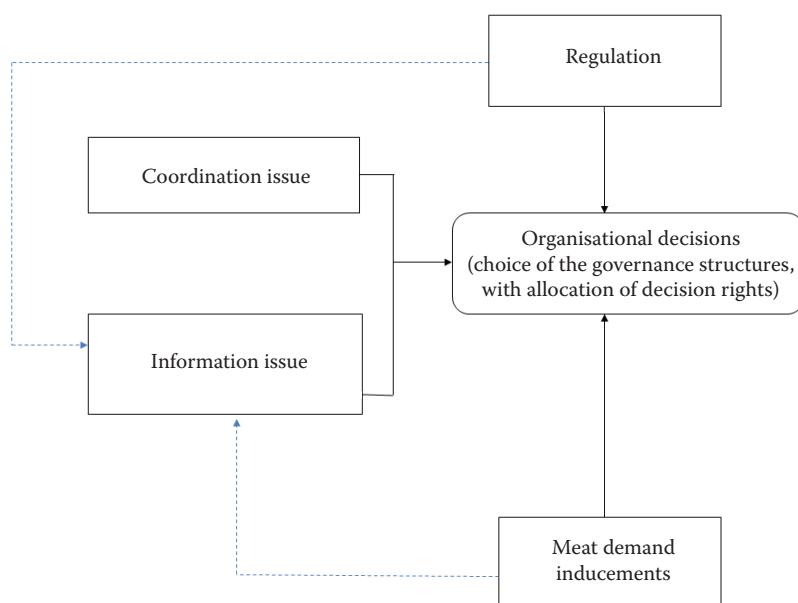


Figure 1. Coordination and information issues and organisational decision

Source: the authors

in details at least the alignment of their technology. This would raise a large cost and therefore, according to Coase (1959) regulation has to be held as preferable. Accordingly, regulations set by dedicated legal decisions are an ‘essential prelude to market transaction’ (Coase 1959). The law can then be interpreted as one of the main causes motivating the decision on investments aimed at guaranteeing the safety of food. In this case, the food safety investment decision would be made by the force of the law. 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. The different parties to a transaction could decide to maintain the decision right to invest or to allocate it to its transaction partner: this allocation could in this way allow the parties to maximise the total economic value of the transaction.

We address the following research questions:

*Research question 1:* Do the inducements resulting from the regulatory framework influence the decision to invest in the implementation of food safety strategies and potentially how these inducements are influential?

*Research question 2:* Does the allocation of the decision right to invest influence the investment decision and does this potential influence vary across different food safety systems?

To address these questions, we carried out an empirical analysis in which we analysed the role of the drivers mentioned above on the decision to invest in physical and human resources and additional costs.

## Empirical analysis

### *Motivations of the case study*

We focused on the Italian meat sector as a case study because of both its economic importance and the relevance of the food safety strategies implemented by the meat firms. Despite a reduction in meat consumption by 12% in the period 2011–2016, with a 2% reduction in poultry and a 5% on average reduction in the bovine sub-sector in 2016 compared with 2015 (Ismea 2017a), increased supply is evident in the entire sub-sector. In the period 2014–2015, the quota of meat products was equal to 18.43% of the total agricultural gross product (bovine meat 5.8%, pork meat 5.35%, poultry 5.34%) (Crea 2016). In 2016, the consumption of meat accounted for about 10% of the total food consumption (this percentage is turn broken down as follows: 44% bovine meat, 26% poultry, 17% pork, 26% other products). The total sales of the bovine meat industry were equal to €5.870 million in 2016 (4.3% of the total sales of the Italian agrifood industry) (Ismea 2017a). The heads slaughtered increased by 10.2% in 2015 with respect to the previous year (Crea 2016). The total sales of pork were equal to €7.968 million (6% of the total sales of the Italian agrifood industry) (Ismea 2017b). The total supply of pork meat increased by 11% in 2015. The poultry sector increased its meat production by 2.8% and accounted for 4.3% of the total sales of the Italian agrifood industry in 2016 (Ismea 2017c), engaging 16 300 production units in the period 2014–2016 (Ismea 2017c). The sheep and goat meat chains, relatively important in Italy, also increased



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their production, by 11% in 2015. In sum, the Italian meat sector has great economic importance both because of its share of the total national agricultural product and due to its capability of supporting viable levels of supply.

Furthermore, the meat sector provides a significant case study for the analysis of food safety strategies. Firstly, human diseases caused by meat pathogens are also spread within properly set-up production systems. This is the case, for example, for human *campylobacteriosis* or *salmonellosis* (European Food Safety Authority 2016). The complexity of meat value chains exacerbates the hazards at each step and requires strategies of control and inspection that ensure coordination of the interventions in a comprehensive framework (Mensah and Julien 2011; Pizzuti et al. 2017).

Secondly, safety hazards in the meat value chain induce companies to implement management systems, including traceability, control and inspection policies, certification and labelling (Unnevehr and Jensen 1996; Lupien 2005; Fulponi 2006; Mataragas et al. 2008). Safety management systems provide effective outputs varying with the type of meat product and firm (Luning et al. 2015; European Food Safety Authority 2016). Moreover, the necessity of dealing with the risks raised by food-borne pathogens in the meat sector result in enterprises incurring usually high additional costs (Unnevehr and Jensen 1996). Food recalls due to food safety concerns result in severe economic losses, which can be mitigated by adequate investments in setting up production protocols as chain coordination tools (Martino and Perugini 2006). The implementation of food safety management systems triggered important changes also at the retailer level (Codron et al. 2005) and induced subsequent changes in steps further up the chain (Fulponi 2006). Therefore, the meat value chain is characterised by interesting elements suitable for exploring the investment strategies implemented by companies to deal with relevant food safety hazards.

### Variables

The variables utilised in the analysis are illustrated in Table 1.

For the purposes of the empirical analysis, we therefore considered three types of investment for each system (HACCP, certification, geographical indication, traceability, brand): (i) physical resources (Herath and Henson 2010; Heyder et al. 2012); (ii) human resources (Wilcock et al. 2011); (iii) additional costs

of the internal organisational activities (Segerson 1999; Heyder et al. 2012).

The variable *Change* denotes the adjustments undertaken by companies because of safety regulations.

Considering the explanatory variables  $X_1$ , the *Beliefs* variable captures the influence upon behaviours (decision to invest) that accounts for the general view of the respondents about the food safety strategies. According to the literature and our conceptual framework, we identified three prominent beliefs. The first is concerned with the regulations, namely compliance with the law (*Law*) (Loader and Hobbs 1999; Henson and Holt 2000; Trienekens and Zuurbider 2008). Then, we considered two market inducement beliefs: expectations about profitability in terms of the number of clients and sales (*Custom*) (Segerson 1999; Trienekens and Zuurbider 2008; Zhou et al. 2012) and of premium price for the certainty of the safety degree (*Price*) (Loader and Hobbs 1999; Trienekens and Zuurbider 2008; Fares and Rouviere 2010).

Further variables in Equation 1 are grouped in the *Source in information* and the *Control variables*. *Technicians* are here intended to be associated with the chain relationships (therefore we expect that this variable strengthens the role of *Partnerdir*, which is shown below, in explaining the investment decisions). Analogously, we expect that *PHoff* is associated with *Law*, representing the public health related to legislation. *PublAdv* is here taken to mean a free source of information, driving zero-cost information. With *Entrepr* (other entrepreneurs) we thus capture the horizontal exchange of information, mainly channelled in a network's relationships (Omta et al. 2001). The information considered here is concerned 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 variables 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. We considered the recent variations of the demand (*Delta*) as a general driver of the investment decisions. Fulponi (2006), Yapp and Fairman (2006) and Shaosheng et al. (2008) have emphasised the importance of the experience of entrepreneurs and managers for the adoption of food safety systems. Both “number of high-level managers” (*Ndir*) and year of experience of the top manager (*Exper*) are intended to account for the capability – based on tacit knowledge – to cope with technological uncertainty and then to invest. We, therefore,

Table 1. Variables description

Variable			Symbol	Code	
Equation 1	Dependent variables	<i>change undertaken because of safety regulation</i>	<i>Change</i>	low, high or very high	0, 1
				I completely disagree	–2
				I disagree	–1
				I do not know	0
	Independent variables	to ensure food safety is a law duty	<i>Law</i>	I agree	1
				I completely agree	2
				I completely disagree	–2
				I disagree	–1
		to ensure food safety increases the number of clients and the sales	<i>Custom</i>	I do not know	0
				I agree	1
				I completely agree	2
				I completely disagree	–2
				I disagree	–1
		to ensure food safety increases the prices of the products	<i>Price</i>	I do not know	0
				I agree	1
				I completely agree	2
				I completely disagree	–2
		sources of information	<i>Tech</i>		0, 1
					0, 1
					0, 1
					0, 1
Equation 2	Dependent variables	<i>type of investments</i>			0, 1
					0, 1
					0, 1
	Independent variables	<i>investment drivers</i>			0, 1
					0, 1
					0, 1
					0, 1
					0, 1
					0, 1
					0, 1

\*HACCP, certification, traceability, geographical indications, private brand

Source: the authors

introduced the variable *Sales* in order to account for the influence of scale.

Regarding the explanatory variables  $X_2$ , in addition to the *Change* variable, we consider three variables

related to the allocation of decision rights, which are three investment drivers: the force of the law (*Reg*), autonomous decisions (*Autonom*) and the allocation to a counterparty (*Partnerdir*).

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### Empirical results

The completed questionnaires numbered 177 (response rate 8.89%). Among these questionnaires, 117 provided the data used in the present study. The remaining part was incomplete and lacking some of the variables needed. The response rate was low and this limits the possibility to generalise the results to larger populations of cases.

The sample was characterised by a low number of skilled workers and technicians. The age of the top managers was medium or high. Only a very small percentage of managers had a university degree. This fact could be compensated for by the prevalence of extensive work experience. From the investigated units, 26.6% are specialised in the production phase and 18.6% in the production and trade phases, whereas 54% are specialised in trading activities.

Tables S1–S2 summarise the estimates of the bivariate probit models. Tables S1–S2 in electronic supplementary material (ESM); for the supplementary material see the electronic version. In all the estimated models, the variable *Change* (Table S2; ESM) is statistically significant except for the *HR\_Cert* and *CO\_Gi* models. This indicates that the decision to invest is influenced by the change caused by the regulatory framework inducements. Except for *PR\_Cert*, *HR\_Cert*, *HR\_Trace*, *PR\_Gi*, *HR\_Gi*, *CO\_Gi*, *HR\_Brand* and *CO\_Brand*, the coefficients related to the *Change* variable are high and positive (Table S2; ESM). This supports our suggestion about the relationship between *Change* and the decision to invest: some of the decisions to invest are conditioned by the regulation-induced change. The influence of *Change* is evident for all the system, but its effect is variable. *Change* has a positive effect on the decision to invest in regulation-oriented systems. The largest influence is on *PR\_Brand* and *CO\_HACCP*. Notably, this effect is negative for all types of investment in *Geographical Indications* and in the *HR\_Brand* and *CO\_Brand* (the marginal effect is not significant for *PR\_Brand*). In sum, regulation-induced change tends to promote investments in HACCP, traceability and certification systems and reduce the probability of investing in food safety in other systems. This evidence confirms the importance of the regulatory framework for a company's investment decisions in the meat sector.

The results provide a clear picture of the importance of the allocation of the decision right in the investment decisions. Except for *CO\_Trace*, in all the systems the right to decide is maintained by a party or transferred

under the rule of law. From Table S1 (ESM) we can see that for the *Beliefs* the compliance with the *Law* is only influential in the case of *PR\_Haccp*. The market inducements of *Beliefs* in terms of customs expectations are negative for all the systems, while there are positive effects on the variable *Price*. So, the demand variables have a negative influence. Furthermore, the results confirm the importance of many *Sources of information*, with differences in the case of traceability. There is no evidence about the importance of knowledge (*Ndir* and *Exper*), while the role of the *Enterpr* is found to be important. Notably, *Sales* has no influence, except for *PR\_HACCP*: this evidence indirectly confirms the role of the allocation of the decision rights. Allocation of these rights to the more efficient party allows the agents to overcome the problem caused by the size of the activity.

Table S3 illustrates the marginal effects of the drivers and the other variables. Table S3 in electronic supplementary material (ESM); for the supplementary material see the electronic version.

The marginal effects indicate the probability that the dependent variable has value 1 (e.g. probability that *PR\_Haccp* = 1) when the covariate changes by a unit. We present the effects of the case in which *Change* = 1. The allocation of decision rights has a positive effect on the probability for all the types of investments and all the systems except than for *HR\_Haccp* (*Partnerdir*), *CO\_Haccp* (*Autonom*), *HR\_Cert* (*Partnerdir*), *PR\_Gi* (*Partnerdir*), *CO\_Gi* (*Partnerdir*), *PR\_Brand* (*Partnerdir*), *HR\_Brand* (*Reg*) and *CO\_Brand* (*Partnerdir*). There is evidence for the influence of the regulatory framework for traceability, geographical indications and private brand. The regulation also causes the increase of the probability to invest in additional costs and human resources for traceability. The influence of *Reg* and *Autonom* are associated in *PR\_Haccp*, *PR\_Trace*, *HR\_Trace*, *CO\_trace*, *HR\_Gi*, *CO\_Gi*, *PR\_Brand* and *HR\_Brand*. Except that for *PR\_Trace* and *CO\_Gi*, these influences are quantitatively similar. *Change* has positive effects on all the types of investments for HACCP, certification and traceability (except than *HR\_Cert* and *PR\_Trace*); while it has a negative effect in the case of geographical indication and private brand (except *HR\_Brand*). In both regulation and market-oriented systems, the marginal effect of *Custom* is negative, while it is positive for *Price* (even if it is less evident). Most of the *Source of information* has a positive effect.

The institutional innovation promoted by legislation has mobilised private resources. Private strategies,

on the other hand, rely on chain coordination, which is sustained in turn by the allocation of decision rights among the transacting parties. Our analysis adds to the emerging picture which shows the allocation of decision rights to be a critical area where public and private strategies combine.

Our results show that only in the case of traceability is there a decrease in the probability to invest in additional costs, and it is associated with the allocation of the decision rights to the transaction partner.

## DISCUSSION

In this study, we addressed the question of how much compliance with the law and economic and organisational goals determine food safety investments. We focused on inducements to invest due to the necessity to comply with the law, on individual free economic convenience and particularly on the allocation of critical decision rights to the party who is expected to be able to maximise the total surplus relationship. The choice to allocate the decision rights appears 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 important for investigating how public and private activities interact with each other in food safety provision. Furthermore, the role of public regulations (laws) is concentrated in terms of food systems and types of resources. The allocation of decision rights to the counterparty is evident. Thus there is also a confirmation of this organisational solution, as predicted by the theory. This evidence sheds light on the strength of the coordination devices associated with safety strategies.

### Implications for managerial practices

Based on our study, we propose that there are two implications for management practices: the first one concerns the systems considered in effective food safety strategies; the second is associated with the emergence of the organisational dimensions of food safety management systems.

Previous studies highlighted the influence of both regulatory and private inducements in adopting food safety systems (Fares and Rouviere 2010). Kafetzopoulos and Gotzamani (2014) analysed the critical factors driving the adoption of effective safety management systems and underlined the importance of the joint adoption of both HACCP and ISO 9001. Their analysis implies that managerial strategies should

be primarily shaped by the adoption of both quality and safety systems. Our study adds to this picture the idea of combining compliance with regulation with the adoption of appropriate private systems.

Moreover, our study clearly indicates that effective managerial practice should be based on an accurate design of the allocation of the decision rights to invest. It is thus clear that the strategies designed by the agents of the final chain steps (Codron et al. 2005; Fulponi 2006) determine the necessity of negotiating the allocation of the decision rights further up the chain. Accordingly, we also claim that our study enlarge the understanding of the organisational dimension in food system management and it makes clear how this dimension has to be conceptualised starting from the organisation of the transaction between chains agents.

## CONCLUSION

In this study, we analysed the investment decisions in food safety management systems. Our results indicate that the allocation of decision rights among transaction partners significantly contributes to explaining investment decisions. The allocation of decision rights appears to be the organisational response of public and private agents. From this perspective, our study indicates that a specific regulatory regime can be better understood by taking into consideration the organisational architecture and that the study of the allocation of decision rights (Ménard 2013, 2017) enhances the conceptualisation of the organisational dimensions of food safety management identified in the literature (Kafetzopoulos and Gotzamani 2014). The main limitation of this study is the impossibility of generalising these results to a larger population. Moreover, the study does not provide any systematic evidence about the potential complementarity between both private and public inducements to invest and among different safety systems. Two main research tasks should be carried out. One concerns with the analysis of such potential patterns of complementarity, the other relates to the necessity of investigation larger and representative samples.

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