Collective Voluntary Approaches to Food Safety with Heterogeneous Firms: Monitoring and Design?

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Abstract:

Collective quality management systems are well known instruments to manage the quality and/or the safety of foodstuffs. They can be considered as voluntary approaches to food safety. In environmental economics some empirical studies emphasize that firms entering into a collective voluntary program behave differently because their motivations differ. To the best of our knowledge, there is no formal discussion on the effectiveness of a collective voluntary program in which firms adopt different behaviour once they entered the program. Starting from this two strand of literature, we extend the analytical framework of collective voluntary approaches considering heterogeneous firms and applying it to food safety issues. We show that according to firm's heterogeneity, in some situations increasing the number of inspections is useless and the effectiveness of the collective program is only reliant on its minimal requirements. We econometrically test our theoretical propositions on the case of the safety self-monitoring agreement, which exists on one of the most important import market of fresh produce in France. Our results lead us to discuss the design these new regulatory instruments and its relative cost-effectiveness from a societal point of view.

Key Words: Voluntary Approaches, Food Safety, Collective Action, and Heterogeneity.

JEL: Q18,L51, L81

1. Introduction

Voluntary programs are now well known instrument for reducing environmental damages created by polluting firms. This alternative to traditional environmental regulatory policies is well developed both in the European Union and the United States (Borkey and Leveque, 1998). In the literature, there are now lots of studies dealing with voluntary approaches to environmental protection (see Khanna, 2001 for a survey). More often than not firms commit themselves in Voluntary Programs to avoid a more costly environmental policy imposed by public authorities and/or to communicate on their environmental friendly goodwill.

These new regulation tools are not only used to deal with environmental threat (Segerson, 1999). During the nineties, voluntary quality management systems have emerged in the food supply chain and could be assumed as voluntary approaches to food safety. In the agro food industry, voluntary initiatives from food operators have been developed and give new perspectives to the food supply chain. For example, in the European fresh produce industry, systems like Eurep-Gap was primarily drafted and initiated by British retailers because of their need to meet new requirements of the due-diligence liability rule[1] (Fulponi, 2006). Even though it was first understood as a protection against prosecution, such a system is now worldwide adopted and thus changes the whole understanding of fresh produce supply all over the world.

However, managing food safety differs from dealing with pollution reduction issues. Food safety is a particular attribute of food product. For consumer, more often that not it is a credence attribute following the definition given by Darby and Karny (1973). However, food

1 The due diligence principle is defined under the Food Safety Act: It means ensuring that every reasonable precaution has been taken for every circumstance such that all concerned parties, for instance consumers, are protected. It also means that if a the firm has tried to meet its obligations and has done what is reasonable and still fails, then it would not be found guilty of wrongdoing in court.

safety becomes an experience attribute unfortunately when the more sensitive of consumers gets sick. From farm to fork, across boarders, food supply chain involves a large number of food operators who handle food products. However, there is a wide array of sources leading to potential sources of a food safety hazards and contamination. This induce some difficulties to identify the contamination source in the supply chain and then to identify, sue or prosecute the true responsible of the offence**.** Moreover, the heterogeneity in food products can be exacerbated these difficulties according to the number of food operators (the length of the supply chain), of the type of food product (raw or processed, branded…). Food safety is directly linked to health risk. However, according to the kind of safety contamination, consequences for health are different. Indeed, a contamination can have instant and lethal effects (pathogenic contamination) or cumulative effects (pesticides residues). Sometimes, the effects on health are not well known (GMOs). Following a safety failure, all the operators of the food supply chain are under the commercial threat. A safety contamination, can lead to some spill-over effects both on the incriminated product but also on its substitutes and on the food industry as a whole (Biglaiser and Friedman, 1994).

Contrarily, pollution issues are reliant to emissions/releases of pollutants in the air and/or water and involves either one firm or a group of firms within an industry. Non-source pollution is the only case for which it is not possible to perfectly identify who is the one responsible of pollution. Pollution is directly linked to environmental risk and indirectly linked to health risk. For example SO_2 emissions are bad for global warming and for the quality of the air we breathe. For asthmatic people, the quality of air affects their health and can have strong consequences. Pollution failure from one firm has no spill-over effects on the industry as a whole. More often than not, consumers are not aware of these accidents and the largest firms face to commercial stakes when a pollution accident occurs. In the food safety economics there is a bloom of analytical studies dealing with food suppliers' voluntary

adoption of such food quality system (Segerson, 1999, Noelke and Caswell, 2000; Venturini, 2003, Fares and Rouvière, 2006). However there is little formal discussion on food suppliers' behavior in collective food safety management system (Giraud-Herault et ali, 2006). Such collective quality management systems as developed in Olson (1965) generate a collective action issue.

In environmental domain, numerous empirical studies have emphasized this point. Firms, which join a collective program, don't face the same institutional pressure and then will behave differently once committed in the voluntary collective program. Once the firm has committed itself to fulfill the agreement's requirements, it could decide not to comply with the whole set of requirements. Firms thus may voluntary choose to partially free-ride on the effort provided by others (Delmas and Keller, 2004; Delmas and Montes 2005; King and Lennox 2001). These free-riding behaviors could then alter the credibility of the voluntary program and lead it to collapse.

To the best of our knowledge, most theoretical papers dealing with collective environmental voluntary program consider models identical firms and define free-riders as firms which do not participate to the agreement (Dawson and Segerson, 2006; Millock and Salanié, 2003). Firms behave non-cooperatively at the participation stage. Once committed within the agreement they behave cooperatively and choose an effort level in accordance with the required one. There is no opportunistic behavior within the collective program.

The aim of the paper is twofold. First, we develop a model that takes into account firms' heterogeneity in its specification and then consider that opportunistic behavior may exist within a collective voluntary program applied to food safety issues. Our model considers a third party that is independent from the group of firms that monitors and enforces the collective agreement through inspections in individual firms. According to the impact of firms' heterogeneity we show that when the threat of being inspected is too low, whatever

their characteristics all firms would only refer to the minimal requirement of the collective agreement. In such a situation, the performance of the voluntary program only relies on this minimal level negotiated before the implementation of the program. Second, we test our theoretical propositions on firms' behavior in the case of safety self-monitoring agreement, which exits on one of the most important market of import of fresh produce in France. Our empirical results lead us to discuss both the design of these collective voluntary programs and the way to ensure their performance, considered as the average level of safety effort within the group.

The paper is organized as follows: section 2 refers to the related literature; Section 3 develops the analytical framework, Section 4 is dedicated to the research data and the methodology, Section 5 the econometric analysis and results and Section 6 provides a discussion.

2. Related Literature

Some empirical studies applied to the environmental domain outlined that firms could act differently in a voluntary agreement because they are heterogeneous. For example, Delmas and Keller (2005) focus on factors that favor or hamper free-riding within the U.S. EPA WasteWise voluntary program. They analyze how both the incentives to participate to a voluntary program and the firms' characteristics affect the likelihood to free-ride within the agreement. They show that compliance behavior depends on the initial motivation that led firms to join the voluntary program. Joining the agreement is associated to private benefits like an increase in reputation firms are more likely to fully comply with the requirements of the program.

In 2000, King and Lenox and then Delmas and Montes, in 2005 (2005) have distinguished two ways for firms to behave once firms commit themselves within in a collective voluntary agreement i) collaborative & symbolic and, ii) collaborative & substantive. In these studies, a

collaborative & symbolic behavior stands for firms which commit to the agreement and then do not fully comply with its requirements whereas a collaborative & substantive behavior characterize fully compliant firms. The authors distinguish early joiners from late joiners Early joiners differ from late joiners because of the institutional pressure they face, their visibility on the market their resources and finally, their environmental effort prior to participation. More often than not they are larger firms. They show that early joiners they are more likely to adopt a collaborative & substantive behavior.

In the theoretical literature there is little formal discussion firms'behavoir once committed within a collective and industry-wide voluntary approaches dedicated to environmental protection. Dawson and Segerson (2006) developed a comprehensive model under which firms choose to participate in the program to avoid a more costly policy tax imposed by the government. The tax would be imposed either there is no voluntary initiative proposed by the industry: or if the group of participating firms fails to achieve the emission goal set by the public authorities. Under such assumptions, non-participating firms benefit from the level of pollution abatement reached by participating firms. Developing a three-stage model with n identical firms they show that there is always an incentive for a sub-group of firms within the industry to participate in voluntary agreement according to the existence of a sub-group of free-riders. Participating firms make higher abatement efforts to achieve the industry emission goal, internalizing the negative externalities generated by non-cooperative firms. Collective voluntary agreement is thus always preferred to a tax policy even if the model shows that, in some cases, it is not socially efficient. However, there are two limits in this paper. On the one hand, firms are identical. On the other hand, they assume that once committed in the collective agreement, firms well-behave and then fully comply without need of any enforcement to do so (MacEvoy and Stranlund, 2006).

In the food safety literature, most of studies emphasize firms' decision to voluntary implement individual quality management system. For instance, Segerson (1999) develops a model to analyse the voluntary adoption by firms when a mandatory safety system is more costly than a voluntary one. She shows that the only credible mean to induce a firm to adopt voluntary preventive measures is a strong mandatory threat to be imposed a more costly system. Venturini (2003) assumes there is not a differential cost between a voluntary and a mandatory adoption of a quality management system. He shows that a strong mandatory threat is a necessary but not a sufficient condition to induce voluntary adoption.. Government intervention is needed: to help firms to signal their safety initiative to consumers. A second strand of literature considers that firms operate in the food supply chain. Noelke and Caswell (2000) explore the incentives to implement a voluntary system in a simplified supply chain. The authors show that the level of safety the firm implements through a voluntary quality management system are always higher than in all the other alternatives. However, this level of effort relies on the safety level implemented by upstream and downstream firms. Fares and Rouvière (2006) proposes a unified framework on these two literature strands. They show that, for food safety issues where the liability rule and reputation effect cannot be effective, a well-designed contract offered by "the downstream" firm is the only way to induce upstream firms to voluntarily implement safety measures.

However, these studies do not consider that the food operator can choose to voluntary enter and implement a collective food safety management system. It is obvious that because these quality management systems are collective, they lead to a collective action issue as defined by Olson (1965). To the best on our knowledge, the only study available is the one of Giraud-Hérault and al (2006). The authors propose a model of vertical integration between producers and retailers where a spot and a safe markets coexist. They derive the conditions under which such coexistence leads to an improvement of food safety. The collective system should then

induce to an increase of the safety level on the market. However, they do not consider that opportunistic behaviour may occur within the group and then alter the average level of safety of the safe market. We borrow from these two literature strands to propose a model "à la Dawson-Segerson (2006)". We extend the initial framework in order to take into account of firms' heterogeneity and behavior in a collective voluntary program.

3. Analytical Framework.

We consider, a group of N firms denoted by i and characterized by their size y_i with $i \in \{1,2,....n\}$ ordered in increasing size. In the short run, the number of firms in the group is exogenous (denoted by N) and known by all the firms. These firms have voluntarily joined an industry agreement to voluntarily monitor the safety of their products'. By joining the agreement, firms commit themselves to monitor the safety of their products on a regular basis. We assume that the group of firms doesn't generate any externalities on firms that didn't join the agreement. The group of firms thus produces a "club good" (non rival and excludable good) that would only benefit to the members of the agreement. We assume that the nature of the "club good" lays in the "collective reputation" or "group reputation" which benefits to all group members. We suppose that the "club good" we deal with allow members to signal themselves; being a member is thus viewed as a sign for a potentially high level of monitoring food safety. Joining the agreement is voluntary and free. Such an agreement it is not legally binding and then could lead to a collective action issue as pointed out by Olson (1965). Contrarily to Dawson and Segerson (2006) we only refer to opportunistic behaviors within the group of firms and we do not consider that free riders might be outside of the group.

In a first time, we follow the propositions suggested by Delmas and Keller (2006) and as King and Lennox (2000) shown we focus on the decision of firms which once committed in the

agreement and according to their individual characteristics (size, products, institutional pressure), firms would adopt differentiated behavior once committed within the group.

In a second time, we characterize situations for which increasing the frequency of inspections lead to an increase of the performance of the collective program.

Once committed in the agreement, we consider that the decision of the firm is binary:

i) The firm can comply with the requirements of the agreement by providing the minimum level of effort required by the agreement, e_L. Firms are considered as low-effort firms, *they implement the least they must do*.

ii) The firm can comply with the requirements of the agreement by providing an effort level e_H that is higher than e_L, that is $e_H > e_L$. Firms are considered as high-effort firms, *they implement a higher level of effort than they must do*. We consider that e_H is exogenous.

Let N_H be the proportion of high-effort firms, then $N_L = N - N_H$ is the proportion of low-effort firms.

The production of the "club good" is not costless. Each participating firm to the agreement commits to contribute to the production of this "club good" through the implementation at least of the minimum level of safety monitoring effort that the agreement required. We assume that firms' production costs function is given by $\boldsymbol{C(y_i,e_i)}$ is discontinuous. We assume that the production cost function of i is also convex as suggested by Antle (2001). $\boldsymbol{C(y_i,e_i)}$ denotes for the firm $\boldsymbol{i}$ the cost of producing $\boldsymbol{y_i}$ units of the good with the associated level of safety effort $\boldsymbol{e_i}$. e_i is dichotomous, $e_i = \{e_H; e_L\}$ and the production cost function is strongly separable. Being a member of the collective agreement acts as a signal. Without loss of generality, we assume that $\boldsymbol{a}$ and $\boldsymbol{b}$ represent the costs for respectively high-effort firms and

low-efforts firms to provide the signal that participating to the collective agreement generates. We assume that $\{a;b\}\in[0.1]$ and are such as $a>b$. However, the larger the proportion of low-effort firms is the more costly it is for high-effort firms to maintain the signal.

We assume that the production costs functions are strongly separable. Then, for a high-effort firm, the cost function of providing safety effort is $\mathbf{C(e_H)}=\left(ae_H(1+\frac{N_L}{N})\right)$. For a low-effort firm the cost function of providing safety effort is $\mathbf{C(e_L)}=\left(be_L(1+\frac{N_L}{N})\right)$.

There exists a third party that designs an inspection plan of randomly chosen firms to detect safety failure. To detect safety failure the third party monitors the level of safety effort the firm has implemented. This effort is only partly observable in the results the firm has achieved. All firms face to the same probability of being inspected, *c*. However, we assume that the probability of failure decreases with the level of safety the firm has implemented. Then, $p_H = c(1-e_H)$ and $p_L = c(1-e_L)$ implying $p_H \leq p_L$ because undertaking preventive safety measures can reduce contamination risks but doesn't allow to completely avoiding it (Segerson, 1999).

Failing firms are punished under a penalties scheme according to their size, y_i, whatever the safety effort they implemented. Indeed, when a safety failure is detected, a failing firm need to recall its products and then could loose a part or even the whole of its production. Consequently, the bigger they are, the larger the loss due to safety failures is.

We assume that a firm, which is indifferent between the implementation of high-effort level or a low-effort level, will always adopt a high level of effort.

The firm compares the expected costs of providing each alternative that are for high-effort firms $C(y_i;e_H)+p_H y_i$ and for a low -effort firm $C(y_i;e_L)+p_L y_i$.

The firm i will choose a high effort level if and only if:

$$ae_H(1+\frac{N_L}{N})+c(1-e_H)y_i \leq be_L(1+\frac{N_L}{N})+c(1-e_L)y_i$$

Firms' are equally distributed over the size (for each size, there is only one firm).Therefore, $\frac{N_L}{N}=y_i^*$.

The firm i will adopt a high level of safety effort if and only if:

$$(ae_H-be_L)\leq y_i^*(c(e_H-e_L)-(ae_H-be_L)) \tag{1}$$

According to condition (1) y_i^* is such as $\lambda y_i^*=(ae_H-be_L)$ with $\lambda=(c(e_H-e_L)-(ae_H-be_L))$.

When $\lambda>0$, then condition (1) implies:

$$\begin{cases} y_i^*\leq y_i, \ e_i=e_H \\ y_i^*>y_i, \ e_i=e_L \end{cases}$$

When $\lambda\leq 0$, then condition (1) implies that $\forall i, \ e_i=e_L$.

That is,

$$\lambda\leq 0 \Leftrightarrow c(e_H-e_L)-(ae_H-be_L)\leq 0$$
$$c\leq \frac{(ae_H-be_L)}{(e_H-e_L)} \tag{2}$$

Condition (2) implies that c the probability to be inspected must be high enough to induce that firms according to their size would choose a high level of safety effort.

From Condition 2., we derive Proposition 1 and Proposition 1Bis.

Proposition 1: If the probability of being inspected is low, that is $c \leq \frac{(ae_H - be_L)}{(e_H - e_L)}$ ***, firms will implement a low level of safety effort, whatever their size.***

Proposition 1Bis: If c is sufficiently high ($c > \frac{(ae_H - be_L)}{(e_H - e_L)}$ ***) larger firms exert a high level of effort in monitoring the safety of their products.***

We note E the average safety effort provided by the firms within the group. We assume that E is the observable proxy of the performance of the collective agreement.

$$E = e_H * \frac{N_H}{N} + e_L * \frac{N_L}{N} = e_H(1 - y_*) + e_L y_* \tag{4}$$

and c_* **such as** $c_* = \frac{(ae_H - be_L)}{(e_H - e_L)}$**, with** c_* **as a probability is such as** $0 \leq c_* \leq 1$**,**

We determine how an increase in *c*, the frequency of inspections impacts on *E*.

First, in the case where $c \leq c_*$, then $E = e_L$ and,

$$\frac{\partial E}{\partial c} = 0 \tag{5}$$

Until $c = c_*$, increasing the number of inspections has no impact on E. In such a situation, the average level of safety within the group E just depends on the exogenous level of low effort e_L, that is the minimal requirements of the agreement. Moreover, we can underline that $\frac{\partial c_*}{\partial e_L} > 0$. Consequently, the probability that c is lower than c_* is higher in collective agreement where e_L is set at a high level. Indeed, the higher e_L, the higher c_*.

Second, in the case where $c>c^*$, then $E=e_H(1-y^*)+e_L y^*$ and,

$$\frac{\partial E}{\partial c}=\frac{(ae_H-be_L)*(e_L-e_H)^2}{[c(e_H-e_L)-(ae_H-be_L)]^2}. \tag{6}$$

According to (6), $\frac{\partial E}{\partial c}>0$ and $\frac{\partial^2 E}{\partial^2 c}<0$. Increasing *c* leads to an increase in E, the performance of the collective agreement, at a decreasing rate. Namely, the higher the frequency of inspections, the lower the marginal effect of the number of inspections.

Proposition 2: When $c\leq c^*$, the performance of the collective agreement, to food safety (namely, E) only relies on the given level of minimal requirements e_L. Otherwise, when $c>c^*$, increasing the frequency of inspections increases the performance of a collective agreement.

4. Empirical Analysis.

Survey and methodology

To test our propositions, we study one particular case, namely the safety self-monitoring agreement that exists on one of the most important import market of fresh produce in France (Perpignan, South of France). Perpignan import market is the first on the three European main imports markets of Fresh produce ahead of Milan and Munich. 1350 million tons of produce are sold every year on the Perpignan import market. It represents more than 92% of the French traffic of fruit and vegetables (*Sources:* http://www.saintcharlesinternational.com/public). In 2001, a safety self-monitoring agreement was voluntarily initiated and drafted by a group of importers and then approved by French public authorities in charge for safety controls on the French import market *(Codron et al., forthcoming).* This program was initiated following changes in food safety regulation that are characterised by an increase in the involvement and

responsibility of private actors with regard to food safety inspections. Since 1998, importers of fruit and vegetables must individually implement a system of self-monitoring to guarantee the safety of the produce they sell. French importers must then comply with a performance standard: the food operators must achieve prescribed product quality standards and/or safety level. The way to achieve the safety standard is left to their discretion (Henson and Caswell, 1999). In France, the safety of fresh produce is one-dimensional. Produce must satisfy the MRLs (Maximal Residue Limits) for pesticides defined by both European and French regulations[2].

The safety self-monitoring agreement of Perpignan promotes a collective framework for the management of safety controls through a collective code of conduct for monitoring the safety level of supplies. The main objective of the collective self-monitoring agreement is to make sure that imported produce marketing in France satisfy these MRLs. By participating to the agreement, importers voluntarily abide to implement the collective safety procedure and to carry out laboratory analyses to monitor MRLs on fresh produce. At least, firms must carry-out at least 10 laboratory analyses a year, whatever their size.

We use a data set from a survey that was conducted with French importers of fresh produce on the Perpignan import market. The interviews were conducted in July 2006 on a face-to-face basis with firm owners, or employees (the person in charge of quality or salesman). The interviewees were asked about the characteristics of their firm, supplies and sales, resources allocated to safety monitoring and about their motivations to join the safety self-monitoring agreement. We collected figures for 55 firms, over the 65 members of the safety self-monitoring agreement (See appendix 1 for the statistical description).

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[2] When the MRL is not defined at the European level, the French MRL prevails.

Analysis and Results

In this section, we test whether the monitoring effort observed in a firm (on-site safety inspections through analyses of residues of pesticides)[3] can be related to the heterogeneity of the group members. We study the determinants of the firms' effort level for importers that committed themselves in the self-monitoring safety agreement[4]. We define an indicator standing for the effort level (on-site safety inspections through analyses of residues of pesticides) the firm chooses concerning the monitoring of food safety. We then turn to the empirical analysis of the determinants of this level.

Our dependant variable is an indicator of the effort level the firm chooses in order to monitor the safety of its products: *Safety Effort*. Firms were asked about the number of laboratory analyses they carry out to monitor the safety quality of the products. We assume that the minimum number of laboratory analyses firms must implement within the agreement is defined in a way that all firms could join the agreement. That is to say that the minimum number is defined to avoid the exclusion of the smallest firms of the industry. The minimum number of analyses is 10 analyses a year. However, larger firms are supposed to voluntarily implement more laboratories analyses according to their size than the compulsory minimum number of analyses. The effort made by the firm *i* in monitoring safety is the number of laboratory analysis implemented in 2005 relatively to the firm's turnover for the same year.

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[3] Substitutable strategies exist in order to guarantee safety: for example the supervision of the production process aims at lowering the risks. We captured the potential endogeneity of the governance structure chosen by the firm by using a bi-probit estimation that simultaneously investigates the determinants of the production integration level, and the determinants of the ex-post pesticide analysis. The results turned out to be very similar to that of the simple probit estimation we present hereafter. Consequently, and as we just work with a 55 observations sample, we decided to keep the probit: a second survey will be conducted by spring 2007 to get an exhaustive sample of French importers who participate to this voluntary programs.

[4] We didn't correct for potential selection bias that could occur when selecting only importers that decided to enter into the group for two reasons. First, our analytical framework focuses on the firms' behaviour when they are in the group as moral hazard may be at stake. Second, on the statistical point of view, all non-participating firms that were interviewed reported zero effort: they don't implement pesticide analysis on their products, so that a comparison between the effort levels of members and non-members is straightforward

We then compared this figure to the number of analysis per unit of turn-over that the first quartile of firms within the group (denoted Q_{25}, in our case the 14th smallest ones) carried out. If our indicator of safety effort of the firm *i* is higher then we say that the effort level is high and affected by 1, and otherwise is low and takes 0. Let T_i be the turnover of firm *i* and An_i the number of analysis.

More formally,

$$\boldsymbol{E}_i = \frac{\boldsymbol{An}_i}{\boldsymbol{T}_i} \times \frac{\sum_{j \in \boldsymbol{Q}_{25}} \frac{\boldsymbol{T}_j}{14}}{10}$$

$$\begin{cases} \text{If } \boldsymbol{E}_i \geq 1 \text{ then } \textit{Safetyeffort} \text{ is affected by 1 and the effort level is said to be high} \\ \text{If } \boldsymbol{E}_i < 1 \text{ then } \textit{Safetyeffort} \text{ is affected by 0 and the effort level is said to be low} \end{cases}$$

Using this definition, we find there are 33 low-effort firms in our sample that is 60% of the sample. These firms are smaller than the one considered as high-effort firms and their average turnover is 10,1 k€ (respectively, 25,1 k€ for those with a high effort level), but their dispersion is lower: the standard error is 8,3 compared to 19,05 for the high-effort firms.

To test our theoretical propositions we test the following model:

$$\boldsymbol{prob(Safetyeffort)} = \alpha + \boldsymbol{X}_i'\beta + \boldsymbol{Y}_i'\gamma + \boldsymbol{Z}_i'\delta + \varepsilon_i$$

We evaluate the impact of three sets of variables on the probability to choose a high effort level:

X_i is a set of variables summarizing the characteristics of the firm. We consider characteristics such as the size, the firm's specialization, the main characteristics of its first customer and supplier and firm's dependence relatively to its main customer. The main characteristics of first customer and supplier were used to assess how the upstream and downstream relationships of the firm could influence the level of safety effort the firm will exert.

- The firm's size is approximated by the number of permanent employees *employees*
- To take into account of the firm's upstream and downstream relationships we consider two variables:
    - *DirectSupp* is a dummy variable standing for the type of the major supplier. *DirectSupp* is affected by 1 when this supplier is an identified one. By identified, we mean that the produce comes directly from producers, either from the firm's own production, a production site in which the firm invested, or when fresh produce comes from a direct producer. *DirectSupp* is affected by *0*. Otherwise, that is there is a third party between the producer and the importer (cooperatives, exporters and other types of suppliers).
    - To approximate the firm's downstream relationship, we consider the type of the major French customer (in terms of the firm's turnover). Importers have two main customers: Supermarkets and wholesaler. *CustFce1* is dummy variable with 0 when the main customer of the firm is a "wholesaler" and with 1 when it is "supermarkets".
    - We approximate the dependence level of the firm by the share in the firm's turnover represented by the major French customer is: *CaCustFce1*.

Y_i contains the characteristics of the main product the firm sells, namely that represents the highest proportion in the firm's turnover. We selected two characteristics of this major produce.

- *Branding* indicates if the firm owns a brand on the first produce it sells.

- We consider that a firm is specialized (*Specialization* is 1) when the share of one product it sells represents more than 30% of its turnover. *Specialization* is 0 otherwise.

Last, Z_i is a vector of environmental characteristics; in particular, we are interested in studying if the public threat, individual commercial threat, and collective aspects of the agreement have an impact on the decision of exerting a high effort level.

- We create a dummy variable *PUthreat* to approximate the threat that public authorities could exert on firms with respect to safety issues. Respondents were asked how they feel about this public threat on safety. *PUthreat* is 1 if the threat is considered as "important" (0 otherwise).
- In the same way, we created a dummy variable *CMthreat* to approximate the commercial threat, particularly the one supermarket could exert on firm. Respondents were asked how they feel about this commercial threat *CMthreat* is 1 if the respondent consider this threat interfere with the firm's activity (0 otherwise).
- By participating in the safety agreement, importers benefit from a discount on prices of laboratories analyses. This discount is about 20% on the price of residues analyses[5]. To take into account of the collective aspects of the agreement, we create a dummy variable *ImutCont. ImutCont* takes 1 when respondents consider that the collective aspects of the agreement are important for them (0 otherwise).

[5] This is not marginal as the price of a "basic analysis" for pesticides residues is about of €300 for one sample of fresh produce.

Results

The results of our regressions are presented in table 1.

Table1. Regression Results.

Endogenous variable Safety Effort	Coefficients (T)
Firm's Characteristics	
Employees	-.263** (-2.46)
DirectSup	1.75** (2.08)
CustFrce	4.04** (2.36)
CaCustFrce	.075** (2.11)
Firm's Product	
Branding	1.83* (1.78)
Specialization	-1.62** (-1.99)
Environmental Characteristics	
PUthreat	-3.16**(-2.12)
CMthreat	2.62** (2.46)
Imutcont	2.40** (2.38)
Observations	52
Pseudo R-squared	0.607

Student-T in parenthesis. For 10% significance Student-Tvalue=1.67, for 5% significance Student-Tvalue= 2,00, for 1% significance Student-Tvalue=2.67.

Note: *; **, *** represent 10, 5 and 1 % significance respectively.

Firm's Characteristics:

Variables standing for firm's characteristics are significant. However, some of the coefficients are quite surprising particularly the influence of the size.

The firm's size represented by the number of permanent employees has a negative effect on the safety level exerted by firm. Relatively to their size, large firms exert lower safety effort than small firm, which is contradictory of what we could expect, especially if we think that large firms entertain a high reputation level. Larger firms are expected to be more self-conscious about produce safety and were expected to implement a level of safety according to their size. As we worked out our variable of effort, we assume that the minimum number of analysis had been designed for the smallest firms in the industry. According to this point, the public authorities would like that all firms behave in the same way they expect that the smallest firm would behave. However, it seems that the size of the firms does not really influence the level of safety they will adopt. We thus validate the proposition 1 and invalidate proposition1Bis.

The dummy variable that represents the direct supply of the firm is significantly positive. However, direct supplies should decrease the need of exerting downstream safety controls. We could explain this result in two ways. First, direct supplies involve commitment in the production process, directly or indirectly. By investing in the production process an importer devotes resources to the product it will sell on the French market. Then, importers should exert a higher effort level to preserve their product and thus to preserve this "risky" investment. Note that such transaction arrangements are developing and importers are more and more integrating the production process. Second, even if the supplier is well-known by the firm the transaction requires a commitment from both parties, leading to transaction costs. The breakdown of such an arrangement entails losses for both sides, in particular because

such contracts are very frequently exclusive. Exerting high effort level on safety issue is a way to preserve the transaction: importers protect themselves from moral hazard issues.

Last, if the major customer is a supermarket the probability of exerting a high effort level is higher than if the firm sells its produce to a wholesaler. In fact, supermarkets are known to be tough commercial partners. They also represent great opportunities for firms in terms of volume. As fresh produce is generally considered as generic product, customers can switch from one supplier to another. Firms try then to contract with supermarkets to maintain this "brittle" relationship where supermarkets hold all the negotiation power. Exerting a high effort level concerning safety is a way to preserve this relationship even it is not a mean for firms to differentiate themselves.

Firm's product:

Specialized firms –that is, firms for which the major product represents more than 30% of the sales- are more likely to exert a high effort level. So are firms that have invested in branding strategies for their main products. Generally, specialized firms operate in very particular sectors: specific products (organic carrot, frozen broccoli) or very sensitive one (strawberry, green bean, raspberry). They ensure their reputation and their market share (niche market) by ensuring quality. The same statement can be made for firms that engaged in branding strategies. Safety can be considered as a "quality" posture in order to raise their market share.

Environmental Characteristics:

The way environmental characteristics influence firms' decision is very insightful. Concerning the commercial threat a firm that feels this commercial threat exerts a higher effort level. It is consistent with firms willing to maintain their market share and to consolidate their business structure.

As expected, the collective benefits of the agreement have a positive influence on the effort level. When firms view the collective aspects of the agreement as being important, they are

more likely to exert a high effort level. Firms that would have devoted resources to safety controls operate more analysis.

Unexpectedly, when a firm considers that the public threat exerted by public authorities is real and important, it is more likely to exert a low level of monitoring effort. In fact, the credibility of this public threat seems at stake in this complex influence. On the one hand, from a legal point of view, firms remain uninformed about the behavior they should adopt to comply with regulations. For a large proportion of the observed firms, it leads to a minimum compliance with the requirements set by the agreement: to take any reasonable precaution in order to ensure food safety is understood as implementing the 10 laboratory analysis stated by the agreement. Firms only refer to the minimum level they must implement, that is they only refer to the level, which is compulsory. They do not voluntarily go far away beyond this compulsory level.

On the other hand, firms know that they can be inspected, even though the sanctions are rather rare in case of misbehavior in the monitoring procedure, and remain often verbal. Thus, public threat is not particularly credible in firms' eyes, but it seems to be a punctual constraint in firms' activity through random public inspections.

These statements lead us to validate proposition 2. According to the empirical results, an increase in the number of inspections won't induce an increase in the safety level implemented by firms. Indeed, even if firms fear public inspections, this doesn't lead them to implement a higher level of safety. The effort level they implement is thus not linked to their perception of the public threat. We may think that, food safety through analyzing pesticides residues is a new stake for French importers of fruit and vegetables. In the case of the collective self-monitoring agreement, importers seem to misunderstand what public authorities are expecting from them through this new regulatory instrument. The voluntary

characteristic of the instrument seems to be constrained by the compulsory minimal level of safety measures the firm must exert to be part of the collective agreement.

5. Discussion.

In this paper we deal with individual behavior within a collective voluntary approach to food safety. We characterize situations in which a third party could higher the performance of a collective voluntary program by intensifying the frequency of inspections in individual firms. We show that increasing the number of inspections can be useless if the threat of being inspected is not sufficiently high. Then firms only refer to the minimum level, which is compulsory they must implement. They do not voluntarily go far away beyond this compulsory level. We tested this proposition in our empirical model and show that the credibility of public inspections need be questioned. Even though interviewees report that they fear public authority's action, this threat doesn't lead to an increase of the number of residues analysis they would carry out.

This result leads us to question the design of collective agreement to food safety, at least in the fresh produce industry. Indeed, the behavior of the major part of the firms seems to be constrained by the minimum numbers of analyses they must implement in the agreement without taking into account their own characteristics. Firms implement the level of safety, which is compulsory. We thus bring two conclusions into light. First, when the treat of being inspected is useless, to be effective such voluntary programs should provide a minimum compulsory level that must be high. However, such voluntary program even they are more effective raises an exclusion issue, particularly for the access to such voluntary program for medium and small firms. Second, if the minimum compulsory level negotiated with firm is low, particularly to avoid such exclusion issues, then the treat to be inspected must be high enough and credible. Therefore, in order to be really effective, such programs need to define

an appropriate scheme of safety levels according to both participants firms' characteristics and to the minimal negotiated safety requirements that firms and public authorities negotiate. Their enforcement induces thus sort of differentiated compulsory constraints and their cost-effectiveness from the public authorities point of view should be questioned, as their efficiency from a societal point view.

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Appendix1. Descriptive Statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
SafetyEffort	54	0,61	0,49	0	1
nbrepest05	53	27.45	28.54	5	150
Firm's Characteristics					
Employees	55	13.63	13.52	1.5	79
CaCustFce	53	71.92	18.65	30	100
CustFrce	55	0,33	0,47	0	1
DirectSup	55	0,34	0,48	0	1
Firm's product					
Specialisation	55	0,38	0,49	0	1
Reputation	55	0,42	0,49	0	1
Environmental Characteristics					
CMthreat	55	0,64	0,48	0	1
Puthreat	55	0,74	0,44	0	1
Imutcont	55	0,83	0,37	0	1