The Virtues of the Vice of Cooperation between Rival Firms: A Simulation Model to Evaluate the Performance of Coopetition Strategy in the Grain Merchant Industry

Mourad Hannachi[1] & François-Christophe Coléno[1]

[1] INRA, UMR SAD-APT, Paris-Grignon, France

Correspondence: Mourad Hannachi, INRA SAD APT, Bâtiment EGER, BP1- 78850 Thiverval-Grignon, France. Tel: 33-6-1755-4991. E-mail: mhannachi@grignon.INRA.fr

Abstract

Coopetition is often seen as a phenomenon present in the tertiary sector encouraging the competitors to achieve cooperation upstream the production particularly in R & D. The literature suggest that coopetition's benefits occur in knowledge-intensive sectors. The aim of this paper is to explore how coopetition enables superior industry performance in primary sector. Using a simulation model on the case of grain merchant's industry in the context of coexistence between GM (genetically modified) and non-GM production, we demonstrate that coopetition enables superior performance and competitiveness in a context of market segmentation. The use of modelling enables us to compare a cooperative strategy with a non-cooperative strategy.

Keywords: coopetition, performance, GMO, simulation model, inter-organizational level

1. Introduction

The relationship between rival firms has been the subject of investigation since the birth of the science of economics. It encompasses specialized disciplines (strategic management, industrial organization), has become the subject of a specialized policy field (antitrust policy) and the topic of a specific branch of law (Competition law). All these fields have been, for a long while, based on the concept of perfect competition that regards competition as the optimal behaviour for the firm and for social well-being.

However, in the second half of the 20th century, research showed that cooperation between firms in the same sector can be beneficial for business and industry, and even generate social well-being (Nash, 1953; Axelroad, 1984; Richardson, 1972; and Astely Formburn, 1983; Pfeffer and Salancik, 1978; Garette and Dussauge, 1995). In the United States, the success of Japanese companies organized in consortia to improve their performance in the international markets has inspired firms and politics (Dyer and Singh, 1998; Browning et al, 1995). This has resulted in a change in anti-trust policies and many nations began to encourage the establishment of shared organizations between enterprises in a situation of rivalry in the markets.

At the legal level, the United States introduced in 1993 the National Cooperative Research and Production Act (NRCPA). This act provides that agreements for cooperation in research and development (R&D) must be assessed by applying a "rule of reason." Finally, in 1997 guidelines on the treatment of industry concentration have been relaxed as well as those relating to intellectual property (Encaoua and Guesnerie, 2006). In Europe, it has resulted in the exemption of R & D consortia from antitrust laws and the setting up of policies that promote cooperation between rival firms (e.g. in France the government supports the setting up of clusters called "poles de compétitivité"). Nowadays, although any market sharing or fixing of production quotas or agreements on prices between companies is prohibited under Article 81 of the Treaty of Rome, in fact, some agreements are valued in the light of a "rule of reason". That is to say that the regulator judges whether or not the economic benefits outweigh the disadvantages (Encaoua and Guesnerie, 2006). The existence of the rule of reason recognises that agreements between competitors may sometimes generate social well-being.

This ambiguity of contemporary competition law sometimes causes some problems and raises several questions. For example: if fish stocks tend to be dangerously exhausted, should we limit competition by setting quotas and fishing cartels? This question arose in practice in the United States where fishing cooperatives are treated with suspicion by

the antitrust authority. The fishermen argue that free competition may lead to depletion of the resource (Le Roy and Yami, 2009). This shows that in a business world based on alliances and shared developments, firms may no longer be satisfied with theoretical models that view the firm alone facing the market.

In this context a new field of academic research emerged, that of coopetition. This neologism, created by the hybridisation of the words of competition and cooperation, was used by academics to describe market configurations, which are becoming more and more frequent, where firms are lead to compete and to cooperate at the same time (Nalebuff and Brandenburger, 1996; Dagnino and Padula, 2002). Coopetition is today the focus of a growing community of researchers (Yami et al., 2010) and coopetition has become an important and complex concept that is emerging as a new theoretical perspective in strategic management (Gnyawali et al, 2008). Some theoretical issues, however, remain unexplored. The literature fails to show unambiguously that firms pursuing coopetitive strategies achieve superior performance (Ritala et al, 2008; Galvano and Garraffo, 2010).

The aim of this paper is to explore how coopetition enables superior industry performance. Using a model of the case of the grain merchant's industry in the context of coexistence between GM (genetically modified) and non-GM production, we demonstrate how coopetition enables superior performance and competitiveness in a context of market segmentation.

This paper will be divided into 6 sections. First we will review the existing literature on the effect of coopetition strategy on a firm's performance and we will position this paper (Section 2). Then we will present the case study (section 3), the model (section 4), and the results (section 5). Finally we discuss these results in regard to the existing literature in section 6.

2. Theoretical Background

2.1 Coopetition at the Industry Level

Relationships between firms have been the subject of considerable attention from strategic management researchers. Many academics studied the competitive relationships (Porter, 1980, Smith et al 1992, Young et al, 1996); and others studied the cooperative relationship through alliances (Garette and Dessauge, 1995), joint ventures (Kogut, 1988), federations and clusters (Oliver and Ebers, 1998). But, as argued by Dyer and Singh (1998) for the cooperative relationship or Rumelt (1991) for the competitive relationships, neither of them succeeded in explaining the variation in business profitability.

With the emergence of the concept of coopetition (Nalebuff and Brandenburger, 1996) the traditional dichotomy between competition and cooperation seems no longer appropriate for understanding inter-organizational relations (Padula and Dagnino, 2007; Yami et al, 2010). The idea of this ambivalence in the relations between firms is not new, and seems to be older than the word "coopetition". We find it in the works of Richardson (1972) or Perroux (1973). This last author pointed out that in reality we do not observe absolute forms of competition or cooperation but that these two dimensions are connected. The idea of this ambivalence of the relations between firms was however the subject of discussion and a beginning of theorisation on the concept of collective strategy (Astley and Fombrun, 1983; Bresser and Harl, 1986). The notion of coopetition allows this duality of competitive relationship to be qualified.

The recent literature shows the complexity of the concept and the practice of coopetition. The coopetition is revealed as a multiscale phenomenon and academics distinguish the individual level (i.e. at the manager level as in Loch et al, 2006; Tjosvold and Sun, 2001), the organization level (Tsai, 2002; Luo and Slotegraaf, 2006; Chen and Tjosvold, 2008), the dyadic relationship (Das and Tang, 2000; Bengtsson and Kock, 2000 ; Bonel and Rocco, 2007) and the inter-organizational level by focusing on the relationship between rivals in clusters or industrial districts (Gnyawali and Madhavan, 2001). Nevertheless, industry-level coopetition has been less intensively studied in the field of management (Luo, 2004). In this paper we will study the coopetition phenomena at inter-organizational level and we will try to clarify the effect of coopetition on industry performance.

2.2 Coopetition and Performance

Since its first development, coopetition has been defined as a strategy designed to achieve better performance by a firm (Nalebuff and Brandenburger, 1996), and ultimately above-average profitability through cooperation with the firm's competitors. The coopetition phenomenon has been observed in the cinema sector (Roy and Yami, 2009), ICT (Dittrich and Duysters, 2007; Gueguen, 2009), the canning industry (Le Roy, 2008), air transport (Garrette et al, 2009), healthcare (Barretta, 2008; LeTourneau, 2004; Peng and Bourne, 2009), R&D consortia (Browning et al., 1995; Gnyawali and Park, 2011) and the automotive industry (Gwynne, 2009; Segrestin, 2005). In those papers there is evidence that coopetition is chosen by managers to foster greater knowledge development, economic and market

growth, and technological progress of their firm. But the question of the real effect of the coopetition strategy on performance remains under-researched (Ritala, 2012). Do coopetition strategies really provide better results at the industry level than competition or cooperation individually? Is the strategy of coopetition as a strategic choice efficient or just a bandwagon effect?

The existing literature provides a rich but so far inconclusive account of how coopetition affects a firm's performance. Two types of benefit are generally attributed to coopetition: studies suggest that coopetition can have a positive effect on innovation (Belderbos et al, 2004; Quintana-Garcia and Benavides-Velasco, 2004; Tether, 2002) and market performance (Luo et al, 2007).

On the effect on innovativeness, previous work has produced much evidence that coopetition is beneficial to the innovative output. Some research has compared coopetition with other types of collaboration and has found that coopetition is more beneficial in the introduction of new product lines (Tether, 2002; Quintana-Garcia and Benavides-Velasco, 2004). Some studies suggest that coopetition in R&D relationships enables firms to create incremental and radical innovations through better knowledge sharing and emulation (Tether, 2002; Belderbos et al 2004; Faems et al., 2009).

As to market performance, although there is already much evidence that coopetition is beneficial to innovation, there is much less evidence about its effects on market performance (Ritala, 2012). At the organisational level, Luo et al (2007) have found that coopetition was beneficial in terms of return on equity up to a certain threshold. Qualitative and theoretical analyses corroborate this finding and indicate that allying competition and cooperation could be considered potentially superior because it enables the benefits of both competition and cooperation to be reached (Nalebuff and Brandenburger, 1996; Lado et al 1997). The literature on strategic alliances argues, via a resource-based view, that the sharing of similar resources, in particular to spread the risks and costs involved in activities such as technology development and standardization, enables firms to reach a critical mass, and thereby to gain economies of scale (Das and Teng, 2000 ; Garrette et al, 2009). Apart from qualitative research, much of the existing evidence was obtained through research conducted on the level of dyadic alliances focusing on individual benefits (Kim and Parkhe, 2009) rather than the inter-organizational level and benefits to industry.

2.3 The Lack of Evidence on Coopetition Performance in Non-knowledge Sectors

The majority of the research was done on cases where contingency variables could partially explain the findings. Some of these studies demonstrate that the business sector is a determinant variable which influences the benefits of coopetition. Some authors have suggested that coopetition's benefits occur in knowledge-intensive sectors where competitors collaborate and share information and risk in order to create collective standards and interoperable solutions in R&D. (Fjelstad et al, 2004; Mione, 2009; Gueguen, 2009). Some authors also argue that coopetition is not always a winning strategy in industries that are less knowledge-intensive, like manufacturing (Nieto and Santamaria, 2007; Arranz and Arroyabe, 2008).

In this paper we will focus on this gap in the literature and explore how coopetition enables better performance in the primary sector. For this purpose, we focus on the case of the grain merchant industry in a context of market segmentation caused by the introduction of genetically modified crops. This market segmentation put all the operators in a strong interdependence situation: at the farmland level, the conduct of an operator who cultivates or produces GMOs can affect the well-being of others who do not want to. So this situation required the setting up of collective strategies and the emergence of new forms of governance. These methods of governance must enable coordination between all the stakeholders and particularly between rival grain merchants.

3. The Case Study: The Grain Merchant Industry under GM and Non-GM Coexistence

The prospect of growing GM crops in Europe generated conflict between proponents and opponents of this technology (Levidow et al., 2000), leading at first to a moratorium on GM crops. This ended in 2004, since when both types of crop have co-existed in the landscape, with GM and non-GM material segregated in the supply chain. Several European regulations define the rules of coexistence and segregation:

- For the consumer's information the aims of these regulations is to guarantee that any food containing material that contains more than 0.9% of GM would be labelled "contains GM" (EC 2003a).

- For the food industry the objective is to enable GM products to be traced throughout the supply chain ("from farm to fork") (EC, 2003b).

- Regarding agricultural production, this regulation concerns the release into the environment of GMOs (EC, 2001) and so aims to avoid cross-pollination between GM and non-GM crops (EC, 2003c).

For agricultural production, this coexistence generates several problems. On a farm, use of the same agricultural machinery, such as a seed drill or harvester, for both GM and conventional production, increases the risk of admixture (Jank et al. 2006). Moreover, a farmer using GM seed has to be sure that his fields will not contaminate the conventional production of his neighbours. This can be done in two ways. The first is to have an isolation distance between GM and non-GM fields (Byrne and Fromherz, 2003) because maize pollen has a short dispersal range (Della Porta et al, 2008). The second is to ensure a time lag between the growth of GM and non-GM crops so that they do not flower simultaneously (Messan et al., 2006).

For the industry, the problem is to guarantee the level of GM material in the product. This is done using risk management policies such as HACCP (Scipioni et al. 2005) or FMEA (Arvanitoyannis and Savelides, 2007) combined with testing procedures using quantitative methods such as the PCR test (Lüthy 1999; Arvanitoyannis, 2006)

For maize production, the link between industry and farms is the country elevator (USA), or grain merchant (UK), whose infrastructure is the site of the highest mixing risk between GM and non-GM corps (Le Bail and Valceschini, 2004). Several critical features have been identified in this collection chain (Bullock and Dequilbet, 2002; Le Bail, 2003), concerned with cropping plan management, storage of harvested products and, in the case of maize, drying, which is a bottleneck in maize collection. These critical points are linked with the fact that country elevators have to combine the production of several dozen fields in their collection silos and maize dryers. Furthermore, the batches obtained must be dealt with in less than 48 hours to protect the maize quality (Coléno et al., 2005). It is thus not possible to exclude batches by using the PCR test, which takes more than 48h. Moreover, the large investment necessary for the implementation of two isolated collection chains means that the GM and non-GM products need to be segregated using the existing infrastructure. Two possible strategies have been identified to segregate the two products (Le Bail, 2003, Miraglia et al., 2004; Coléno et al., 2005). These strategies are based on:

- The separation of the two products in space, allocating one chain to each type of crop, so that each collection silo receives only one type of product. Dryers are also allocated to one type of product.

- The separation of the two products by the timing of their deliveries. In this case, each product is delivered to the nearest collection silo to the farm, but at a specific time. Thus, non-GM grain can be delivered in the beginning of the collection period and GM at the end. There is no risk of mixing between non-GM and GM, which might lead to downgrading of the non-GM crop.

Moreover, these strategies do not have the same effect on landscape organization and on the risk of cross-pollination between GM and non-GM fields. The spatial strategy could allocate parts of the landscape to each crop and thus minimize accidental GM presence, which is not possible with the temporal strategy (Coléno et al., 2009). Grain merchants have a key role in creating such homogeneous zones for GM and non-GM production. They can influence farmers' cultivar choices using production contracts and price differences between crops. But if there is more than one grain merchant operating in any given region they would have to cooperate to create a homogenous zone of sufficient size; otherwise it would not be big enough to ensure a sufficiently low threshold in the non-GM batches collected (Coleno et al., 2009).

Moreover, such cooperation between companies could improve the efficiency of segregation of the two products. In this paper we want to explore this hypothesis using a model of grain flow simulation in the collection process. After presenting the model, we will evaluate the different strategies using two criteria: the collection cost and the proportion of non-GM that is stored as non-GM at the end of the collection process.

3.1 The GM and Non-GM Maize Collection Chain

Maize collection in Europe occurs in autumn - generally from September to December. During this period, farmers harvest their maize and deliver it to the collection silos of the firm purchasing their harvest. Each of these silos is made up of different cells, all of the same size. The cells are small compared to the quantity of maize collected. Very often, maize is transferred from collection silos to dryers. When maize is dried, it is stored in uniform batches in storage silos in seaports or railway stations. These storage silos may contain 300 000 tons or more. To ensure a high quality of maize, and hence access to the best food markets, the maximum time from harvesting to drying should be less than 48 hours. To ensure GM and non-GM segregation in the collection chain, several factors have been shown to be important (Le Bail 2003; Coléno et al 2005):

- Mixing of products can occur in the collection silos. When all the cells contain maize the silo manager has to choose between (i) accepting farmers' deliveries and thus mixing the two products or (ii) refusing some deliveries to avoid mixing but with the risk that the farmer will sell his crop to another firm. The type of

relationship between the firm and the farmer, and whether there is another country elevator in the vicinity will influence the silo manager's decision.

- Mixing may also occur in the dryers. To reduce drying costs, dryers are used at their full capacity. In so doing, mixing may occur if there is not enough of one product. Moreover, to avoid contamination between products in the dryer, the first batch of non-GM that follows a GM lot must be sold as GM.

4. Presentation of the Model (Coleno, 2008)

The model deals with these two critical points and takes into account transport between collection silos and dryers. It is therefore made up of three modules: collection silos, dryers and transport.

In order to model the decentralized method we will consider two schedulings of collections from silos and dryers. The first one, in favour of segregation, consists of making uniform batches, while the second focuses on cost minimization using the total storage and drying capacity.

4.1 Collection Silos

The collection silo model is shown in Figure 1. Each day, a collection silo receives a quantity of each product, $D_{t,p}$, where p is the kind of product (GM or non-GM) and t the time period. The delivery is then put into cells (C_i) that contain the same product or are empty. If there is a residue when all the cells have been checked, its management depends on the silo's management strategy:

- In the case of scheduling in favour of segregation (SS1) the residue will be refused and deferred to the next day. So $D_{t+1,p}=D_{t+1,p}+D_{t,p}$.

- In the case of scheduling in favour of quantity maximization (SS2), the residue will be put in the first cell with sufficient free space. The maize in this cell will then be considered as GM.
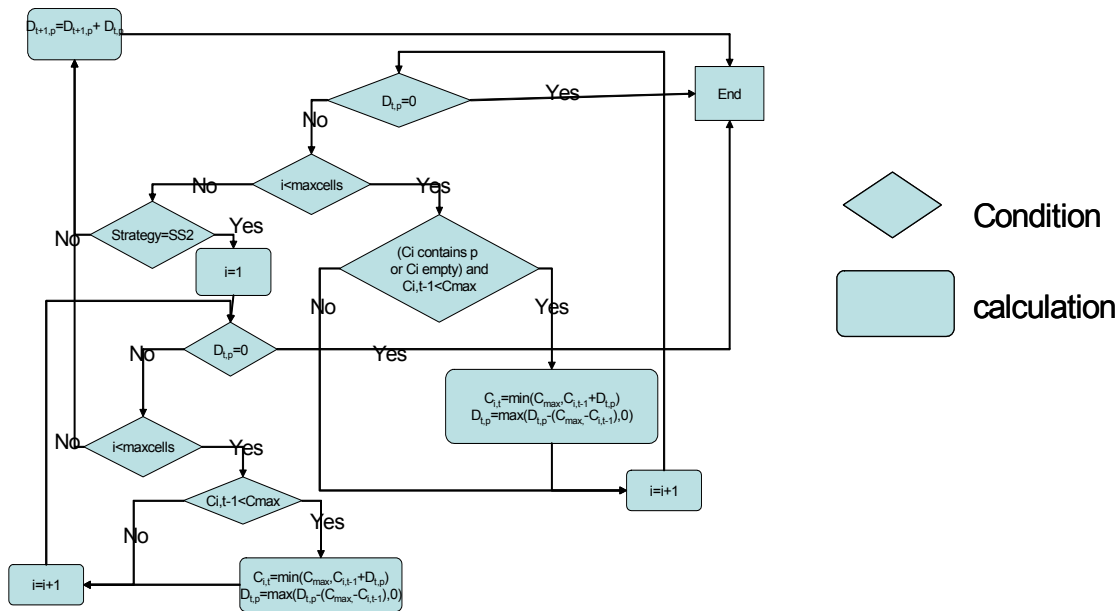

Figure 1. The collection silo model (Coléno, 2008)

4.2 Transport

Each day, the collection silos can call for transport if their stock is above a certain threshold (T):

If $C_i \geq T$ then ask for transport.

These requests are treated using the First In First Out management rule, the older batch being given priority. To take into account the time constraint of 48 hours for the food market, the delivery stored at t-1 has the higher priority level. If it is not possible to store the incoming batch in the waiting silos at the drying facility, the delivery is deferred to the next day.

4.3 Dryers

Drying facilities consist of two structures: dryer waiting silos, where maize is stored before being dried, and the actual dryers. Each day, a dryer dries one batch of maize. Changing the type of product dried (DT_t) from one day to another can cause a loss (the first batch of non-GM following a GM batch is considered as GM). So the model tries first to minimize these changes. Each day the dryer has a waiting quantity (WQ_t) of GM and non-GM to dry.

In the case of the strategy in favour of segregation (SD1) the model works as shown in Figure 2. The model will try to dry a batch of the same product that was dried in the previous period, even if it is not possible to use the dryer at its full capacity (DC).
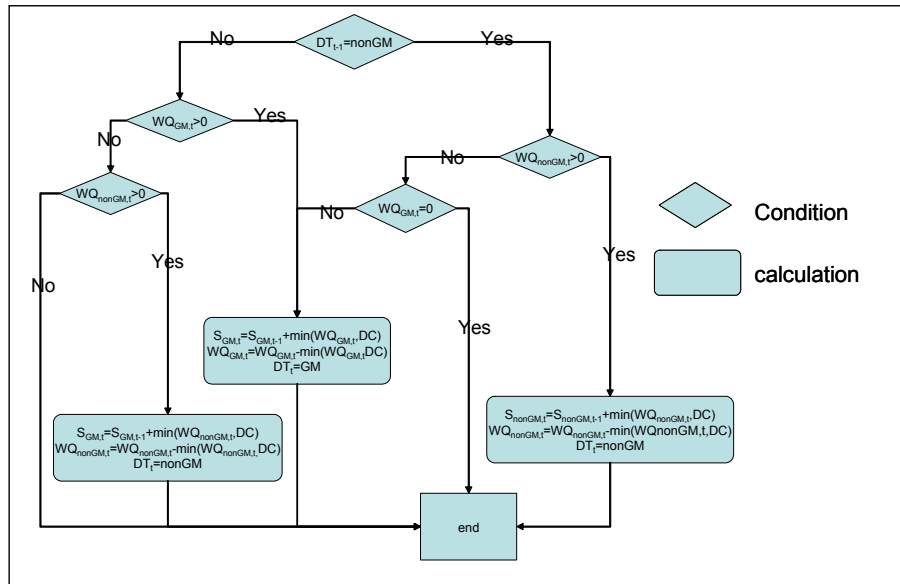

Figure 2. The dryer model for the scheduling strategy in favour of segregation (SD1). DT=type of product dried, WQ= waiting quantity, DC=drying capacity, S= stock of product dried (Coléno, 2008)

In the case of the strategy in favour of cost minimization (SD2) the model works as shown in Figure 3. The model will try to use the dryer at its full capacity over each period, even if this causes a change in the type of product dried or a mixing of the two products.
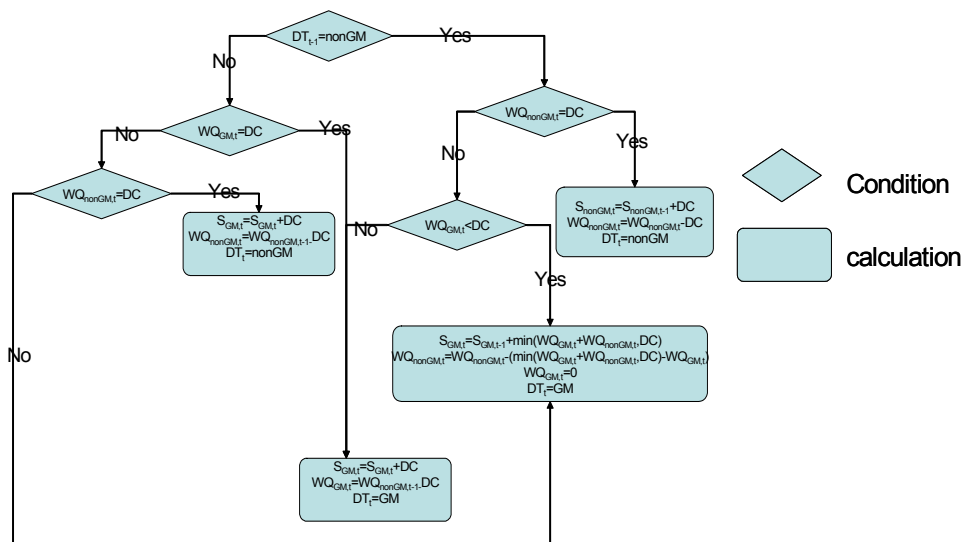

Figure 3. The dryer model for the scheduling strategy in favour of cost minimization (SD2). DT=type of product dried, WQ= waiting quantity, DC=drying capacity, S= stock of dried product (Coléno, 2008)

4.4 Variables Used for Simulation

The model runs with a daily time step. Each day, collection silo stocks are calculated, taking into account the GM and non-GM deliveries. GM and non-GM quantities dried are calculated, taking into account the waiting stock at the drying facility. From these new values of stocks in collection silos and dryer waiting silos, transport of maize from collection silos to drying facilities is calculated.

We first simulated the collection with only one product collected in order to compare the cost of a situation with segregation with the present situation (without segregation). The deliveries per day for the whole collection period in this case are shown in Figure 4. This curve is the ideal situation for country elevators. It arises from the combination of an optimal management of grain maturity and the desire of farmers and country elevators to harvest maize when it is as dry as possible.

We then made a simulation for the case of segregation between GM and non-GM crops. In this case, we considered three distributions of GM and non-GM products in the deliveries (non-GM representing 25, 33 and 50 % of the total deliveries). Beyond 50 % of non-GM in the total deliveries, the results would be reversed between non-GM and GM because the question would be to isolate 25, 33 or 50 % of GM. For each of these situations we made a simulation with 5 different distances between silos and dryers. In order to estimate the value of cooperation between competing cooperatives we considered a landscape with 25 collecting silos and 5 dryers managed by two cooperatives. Three hypotheses of distribution of dryers and silos were considered:

- All the silos and dryers are managed cooperatively by the two companies.

- One company owns 4 dryers and 20 silos and the other one owns one dryer and 5 silos. The companies manage their silos and dryers without cooperation (competition A).

- One company owns 3 dryers and 15 silos and the other one owns 2 dryers and 10 silos. They don't cooperate in the management of the grain collection (competition case B)

When the companies own more than one dryer we assumed that they adopt a spatial management of the collection (Miraglia et al., 2004; Coléno, 2008). This management is the one mostly used by French companies in order to take into account how the landscape is split up (Hannachi, 2011). When there is only one dryer we considered a local management strategy (Coléno, 2008) where the two products are taken into the silos and flow management is used try to get homogenous batches.

Taking into account all these hypotheses we made 75 different simulations.

For each of these simulations we compared the quantity of each product (GM and non-GM) at the end of the process to the quantity of the product delivered. To do so we calculated the ratio between these two values. The ratio of GM can therefore be higher than 100% if there is non-GM crop mixed with GM. To consider the cost we compared (i) the increase in transport cost compared with the situation with one product and (ii) the rate of dryer use, which is a good indicator of drying cost, as this cost is almost independent of the quantity dried.

5. Results

Table 1. Percentage of non-GM grain sold by companies compared to non-GM grain bought by companies

	75 % of GM grain	66% of GM grain	50 % of GM grain
cooperation	100%	96%	81%
Competition case A	66.6%	73%	69%
Competition case B	100%	95.6%	72%

Table 1 shows the percentage of non-GM product at the end of the process compared to non-GM product delivered to the grain merchant. We can see that cooperation is the most efficient strategy in every case. In the cases where there is 66 or 75% of GM grain in the collection it is possible to separate 100% of the non-GM grain, but when there is 50% of GM grain, the percentage separation is lower. This is because the number of dryers allocated to non-GM is insufficient for the quantity of grain delivered by farmers. The companies are thus unable to manage all the non-GM batches during the collection.

When the companies do not cooperate the efficiency of the collection management depends on the numbers of dryers owned by the two companies. Thus in case B the efficiency of the non-GM collection is the same as when the

companies cooperate. But in this case there is only 60% of the non-GM grain separated in the collection process. This is because with one dryer the company is not able to segregate the non-GM batches and mix them with the GM batches.

Table 2. Percentage of GM grain sold by companies compared to GM grain bought by companies

	75 % of GM grain	66% of GM grain	50 % of GM grain
Cooperation	91%	86%	96%
Competition case A	79.5%	86%	105%
Competition case B	68.8%	71.4%	71.7%

Table 2 shows the quantity of GM grain at the end of the process compared to the quantity of GM grain delivered by farmers. When there is cooperation between the companies, the quantity of GM grain segregated is between 80 and 90% of the GM grain delivered by farmers. The fact that all the GM batches are not in the stock of the companies at the end of the process is linked to the low capacity of the infrastructure dedicated to GM grain. This is because the management strategies tested give priority to non-GM grain because of its greater value. When the companies do not cooperate the result depends on the distribution of the infrastructure. In case A the proportion of GM at the end of the process is greater. This is because in this case one company is not able to use spatial segregation and so takes all the grain (GM and non-GM) into the same silos and dryers. The two products are thus mixed and sold as GM. The high proportion of GM grain is therefore linked to a low proportion of non-GM. In case B the level of GM at the end of process is lower, even compared to the situation when the companies cooperate. This is due to the arrangement of the infrastructure in favour of the non-GM grain. As each of the companies has the same strategy, the number of dryers allocated to GM grain is lower than when they cooperate. The dryers allocated to GM grain are thus under-used, as the ones dedicated to non-GM grain are used to overcapacity.

Table 3. Total grain at the end of the collection process compared to the amount bought by the companies

	75 % of GM grain	66% of GM grain	50 % of GM grain
Cooperation	90%	90%	88%
Competition case A	76%	82%	86%
Competition case B	76%	79%	72%

Table 3 compares the quantity of grain at the end of the process with that delivered by farmers. For all types of organization, segregation leads to a loss in the quantity of grain collected and dried as the companies are not able to dry all the grain delivered by farmers. Nevertheless, the cooperation strategy is the most efficient: from 90% to 88% of the grain delivered by farmers is collected. On the other hand with the other two strategies only 70 to 85% of the grain is collected (depending on the proportion of GM grain). Moreover, when the companies do not cooperate, the quantity of grain collected is higher in case A. This is because the company which has only one dryer collects all the grain, mixing GM and non-GM, so being able to use all its drying capacity, while the other company cannot use all its drying capacity. The drying capacity of this company is dedicated to dry only one product. Using it to dry another product at the same time leads to inefficient use.

Table 4. Average cost increase due to segregation for the 3 strategies (€/t)

	75 % of GM grain	66% of GM grain	50 % of GM grain
Cooperation	3.08	3.47	3.83
Competition case A	4.92	4.6	4.41
Competition case B	4.18	4.16	5.25

Table 4 shows the increase in transport cost due to segregation for the 3 strategies. Firstly we can see that the transport cost is lower when the companies work together. In this case the companies can minimize the distance between silos and dryers for all the 25 silos and 5 dryers. On the other hand, when there is no cooperation between

the companies it is not possible to do so. The company can only try to find a local optimum, taking into account their own infrastructure. This is less efficient than when both companies cooperate. Moreover, comparing table 1 and 2 we can see that the transport cost is linked to quantity of grain collected. This explains why the transport cost in the case where one company owns 3 dryers and the other owns 2 is higher than when there is 50% of GM grain. In this case it is the distribution that allows more grain to be collected.

6. Discussion and Conclusion

We have studied the case of the grain merchant industry in the context of market segmentation (caused by the introduction of genetically modified crops). This market segmentation put all the operators in a strong interdependence situation. We have modelled the management context of the operators on farmland and we find that this situation required the setting up of collective strategies and the emergence of new forms of governance. These methods of governance must enable coordination between all the stakeholders and particularly between rival grain merchants. Through modelling we demonstrate that coopetition between grain merchants is the most suitable strategy to manage this market segmentation and to maintain the competitiveness of the industry. In the context of coexistence of GM and non-GM crop, the coopetition strategy is the one which achieves better market performance.

Literature on the performance of coopetition strategies has focused mainly on innovation: there is much less evidence concerning coopetition effects on market performance (Ritala, 2012) and even less at the inter-organizational level (Luo, 2004). Our results show that coopetition enables better performance level at the industry level: coopetition enables the industry to absorb the market segmentation with less over-costs and less flow losses than non-cooperative strategies.

Our study shows that coopetition leads to other benefits: those due to market uncertainty. Market uncertainty refers to uncertainty about the dynamics of and changes in the demand or the technologies (Burger et al, 1993). Beckman et al (2004) showed that market uncertainty motivates rivals to develop suitable cooperation in order to reduce that uncertainty through sharing of information and coordination. Our study shows that market segmentation involves market uncertainty and thus motivates rivals to engage in a coopetition relationship.

Competitors often possess similar resources, and this makes them potentially crucial partners with regard to cost sharing and risk limitation. There is much evidence in the literature about cases where rivals achieve benefits of scale and scope by bundling similar resources such as capital and manufacturing facilities and capacity (Segrestin, 2005 ; Nieto and Santamaria, 2007; Arranz and Arroyabe, 2008; Gwynne, 2009). Compatibility between rivals is often a prerequisite in the creation of new markets or, as we have shown, the absorption of market segmentation without major overcosts. In order to enter new markets, firms often need to share costs and risks. In this case, competitors are particularly likely have the necessary supplementary and complementary resources (Das and Teng, 2000; Garrette et al, 2009). Furthermore, in such cases, competitors often share a willingness to decrease risks and costs, and sharing resources and information for such purposes is efficient. This motivation has been observed with scale alliances which are formed by rivals in order to gain efficiency benefits, as seen in the airline industry (Garrette, et al, 2009) or the automotive industry (Segrestin, 2005) where competitors aggregate similar resources in order to share risks and decrease the overlap in resource utilization for similar tasks. Such collaboration allows rivals to provide added value for their clients in the form of an improved and interoperable basis for their offerings (Fjelstad et al, 2004). Moreover, such collaboration in primary sectors is less risky than in knowledge-intensive sectors in terms of the risk of unwanted knowledge spillover (von Hippel, 1987).

Previous work on the performance of coopetition focused on knowledge-intensive sectors (Ritala, 2012). In these industries, rival firms cooperate to achieve collective solutions and standards in R&D (Dittrich and Duysters, 2007; Fjelstad et al, 2004; Gueguen, 2009). The existing literature on coopetition lacks studies on less knowledge-intensive industries. A few studies argue that coopetition is not necessarily a successful strategy in sectors that are less knowledge-intensive, such as manufacturing (Arranz and Arroyabe, 2008; Nieto and Santamaria, 2007). Our results show that coopetition can be the most successful strategy in the primary sector and thus less knowledge-intensive industries.

The existing literature argues that coopetition is the most suitable strategy to achieve better performance, but in all these studies there is no way to compare competitive against cooperative benefits in the same management context. Some of them give evidence that coopetition generates benefits to the industry, but it is not possible to verify the performance of coopetition against competition with other things being equal. For this purpose we create a sort of virtual cluster of grain merchants. The use of modelling enables us to compare a cooperative strategy with a non-cooperative strategy. This point is a highlight of this paper. Many studies have underlined that coopetition enables to achieve better performance but those studies are not able to explore the performance of a competition

strategy in the same context. Using modelling we have compared cooperative and competitive strategies between rivals in the same management context. In this way we find that coopetition is the most advantageous strategy in the context of the grain merchant industry under GMO and non-GMO coexistence.

However, our study is subject to the effects of contingency factors associated with the grain merchant industry. It will be interesting to aggregate more case studies on differing industries to identify where coopetition is the most suitable strategy to achieve better performance level and where it is not.

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