Retailer-led Regulation of Food Safety:
Back to Spot Markets?

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Abstract

At the end of the 1990s European retailers had significantly contributed to restructuring fresh agricultural product food chains (meat, fruit and vegetables), and had turned away from spot markets in order to create their own supply chains, based on private technical requirements and verification systems usually managed from within the firm. However, over the last few years a second type of system has appeared, as the range of standards adopted by retailers has been broadened to include generic standards common to several retailers. A telling example of this new approach is provided by the EUREPGAP protocol. In this paper we propose a theoretical analysis of this new procedure and its possible impacts.

Keywords : Food safety, Spot markets, Retailer, Supply Chain

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Introduction

The food safety crises in the 1990s prompted the public authorities to adapt domestic and international regulations related to food safety and protection of consumer health. The agreements signed under the aegis of the World Trade Organization (SPS - Sanitary and Phyto-Sanitary) and the European Union (EU) thus strengthened the verification mechanisms for international exchanges. The main aim of these agreements was to reduce the number of non-tariff barriers while also implementing appropriate tools designed to lower the level of risk related to microbial pathogens, pesticide product residues and input into agricultural production (Unnevehr 2003 and Henson 2004).

At the same time that the public authorities were upgrading their regulations, the private operators, for their part, were seeking ways to meet customer expectations in terms of food safety. This was done by implementing private standards. As shown by numerous studies, European retailers have strongly pursued this approach and have played a central role in enhancing the safety of food chains. As retailers are held accountable for any failings committed by their suppliers first under the Food Safety Act in Great Britain and later by EU regulations, they have had to apply a due diligence approach to the production, storage and transportation of products (Marsden and

Wrigley, 1996). The EU program related to maximum residue levels (MRL) of pesticides has played the same role and has enabled governments to "name and shame" retailers selling products containing residue levels higher than that of the standards defined by the public authorities (Chan and King, 2000). Yet in many cases, European retailers have exceeded the requirements imposed by public regulations, and have developed private standards. Retailers have adopted this approach in order to protect themselves against the commercial fallout resulting from food safety crises and in some cases to develop new store brands and differentiation strategies (Codron et al, 2005).

The regulation of product safety under the control of retailers was implemented in two main ways. As described in numerous articles, the first way is based on the decreasing utilization of spot markets, the increasing involvement of retailers in the processes of their suppliers, and the establishment of relatively formalized contractual relationships aimed at fostering stable relations with producer organizations. As a result, the creation of vertical alliances between producers, manufacturers and retailers has proven to be an important mechanism in the regulation of agricultural product food chains, with a view to ensuring food safety and quality characteristics. Several examples may be put forward to illustrate these changes.

In Great Britain, Marks and Spencer (M&S) created its own supply chains by directly concluding agreements with producer groups. For example, the "M&S' Select Beef Scheme" is designed to provide consumers with products based on stringent requirements of traceability and quality. Tests and experiments directly managed by the retailer are regularly conducted. The resulting conclusions are used to compare different consumer food consumption patterns, and therefore serve to guide the action taken by suppliers. Inspections are carried out on a regular basis directly on the farms in order to ensure permanent verification of production conditions (Fearne, 1998).

Carrefour has adopted a similar approach through the creation of its private Certification Chain Brands ("Filières Qualité Carrefour") which are now commercialized in the majority of the countries in which this firm is present (e.g. France, Italy, Portugal). This action is intended to structure the supply chain by obliging suppliers to meet production requirements related to safety, quality and environmental levels, which are more demanding than public regulations. In order to encourage producers to adopt this system, Carrefour makes a relatively formalized contractual commitment, which provides price and volume guarantees higher than the spot market. These approaches have been studied in detail by Mazé (2003), Giraud-Héraud et al. (2005), Bazoche et al. (2005).

Another illustration of this phenomenon is provided by Dolan and Humphrey (2000) in the fruit sector. The relationships between producers, importers and retailers in this sector underwent a profound transformation in the 1990s. During this period retailers sought to organize product flow in such a way as to optimize transportation, storage and packaging conditions, from the producer to shelf-space. Technical requirements were drawn up in order to effectively control

harvesting conditions and production scheduling. This pre-supposed an efficient coordination of all the activities included in the supply chain, as well as enhanced information exchanges, not only to coordinate annual production plans, but also to manage day-to-day adjustments in reaction to unexpected events. Inspection and verification procedures were implemented to guarantee the recording of all activities, product traceability and certain technical characteristics, in particular the level of pesticide use. Relationships within the supply chain were built with a long-term view, and even sometimes based on the sharing of risks, with retailers undertaking to pay retailers a fixed percentage of the final product's price.

As demonstrated by these three examples, it was thus at the end of the 1990s European retailers had significantly contributed to restructuring fresh agricultural product food chains (meat, fruit and vegetables), and had turned away from spot markets in order to create their own supply chains, based on private technical requirements and verification systems usually managed from within the firm.

However, over the last few years a second type of system has appeared, as the range of standards adopted by retailers has been broadened to include generic standards common to several retailers. A telling example of this new approach is provided by the EUREPGAP protocol, which was developed by a network of European retailers in order to ensure production and supply best practices for fresh agricultural products. This standard functions as a norm for the certification and selection of suppliers, and imposes requirements mainly related to safety risks (pesticides, contamination…). Unlike private standards which are managed and verified by each individual retailer, these generic standards are common to several retailers with compliance regularly monitored by external certification and audit organizations. As a result, retailers are much less involved in the verification and supervision of producers.

The adoption of the EUREPGAP standard by an increasing number of retailers could be interpreted as a step backwards in view of the previous progress accomplished. It could also suggest that such generic standards might replace the private standards of each individual retailer, thereby inducing changes in the organizational forms implemented in the 1990s. Indeed, one may wonder whether external standards such as EUREPGAP could prompt retailers to reduce the intensity of the relationships established in the food chains, though without necessarily lessening the food quality and safety standards which they intend to continue offering to their customers. The process of increasing verification and the development of strong interactions in vertical alliances between producers and retailers could therefore be discontinued, thereby heralding a return to making purchases on the spot market. In this case, the spot market would henceforth provide the required food safety and quality guarantees.

Such a change would raise several issues. Firstly, how would it be possible for a stable spot market to emerge that enabled retailers to obtain products of a sufficiently high safety and quality level without being obliged to enter into vertical relationships with their suppliers, which were too restrictive? Secondly, when the external standards

created by the retailers were ready to impose themselves on the market, they might then replace the MQS defined by the public authorities. What could be their impacts from the public point of view?

As highlighted by Marsden (2002), the regulation of food industry chains is now based on complex interactions between the private initiatives taken by the retailers and the actions of the public authorities aimed at ensuring minimum product quality and safety standards. The aim of this article is to contribute to the study of these interactions within the framework of the public/private regulation of product safety and quality, which emerged in order to react to the uncertainties and food safety crises having occurred over the last two decades (Richardson, 2001).

1. Economic Issues Raised by EUREPGAP Certification

The EUREPGAP standard ("European Retailers for Good Agricultural Practices") was created by a group of European retailers (e.g. Tesco, Ahold, Sainsbury, Monoprix). This standard is used for the certification of farms in the fruit and vegetable sectors (and more recently in the meat sector). In order to qualify as a supplier of these retailers, the farms undertake to comply with HACCP principles (Hazard Analysis Critical Control Points) and to fulfill their commitments in order to reduce safety and environmental risks. A major concern of the EUREPGAP standard is focused on product traceability, the reduction of chemical residue (in particular pesticides) and physical and microbial contamination in order to guarantee both the innocuousness of consumer products, and the protection of natural resources and workers' health.

Producers are granted accreditation by external and independent organizations responsible for audits and verifications. If a supplier is not able to guarantee compliance with a clause classified as "major", its accreditation is temporarily suspended for a period of 6 months maximum. If beyond this period, compliance is still not fulfilled, its accreditation is revoked. As a significant number of retailers have adopted the EUREPGAP standard in some countries, accreditation is increasingly becoming a condition to access the market for fruit and vegetable producers.

The EUREPGAP standard generally requires an upgrading of the farm and therefore an investment, as well as more stringent production practices, which may result in additional production costs. This standard, which is applied solely to the B2B part of the activity, remains unseen by the consumers and is not publicized in any manner on the final market. In requiring compliance with the EUREPGAP standard, retailers essentially seek to impose on producers more stringent requirements than those defined by existing regulations. However, the development of this standard will be based on the extent to which the different players include it in their approach.

There are several reasons why some retailers may wish to keep their own supply chains based on stable agreements and internal

verification procedures. External standards and related verification procedures may only cover a part of the requirements which retailers seek to apply to their own products. In particular, differentiation strategies based on the creation of store brands cannot be implemented on the basis of generic standards. The need to control the logistical aspects and new product development also encourages the building of strong vertical alliances. The adoption of external standards may also result in a cost increase of the product due to more stringent requirements than those of the public authorities. However, this increase in cost does not necessarily justify a higher price on the final market, assuming that the standard is applied only to B2B relationships and that competing retailers continue to purchase their supplies on less demanding upstream markets. On the other hand, the adoption of the EUREPGAP system by a sufficiently great number of retailers may reduce the risks of food safety crises caused by too low production standards, and avoid sharp drops in demand, which are harmful for all retailers in times of crisis periods. In the same way, if upstream markets were able to offer safe products without retailers needing to establish restrictive vertical alliances, retailers could more forcefully take advantage of placing their suppliers in competition with one another in order to reduce their supply costs.

From a producer's perspective, the adoption of the EUREPGAP standard may be beneficial for several reasons. Firstly, the number of certification procedures is reduced, and therefore so are the related costs, as only a single standard is applied to retailers committed to EUREPGAP. Moreover, this approach would in fact become mandatory if all European retailers were to adopt it. Failure to do so would lead to exclusion from the market. Nevertheless, the costs associated with the application of the EUREPGAP standard create significant difficulties for the producers. These costs mainly stem from the investments required for the upgrading of production capacity, working conditions for the personnel, as well as verification and information monitoring systems.

For the public authorities, if in the future the application of the EUREPGAP certification standard were to become a required condition for access to the market, it would in effect act as a MQS defined by retailers in the private sector. Such an approach could be beneficial for the public authorities. The costs related to the verification of minimum quality standards would in fact be borne by private operators, whereas these costs would be paid by the public authorities were they to impose the MQS level. However, on the other hand, there is the risk that the MQS defined solely by the retailers would not be considered as being at the "appropriate" level in terms of the general public's interest.

In order to ascertain the future of these generic standards and their resulting impact, both on the products sold to consumers and the producer-retailer relationships, it is important to examine several key issues. Firstly, what would be the necessary conditions to entice all retailers to apply this common certification standard? What level of requirements will they seek to impose on producers, depending on the number among them which decide to adopt this standard? Can this certification standard establish itself as a Minimum Quality Standard

(MQS)? Should the public authorities intervene in order to influence the retailers choices? In the following section, we propose a model to support this discussion.

II. The Model

The vertical structure is shown in Figure 1. We consider a vertical relationship between J upstream producers and R downstream retailers. Each producer (j=1,…,J) sells a quantity q and is price taker on two intermediary markets :

- A generic spot market which supplies some retailers at the intermediary price ω_0,

- A safer spot market which supplies other retailers at price ω_1.

Each retailer r ($r = 1,...,R$) sells a quantity x_r on the final market, and buys the quantity he needs either on the generic or the safer spot market.

The final product is considered as an homogeneous product by the consumers who have the same willingness-to-pay the product coming from the generic or safer spot market. We consider the following demand function :

$$D(p) = c - dp \qquad (c,d>0) \qquad (1)$$

Nevertheless, in case of food safety crisis, we consider that the demand is null. If this crisis occurs with a probability $1-\xi$ ($0 \le \xi \le 1$), the expected demand on the final market is $D_\xi(p) = \xi(c - dp)$. The demand function is $p = a - b(\xi)X$, where X is the total quantity marketed ($X = \sum_{r=1}^{R} x_r$) and $a = c/d$ and $b = 1/d\xi$.

Insert Figure 1 : Vertical relationship with both spot market and safe market

The creation of a safer spot market by m retailers ($m \le R$) implies a fixed cost C > 0, identical for each retailer (administrative or control cost for instance). In order to be able to sell on the safer spot market, the producers must reach a certain level of equipment imposed by the retailers who buy on the safer spot market. We assume

that the initial equipments of the producers are represented by a one-dimensional parameter e varying between $\underline{e}$ and $\overline{e}$. We assume that parameter e is uniformly distributed within the interval $[\underline{e},\overline{e}]$ according to the density function $f(e)=\frac{1}{\overline{e}-\underline{e}}$. Without loss of generality, we consider that $\overline{e}=1$. We assume that the producers who want to sell on the safer spot market are required to adopt a certain level of equipment e_1 and the investment each producer has to realize is $Max\{0,e-e_1\}$.

The safety risk probability linked to each individual producer , whose equipment level is e, is given by $1-\xi(e)$ with $\xi(e)$ increasing in. We simply consider that $\xi(e)=e$ and $\xi(\overline{e})=1$. As we consider that each producer always markets the same quantity q (non elastic supply), the total safety risk is :

$$\xi=\int_{\underline{e}}^{\overline{e}}\xi(e)f(e)de=\frac{\overline{e}+\underline{e}}{2}=\frac{1}{2} \qquad (2)$$

At the retailer level, a safety crisis leads to a decrease of the final demand, but also to penalty costs in application of the due diligence principle. This penalty is supposed to depend on the safety risk probability and a coefficient Γ such as the retailer profit without a safer spot market is :

$$\pi_i=(p(\xi,X)-w_0)x_i-\xi.\Gamma$$

with w_0 the spot market price paid to the producer.

Benchmark analysis

In the benchmark situation, only one spot market exists and the probability of food safety crisis is ½. Calculating the Cournot-Nash equilibrium between the retailers, we easily obtain the supply on the final market according to the spot market price paid to the upstream producers. Then, as all the producers sell the same quantity q on the spot market, we obtain the equilibrium spot price by equalizing supply and demand on this intermediary market. This spot price is :

$$\omega_0^*=a-\frac{2q(1+R)}{dR}$$

At the equilibrium, the retailer's profit is given by :

$$\pi^*=\frac{2q^2}{dR^2}-\frac{\Gamma}{2}$$

Safer spot market creation

The issue is now to assess the extension of the safer chain by the downstream retailers and the upstream producers who have to adapt their equipments. In order to deal with this issue, we study the following game:

Step 1 : the retailers decide simultaneously to pay or not the fixed cost C to enter the safer spot market defined by the safety standard *e1*.

Step 2 : the upstream producers decide simultaneously to enter the safer market and, if necessary adapt their equipments.

Step 3 : the producers offer the quantity q on the market they have chosen and the retailers decide simultaneously to supply on the final market the quantity x_r (r=1,…,R).

The creation of the safer market is based on the initial commitment of some retailers to set up this market (step 1). This commitment leads the producers to decide to enter or not this market, and to adapt or not their initial equipments, according to the expected prices on the safer spot market (step 2). Given the chain structure (*i.e.* the number of producers and retailers involved in each spot market), prices and quantities exchanged on each market are calculated (step 3). The game is solved by backward induction.

Given (ω_0, ω_1), we obtain the Nash equilibrium in quantity between the R retailers:

$$\begin{cases} x_i(\omega_0,\omega_1) = \dfrac{a-(m+1)\omega_0+m\omega_1}{b(\xi)(n+m+1)} & i=1,\ldots,n \\ \\ x_i(\omega_0,\omega_1) = \dfrac{a+n\omega_0-(n+1)\omega_1}{b(\xi)(n+m+1)} & i=n+1,\ldots,R \end{cases} \qquad (3)$$

Let's assume that the G producers who enter the Eurepgap spot market are involved from the most equipped in the initial situation to the less equipped in the initial situation. This means that G is constituted of producers whose equipment level is initially between $e=1$ and a value $\hat{e}$, on the left of $e1$. Thus, $G=1-\hat{e}$.

Given ω_0 et ω_1, all the producers, having an equipment e, who enter G are such as :

$$e-\hat{e} \leq (\omega_1-\omega_0)q$$

The investments of the producers initially located between $\hat{e}$ et e_1 lead to modify the statistical repartition of producers equipments (initially uniformly distributed on the interval $[0,1]$). Now, the producers are distributed on $[0,\hat{e}]$ and $[e_1,1]$ with the following density:

$$f(e)=\begin{cases} 1 & if \quad 0<e<\hat{e} \\ 0 & if \quad \hat{e}<e\leq e_1 \\ e_1-\hat{e} & if \quad e=e_1 \\ 1 & if \quad e_1<e\leq\hat{e} \end{cases}$$

In this case, the non safety risk is :

$$\xi_s(e_1,\hat{e}) = \int_0^1 \xi(e)f(e)de = \frac{1+(e_1-\hat{e})^2}{2} \qquad (9)$$

It is now possible to determine the supply-demand equilibrium on the intermediary markets (spot and Eurepgap) by taking into account the risk in the calculation of the quantities marketed by the retailers on the final market. At the equilibrium, the spot market prices are given by:

$$\begin{cases} \omega_0(e_1,\hat{e})=a-\dfrac{q(R+m+\hat{e})}{d(R-m)\xi_s(e_1,\hat{e})} \\ \omega_1(e_1,\hat{e})=a-\dfrac{q(m+1-\hat{e})}{dm\xi_s(e_1,\hat{e})} \end{cases}$$

The retailers' profits (in the coalition and in the fringe) depend on the number of producers and retailers involved in the safer spot market. These profits are given by :

$$\begin{cases} \pi_C(e_1,\hat{e}) = \dfrac{(1-\hat{e})^2 q^2}{d\xi_s(e_1,\hat{e})m^2} - (1-e_1)[1-\xi_s(e_1,\hat{e})]\Gamma - F \\ \pi_F(e_1,\hat{e}) = \dfrac{\hat{e}^2 q^2}{d\xi_s(e_1,\hat{e})(R-m)^2} - [1-\xi_s(e_1,\hat{e})]\Gamma \end{cases}$$

The equipment $\hat{e}$ is the solution of the following equation:

$$e-\hat{e} = [\omega_1(e_1,\hat{e})-\omega_0(e_1,\hat{e})]q$$

$\hat{e}$ depends on the equipment level chosen by the coalition and the size of this one. These two variables influence the intermediary prices and the gap between the two spot markets. This gap finally influences the level of $\hat{e}$, i.e. the number of producers who accept to join the safer market.

III. Results and comments

On the basis of the previous section, it is possible to formulate the following conclusions :

1. *The creation of a spot market based on more stringent specifications does not change systematically the sanitary risk level*

The creation of a safer spot market based on more stringent specifications (has no effect on the total safety risk level if only the already equipped producers (such as $e>e_1$) enter this market.

2. *Retailers can reduce the total risk if and only if they pay more the producers who enter the safer market*

If the creation of the safer market is not limited to the already equipped producers, then the retailers involved in this procedure are obliged to pay an intermediary price higher than the generic spot market price (in order to allow investments among the non equipped producers).

3. *In some case, the creation of a safer spot market can be only seen as an " insurance" strategy against the penalty the retailers have to pay when safety crises occur*

If the equipment level required to supply the safer market is low, many producers, already equipped, are able to enter this market. In this case, the already equipped producers are sufficiently numerous to supply the safer market. Like these producers can accept a lower intermediary spot market price (because they do not have to invest), the other producers cannot enter the safer spot market. At the equilibrium, the spot prices are equal on the two markets and the safety risk is the same than in the benchmark situation (without safer spot market). Nevertheless, the retailers can be interested in implementing the safer spot market, because it can reduce the individual penalty cost. In other worlds, the creation of a safer spot market just allow retailers to cover themselves against future penalties. This market acts as an "insurance" against the monetary effects of sanitary crisis.

4. *To change the risk level, the participants to the safer market must be sufficiently numerous*

The retailers must impose a sufficiently high level of minimum equipment to allow non equipped producers to enter the safer spot market. In this case, the total safety risk can be decreased relatively to the benchmark situation. This strategy can be implemented only if a minimum number of retailers (the initial coalition) are agree to commit themselves in this way.

5. *To change the risk level, the participants to the safer market must be sufficiently numerous but they have no interest in the coalition enlargement*

The retailers who participate to the initial coalition get a higher profit than in the benchmark, but their profit decreases if the coalition size increases. The greater the number of retailers involved in the coalition, the smaller their profit. The best would be for them to stay at the minimum coalition size. The reason is that the intermediary price on the safer spot market increases as new retailers enter the coalition.

6. *The retailers who stay outside the coalition benefit from the the coalition size increase (free riding phenomenon)*

When the coalition is stable, the profit of the retailers involved in the initial coalition is lower than the profit they get for the minimum coalition size. The profit of the retailers who are outside the coalition is increasing in the coalition size. It means that there is a positive externality for the retailers who stay outside the coalition (they benefit from the decrease in the total safety risk).

7. *The producers non involved in the safer market are penalised relatively to their own benchmark.*

The total safety risk is decreased relatively to the benchmark situation and the profits of all the retailers and the producers involved in the safer market are higher than in the benchmark situation. The profit of non involved producers is decreased relatively their own benchmark.

8. *The penalty cost is an efficient public instrument to implement a collective action to create a safer market.*

The minimum coalition size depends on the penalty cost. The greater this penalty, the smaller the minimum size of the profitable coalition (regarding to the benchmark). Then, the penalty has as function to facilitate the collective action (creation of a safer market) by reducing the minimal size of the "nucleolus" (initial coalition) which may initiate this action.

9. *The penalty cost is an efficient public instrument to favour the enlargement of the initial coalition.*

If we assume that the retailers of the initial coalition cannot forbid new entrants incumbents, once the initial coalition and the new spot market are implemented, other retailers can demand to enter the coalition. For all the retailers (and if the penalty costs are median), the profits inside the coalition are always higher than in the benchmark situation, and higher than outside the coalition if the coalition size does not exceed a certain threshold. If the coalition size is equal to this threshold, the coalition is stable. So a larger coalition than the initial coalition can be implemented. The size of this stable coalition depends on several parameters, especially the penalty cost linked to safety risk. The stable coalition is compatible with the co-existence of two spot markets.

If we assume that the penalty cost is influenced by the public authorities, and if they want to reduce the total safety risk, they have to set up a penalty rule such as : on the one hand, the penalty cost is sufficiently high in order to decrease the minimum size of the initial coalition and increase the size of the stable coalition (at this point, the total risk is lower); on the other hand, the penalty cost must not be too high because of a too strong decrease in the retailers' profit.

If we go back to the Eurepgap example, these results suggest some remarks. If the certification process and the supplier selection is such as only the already equipped producers supply the Eurepgap market, this procedure would have no effect on the total safety risk. In this case, the spot markets prices would be the same on the both channels. But some retailers could be interested in this solution because it decreases the individual penalty in case of crisis.

If the spot market price of the Eurepgap market is higher than the generic spot market price, it means that the retailers coalition is supplied not only by already equipped producers, but also by producers who have to invest in a new equipment. In this case, the total safety risk is decreased relatively to the benchmark situation and the profits of all the retailers and the producers involved in the Eurepgap market are higher than in the benchmark situation. The profit of non involved producers is decreased relatively their own benchmark.

The progressive entrance of new retailers shows that the coalition cannot forbid new entrances, despite the fact that it is not in its interest. If the stability size is not reached yet, new retailers will enter the coalition. But other retailers can prefer to stay outside and benefit from a free-riding strategy as their profit increase when the coalition size increases.

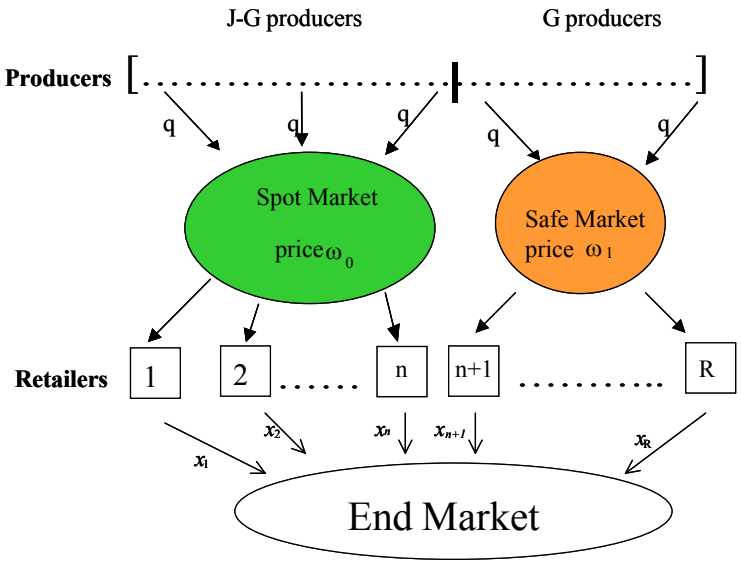

Figure 1. The vertical structure

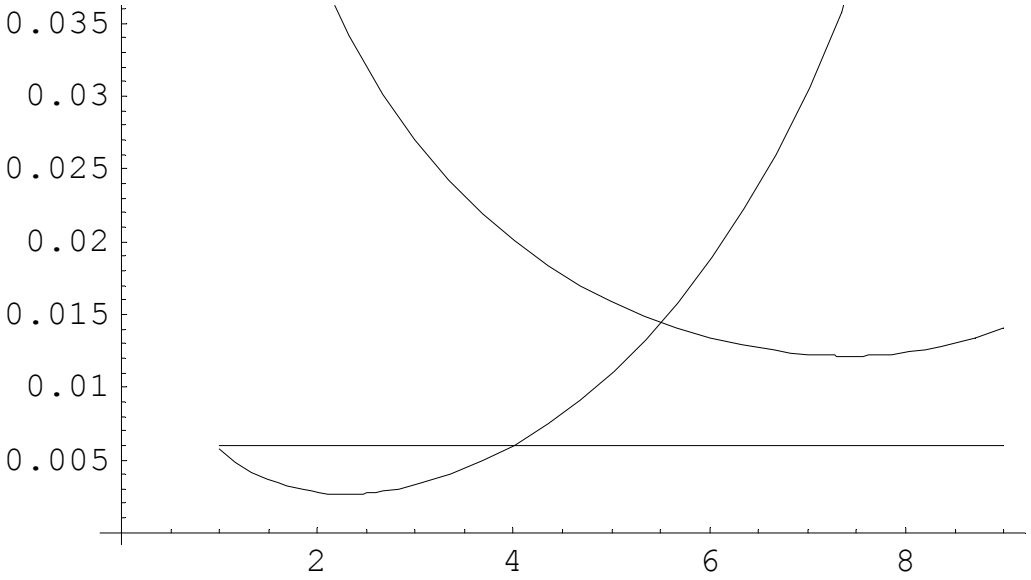

Figure 2: Size of stable coalition
Profit curves in function of the coalition size m: Profit of Retailers belonging to the safer market of size m (the decreasing curve), Profit of Retailers who join the fringe and observe a coalition of size (m-1) (increasing curve). Benchmark profit (linear curve). These curves are valid for m≥4 and the values of parameters are: a=10, d=5, $F=10^{-5}$, q=3, e_1=0.7, Γ =0.06

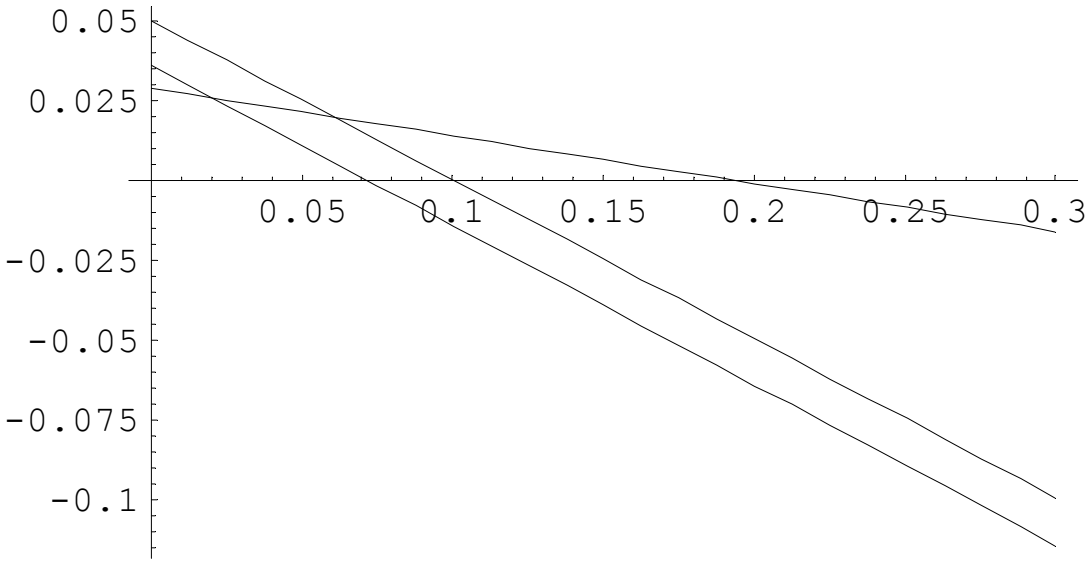

Figure 3: the role of public penalty (for m=4)
Profits curves in function of penalty Γ : Profit of Retailers belonging to the safer market (the higher curve in the right of the abscise axis), Profit of Retailers who join the fringe and observe a coalition of size (m-1) (the median curve in the right of the abscise axis), and the benchmark profit (the lower curve in the right of the abscise axis). These curves are valid for Γ ≥0.02 and the values of parameters are: a=10, d=5, $F=10^{-5}$, q=3,m=4,e_1=0.7

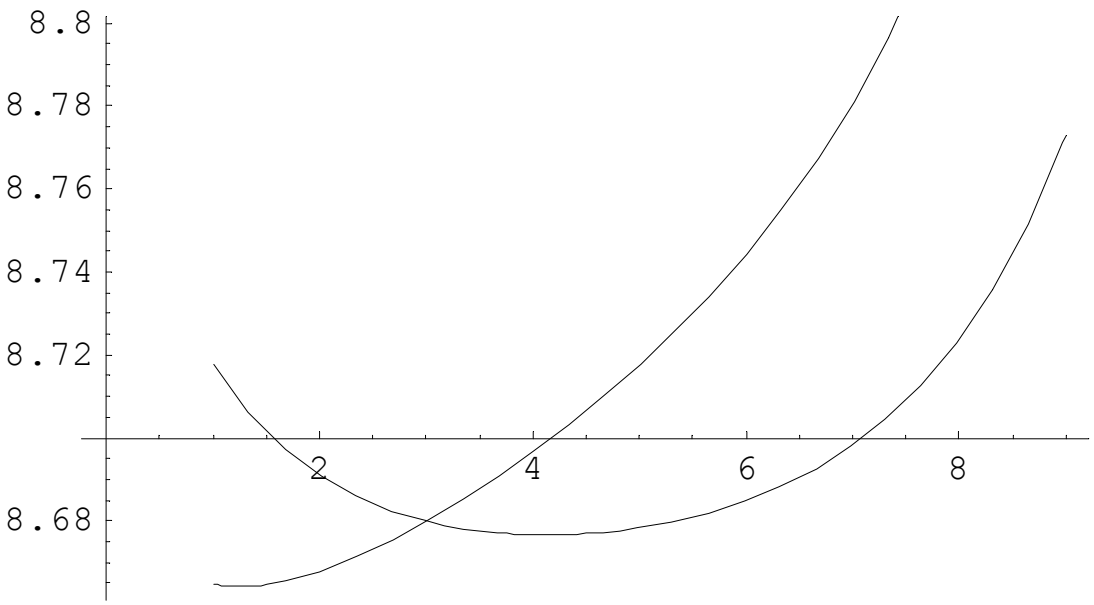

Figure 4: the variation of the intermediary prices

Intermediary prices curves in function of the coalition size m: Intermediary price on the safer market of size m (the higher curve in the right of the abscise axis), Intermediary price in the generic spot market (increasing curve), and benchmark spot market price (the lower curve in the right of the abscise axis). These curves are valid for $m \geq 4$ and the values of parameters are: $a=10$, $d=5$, $F=10^{-5}$, $q=3$, $e_1=0.7$, $\Gamma=0.06$