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Costs and Benefits of Compliance for HACCP Regulation in the Italian Meat and Dairy Sector

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COSTS AND BENEFITS OF COMPLIANCE FOR HACCP REGULATION IN THE ITALIAN MEAT AND DAIRY SECTOR[†]

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1. Introduction

In the last years food safety issues have become more and more important in the UE. Recent food scares have given rise to a demand for regulations able to guarantee healthy foods for consumers and prevent food-borne diseases.

Public agencies involved in food safety regulations need information about costs and benefits of the implemented measures, in order to assess the impacts on welfare and to improve the necessary tuning of their policies. Notwithstanding a general agreement on the need of measures to correct market failures in providing safe foods, different views have arisen with respect to the relative weight to assign to mandatory and incentive based schemes (Segerson, 1998).

During the nineties, HACCP systems has been introduced as mandatory measures in some sectors of food industry (meat and dairy products); moreover the compliance to the HACCP system has become a minimum standard to access to the food market, often within broader voluntary quality systems (ISO 9002, BRC standards, product certifications and so on). Cost and benefits of HACCP system have been the object of a great deal of investigations in the USA (see for example Golan *et al.*, 2000; Unnevehr, 2000). On the contrary, apart from some explorative research (see for instance: Henson *et al.*, 1999) at the European level there is actually a lack of systematic information to support policy assessment.

This paper presents some preliminary results of a study aiming at assessing the economic impacts of firm compliance to HACCP regulation in the meat and dairy sector in Italy. This work is based on a survey that provided for both quantitative and qualitative data at firm level for 4 case studies. The structure of the paper is as follows. After a short discussion of the main issues concerning the analysis of cost and benefit of food safety at the firm level (section 2) and an introduction to the adopted methodology (section 3), the case study is presented (section 4). Then, the main findings of the analysis of HACCP compliance costs (section 5) as well as of the perceived benefits (section 6) at the firm level are discussed. Finally, concluding remarks and some suggestions of possible improvements of the HACCP systems are reported (section 7).

2. Analysing costs and benefits of food safety regulation at the firm level

A growing literature has been recently developed on the application of Regulatory Impact Analysis (RIA) to food safety regulation. Such a trend reflects not only a general tendency of governments towards improved regulation processes from the point of view of efficiency and transparency but also the increasing attention paid by consumers to food quality and safety issues (Antle, 1999). Problems concerning the analysis of costs and benefits of the introduction of food safety standards following a RIA approach have been discussed in several works (see, for example, MacDonald and Crutchfield, 1996; Segerson, 1998; Antle, 1999; Henson and Caswell, 1999; Belzer, 2000). The issues discussed in these works include the identification of costs and benefits, the methodologies for valuating costs and benefits, the models for optimising the regulatory design, etc. For the purpose of this work it is useful to summarize the different typologies of costs and benefits deriving from the introduction of a food

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safety regulation, as is in the case of HACCP. Table 1 crosstabulates costs and benefits with different involved stakeholders (firm, consumers and public bodies). However, carrying out a complete RIA would require to assess all listed items using different empirical approaches (Antle, 1999), which goes far beyond the scope of this study, which focuses only on the first components, i.e. on costs and benefits of HACCP at the firm level.

Table 1. Benefits and costs of food safety regulations

	Benefits	Costs
Firms	<ul style="list-style-type: none"> - avoided costs for faulty products - higher revenues - efficiency gains 	<ul style="list-style-type: none"> - prevention - appraisal
Consumers	<ul style="list-style-type: none"> - avoidance of food-borne illness 	<ul style="list-style-type: none"> - monitoring of compliance to norms (e.g. by consumer associations)
Public Bodies	<ul style="list-style-type: none"> - savings on medical care and social security 	<ul style="list-style-type: none"> - enforcement costs

Referring to the estimation of costs, Antle (1999) lists three alternative approaches that, under proper assumption, can be used: a) accounting, b) economic-engineering methods, and c) econometric modelling. The accounting approach simply implies the identification and assessment of capital and labour actually used to implement and manage the system, without the specification of a cost function. The main advantage of this methodology is its simplicity, due to the nature of required data, usually easily found at the plant level. Several examples of application of accounting approach to the estimation of costs of compliance to different norms and regulations have been recently proposed, namely with reference to HACCP (Zugarramurdi *et al.*, 2000; Cato and Dos Santos, 2000; Colatore and Caswell, 2000), ISO 9002 (Canavari and Spadoni, 2003) and traceability (Mora e Menozzi, 1999). However, the accounting approach presents a major constraint in extending sample results to the universe due to the large variability of plant typologies and does not allow the assessment of the effects on the overall efficiency of the firm.

The approaches sub b) and c) can partially overcome these difficulties. The economic-engineering approach uses optimisation models based on available technical and economic data via the estimation of cost functions for food safety characteristics of produced goods (Jensen and Unnevehr, 2000). The econometric approach uses existing databases to estimate cost function through proper econometric techniques (Antle, 2000). The economic-engineering approach allows for efficiency analysis, but shares with the accounting approach the poor level of external validity. The econometric approach is characterised by a trade-off between production process specification and the theoretical consistency of estimated models (Antle, 1999).

The assessment of benefits of complying with food safety standards is often carried out in a qualitative way. In fact only savings due to the decrease of failure costs (i.e. of outputs that do not meet the required standards) can be easily assessed within the accounting approach (Zugarramurdi *et al.*, 2000; Canavari and Spadoni, 2003). Much more difficult is the assessment of benefits from marketing and/or efficiency improvements. An exploratory survey, based on a qualitative analysis is proposed by Henson *et al.* (1998) for UK dairy sector. The difficulties in assessing benefits depend mainly to the dynamic nature of the complying process (Henson and Heasman, 1998). The responses of firms to food safety legislation are of a strategic nature (Loader and Hobbs, 1999), depending on the structure of incentives to adoption (Holleran *et al.*, 1999). As a consequence, the creation of Quality Assurance Systems, the achievement of certification (as ISO, BRC and so on) and the compliance with food safety regulations have been often carried out jointly by firms, within an overall process of reorganization. Moreover, these changes often take place at the same time of a rapid upsurge of sales and market shares, making problematic a proper allocation of benefits to the process of compliance with a given food safety regulation.

3. Materials and methods

This study is based on a survey carried out to assess costs and benefits of HACCP compliance in a limited number of companies in order to get data for an exploratory comparison between different sectors (dairy and meat processing) and to test methodologies for a more comprehensive study.

The survey was based on a questionnaire for in-depth interviews with managers involved in the compliance process (usually QA manager and member of cost control staff). Also accounting data from financial statements were used. This methodology allowed a quantitative estimation only for costs, while benefits were assessed only in a qualitative way.

Different definitions of costs of compliance are available. Colatore and Caswell (2000) distinguish between: a) total cost (cost of actual HACCP system adopted by a firm), b) minimum HACCP cost (costs necessary to meet the mandatory requirements), and c) incremental cost of HACCP due to compliance with the regulation (the minimum costs net of voluntary adoption of HACCP). In this work, the first definition has been adopted.

The elicitation of HACCP costs followed an 'activity based' approach (Canavari and Spadoni, 2003): first a list of activities carried out by firm to comply with regulation was defined with the collaboration of the managers, and then the amount of capital and labour required to carry out those actions was estimated. The identification of actions required by the compliance process followed the 'Prevention–Appraisal–Failure' (PAF) framework (Zugarramurdi *et al.*, 2000). According to this model an inverse relation exists between preventive cost, i.e. the costs of actions taken to investigate, prevent or reduce defects and failures (prevention costs) and for assessing and recording the quality achieved (appraisal costs), and failure costs, i.e. those arising from failure to achieve the quality specified (recalls, liability costs, etc.). As a consequence, the share of failure costs is inversely related to production quality: when failure costs are high the output quality is low, decreasing gradually in his share when prevention and appraisal actions are carried out and the quality of output increases.

In the analysis, costs for start up phase (design, development and implementation) were disentangled from operational costs for HACCP system and annualised at a standard depreciation rate (10%). The resulting (annualised) start-up cost was added to annual operational costs. Finally, the overall cost figures were normalized with reference to the firm turnover, to allow meaningful comparisons between plants and sectors.

4. Case studies

4.1. The IT – 1D case

Despite his institutional feature as a private corporation, the company is owned by the municipality of an important town. Established in the fifties with the objective of improving the level of safety in dairy product distribution and increasing the consumption of milk and derived products, the company has grown through the years following a strategy of merging and buying out, getting eventually a leadership position in the regional market, although the company does not hold a prominent position in the national market.

Fresh and UHT milks that account for 63% of the company turnover represent the main production. The company also produces other fresh dairy products such as butter, cream, yoghurt and fresh cheese. Some others products are simply re-sold by the company.

The company has devoted to its Quality Assurance System a relevant amount of financial resources, pursuing a strategy of products differentiation and high quality standards. As a results, in the last business plan, the management could reap price premiums far higher than those of direct competitors.

The company shows a strong commitment to high quality and safety standards. The plants were certified under the ISO standard between 1994 and 1996. HACCP itself was implemented as a part of the ISO 9011- Vision 2000 program. Moreover, at the same time, the laboratories of the company were certified according to the SINAL ISO IEC 17025 standard. The investments related to food safety have been relevant and the HACCP system seems to be highly effective.

Costs and benefits of HACCP have been surveyed with reference to the main plant of the company, that can be considered a medium size plant in the Italian dairy sector. This plant produces fresh milk and fresh dairy products.

4.2. The IT – 2D case

The firm was settled up as a shepherds' cooperative with the main object of increasing the added value accruing to members by shifting from sheep-milk production to production of high quality cheese. Currently, the cooperative does not process only members raw materials, but it collects milk from a wider area. It can be considered a medium/small-size company among the Italian dairy sector companies. The firm has differentiated its activities since it was established, processing also cow-milk and producing other agricultural products through direct farming.

In early nineties the increase of production forced the company to build a modern and larger dairy plant. The firm is mainly present in the regional market, even though its products are available on shelves also in other Italian regions due to an agreement signed with a large national retail chain. A minor share of production is exported.

The company has not any certification. Nevertheless, its quality control system does not consist of just HACCP compliance. In fact, its main retail partner, through its national quality consultants, constantly monitors food safety and quality of production. As a consequence, the HACCP system seems to be quite effective and shows a continuous updating process.

The processing activities are carried out only in one plant, where mozzarella, cottage cheese and other cheese are produced. The product strategy shows a strong orientation towards qualitative differentiation through the production of traditional and typical products: some of them are labelled as PDO mark.

4.3. The IT – 1M case

IT – 1M is a private company established in the thirties and operating in the pork meat-processing sector. Despite its leadership position in the regional market, the company can be considered a medium-small size company as compared to other companies in the Italian sector. The strategy of IT – 1M is focused on producing goods with a good price/quality ratio, using the good reputation of Italian pork products to successfully compete on export markets. As a consequence, in the last twenty years the company carried out an investment program to improve the efficiency of its production, and control production costs without impairing the safety standards of its products. Recently IT – 1M has remarkably increased its turnover, expanding its sales on export markets, especially in Northern Europe.

Food safety is considered by the firm management as a precondition to access successfully its markets. Product strategy is essentially oriented to an optimisation of the price-quality ratio of supplied goods. From this point of view HACCP is perceived by managers as one of the main tools to deal with the trade-offs between quality-and costs implied by this strategy.

IT – 1M timely complied with all standard imposed by food safety regulations at national and EU level. The company implemented its HACCP system in 1992. Since 1994 the company has started a self-checking procedure to obtain CE quality mark. In 1996 IT – 1M undertook a complete revision of its Quality Assurance System: the new designed production cycle included not only an updating and improvement of already existing HACCP system, but also to complying with BRC standard to get the relative certification.

4.4. The IT – 2M case

The IT – 2M company is the parent company in one of the largest group operating in the Italian pork meat processing sector. The group produces all kind of cold meats and salami, dairy products as well as other agricultural products through farming in Northern Italy. IT – 2M owns some well-known brands in the sector at the national level. The company, established in the sixties, originally based its strategy on product differentiation, supplying goods of top quality mainly through traditional retail channels. In recent years, however, IT – 2M has remarkably increased its sales through modern distribution.

The company operates several plants, all located in Northern Italy. The figures reported in this study all refer to the oldest plant that progressively increased its production capacity and improved its

production technologies. This plant currently produces only top quality cooked ham (i.e. free of polyphosphate preservatives).

The quality of good has always been crucial in the competitive strategy of the company, since the beginning. This strong quality orientation brought IT – 2M to start a formal QA System in 1992. Currently the company is ISO 9002 certified. Moreover, in the last years, IT – 2M implemented a supply chain certification for the meat processing activities, based on a voluntary code of good practice. The HACCP system has been developed as a part of the QA company system and it is very effective.

5. HACCP costs

5.1. Start-up costs

Table 2 illustrates start-up costs of the HACCP system in the case studies. Costs have been broken down into different categories: those relating to the system set-up, design and development phase and those concerning implementation, the latter being broken down into investment, manual drafting and other implementation costs.

Table 2. Start-up costs by typology (% shares)

Cost typology	Case studies			
	IT - 1D	IT - 2D	IT - 1M	IT - 2M
Set-up, design and development	33.94	39.12	16.61	78.38
Investment	35.55	6.10	40.25	0.00
Manual and communication	1.65	40.51	29.66	4.34
Others	28.86	14.27	13.48	17.29

The structure of HACCP start-up costs seems to be quite diversified depending on cases and sectors. Differences in the relative weights of each component can be attributed to the different nature of internal quality control systems when the HACCP system was implemented. Thus, in the IT – 2M case study, due to the nature of products, specific investments in fixed assets were not necessary, while only hygienic control procedures needed to be rationalized and defined in a formal way: consequently, the main item of start-up costs is the one concerning the design and development phase (78.38%). Conversely, IT – 1M presents a significant share of investment in fixed assets, namely adjustment of product lines through the introduction of a computerized temperature control system in the production process critical points.

The same applies to the other two case studies. IT – 2D was a relatively new plant (four years old), therefore costs are mainly due to the formalization of HACCP procedures. On the other hand IT – 1D presents more or less the same costs for design and development efforts (design of a fully computerized internal information system) and investment (improvement of the structures, e.g. new plant flooring, etc.).

In the table 3, start-up costs are broken down into direct and labour costs. All firms but IT – 2D show a dominance of direct costs, yet with different relative weights. Conversely, IT – 2D features a clear prevalence of labour costs due to low investment costs (very young equipments and assets) and low costs for external advising (included in direct costs) , as the auditing is supplied at a cheaper rate by the partner retail chain.

Table 3. Start-up costs by nature (% shares)

Cost nature	Case studies			
	IT - 1D	IT - 2D	IT - 1M	IT - 2M
Direct costs	70.32	29.69	58.81	65.45
Labour costs	29.68	70.31	41.19	34.55

5.2. Operation costs

Table 4 compares the current operation costs of the HACCP system in the four case studies, broken down into different actions: prevention, appraisal and correction of failures, the last being allocated to internal and external actions.

Table 4. Operation costs by typology (% shares)

Cost typology	Case studies			
	IT - 1D	IT - 2D	IT - 1M	IT - 2M
Prevention	44.53	64.14	83.37	74.22
Appraisal	35.30	31.92	11.85	2.25
Internal failure	16.81	0.41	0.77	16.95
External failure	3.36	3.53	4.01	6.58

First of all, results confirm the high effectiveness of the HACCP systems implemented in the four firms: in all cases actions directed to prevent a departure from the HACCP standards (prevention and appraisal) accounts for more than 75% of the operation costs of the system, with prevention costs accounting for the largest share, though with a different relative weight across cases. It seems that different patterns characterize the two sectors: meat processing firms focus more on prevention costs, while dairy firms devote a significant effort to appraisal (e.g., laboratory analysis).

Moreover, the two large-size companies (IT – 1D and IT – 2M) show a significant share of costs relating to internal failure. In the first case the nature of fresh dairy production exclude reworking, that is faulty products are discarded (related costs include withdrawals, transportation, inspections and substitution of recalled products). In the second case, internal failure costs (mainly withdrawals and reworking) can be explained by the firm’s attempt to achieve very high qualitative standards. External failure costs in the meat sector refer mainly to product liability insurance. A significant cost for products recalls was reported only in the IT – 1D case and it depends, once again, on the nature of its products (fresh milk).

Table 5 breaks down operation costs of HACCP system according to their nature. In this case, the technological features of different production processes are crucial. The two meat processing plants, that carry out similar processes, present both a slightly dominance of direct costs. Conversely, in the case of IT – 1D (fresh products), two third of costs were direct costs, whereas IT – 2D (production of matured cheeses) strikes a substantial balance between direct and indirect costs.

Table 5. Operation costs by nature (% shares)

Cost nature	Case studies			
	IT - 1D	IT - 2D	IT - 1M	IT - 2M
Direct costs	66.84	49.38	54.11	59.02
Labour costs	33.16	50.62	45.89	40.98

5.3. An overall assessment of HACCP costs

The survey characteristics, i.e. in-depth interviews on a limited number of cases, do not allow any statistical inference. However, even in this survey, a different pattern between the two sectors can be appreciated: dairy firms are characterised by lower average HACCP costs per unit of raw material and

by higher HACCP total costs, measured as a percentage on turnover. These feature seems to be related to a lower ratio of value added on turnover in the dairy sector, more evident in the case of IT – 1D, which produces mainly fresh milk for final consumption. In the case of the two meat processing plants, the average HACCP cost per m tons of processed raw material is very different (52 €/t vs. 172 €/t) while the incidence of HACCP total costs on turnover is quite close. This can be explained by the different output mix of the two firms: IT – 2M plant produces just one high value product (cooked ham with no polyphosphates) and this drives down the share of HACCP cost on turnover to a level (1.83%) comparable with that of the IT – 1M case.

Table 6. HACCP components: annualised costs (€/t and % of turnover)

Cost typology	Case studies			
	IT - 1D	IT - 2D	IT - 1M	IT - 2M
Average HACCP cost per ton of raw material (€/t)	34.4	37.1	52.3	171.9
Starting costs rate (%)	0.05	0.09	0.06	0.01
Prevention costs (%)	1.29	1.20	1.02	1.35
Appraisal costs (%)	1.03	0.60	0.15	0.04
Internal failure costs (%)	0.49	0.01	0.01	0.31
External failure costs (%)	0.10	0.07	0.05	0.12
Total annual costs (%)	2.96	1.97	1.28	1.83

The breakdown of HACCP costs makes possible the assessment of the relative weight of the different components. Annualised start-up costs (calculated at 2002 prices and annualised at 10% depreciation rate) are a minor component of the annual HACCP total cost, being always below 0.1% of turnover. Preventive efforts (prevention and appraisal) are the most important components of HACCP total cost: on average, they are four times larger than those for corrective actions (internal and external failure costs). This pattern is consistent with the HACCP approach to food safety: a rationalization of production yielding to a reduction of costs related to safety failure associated with higher management cost for quality assurance.

6. Benefits of HACCP

The pilot nature of our survey and the adopted methodology do not allow for a quantitative assessment of HACCP benefits at plant level. Nevertheless, it was possible to single out some benefit typologies that managers ascribed, in a qualitative way, to the introduction of HACCP system.

In all cases the implementation of a HACCP system is considered a prerequisite to access the markets. The effectiveness of food safety risks prevention is a standard requirement demanded for all customers operating downstream along the food chain. The evidence of system failures above a given threshold (normally accepted as physiologic by customers) would translate into lack of trust and would quickly cause significant losses of market shares. In fact, HACCP is seen always as a tool to reduce the entrepreneurial risks caused by a demand that is increasingly more concerned about food safety risks, whether real or not. Conversely, voluntary forms of certification - as ISO 9002, RBC and traceability - are considered as marketing tools to access new market shares.

In the two meat processing cases, the managers made an explicit reference to a significant decrease of required corrective actions, concerning both outputs returned by clients and the internal checking of lots not fitting with minimum standard. Managers emphasized that this led to the improvement of the efficiency of the production process.

Both validation procedures and revisions of the HACCP manuals were conducive to non-trivial gains in terms of costs-effectiveness. Organizational solutions and technical devices introduced as a part of the HACCP implementation actually improved the quality of production, using the same amount of resources (labour and materials): for example a better coordination of the teams of workers operating the programmed hygiene measures, or the substitution of laboratory analysis and controls

with monitoring of time of execution of tasks that are characterised by relevant risks of microbial nature. The stemming out of *learning by doing* processes as a consequence of HACCP implementation was stressed in all cases: this led to significant improvements of efficiency through a better firm organization (reduction of costs and/or increase in productivity).

A third category of benefits, attributable to the HACCP monitoring routines, relates to the development of workers/employees skills. Sooner or later, in all firms a more or less structured QA team was appointed. Moreover, both in the IT – 2M case (a large company operating at a national level) and in the IT – 2D case (a relatively small company operating on a regional basis), the Quality Assurance function has progressively gained a larger its autonomy within the company organization, shifting from position subordinate to other functions (e.g. production and/or marketing) to a role that refers directly to the top management. Moreover, QA managers stressed that their specific professional skills and abilities have increased dramatically since the implementation of HACCP system. Similarly external consultants, hired in all examined cases to set-up the system and to assist the management in early stages of operation, changed their roles: in some cases, this just ended up to supplement the work carried out by internal QA teams; in other cases (e.g. IT – 1M case), external advisors increasingly became more committed to the company, virtually being part of its organization.

The last category of benefits refers to better circulation of information within the firm. The HACCP implementation usually extends to the whole organization the commitment for information gathering, data assessing and systematic registration of collected information. As a consequence, effective procedures of information transmission are needed. In two cases (IT – 1D e IT – 1M) specific investment were devoted to the improvement of the internal information system. The set-up of an efficient network for internal communication between management and technical staff can be used for more general purposes than just food safety, improving the overall firm efficiency.

7. Suggestions for improving HACCP systems

In the last section of the questionnaire, companies were asked to assess current HACCP performances and to suggest some changes to improve the system. The recommendations can be grouped into three clusters as follows: issues in HACCP operation, supporting measures and demand for future research.

A main concern is the non-homogeneous interpretation of HACCP norms by the different authorities involved in supervising the system¹. This problem holds both at national and EU level of control. At national level, for instance, the supervision of different plants owned by the same company is often in charge of different local authorities: the subjective interpretation of norms by different officials leads to different compliance prescriptions for each plant, though they are managed according to a single set of intra-firm guidelines. Managers also complain about non-homogeneous interpretations of HACCP regulation across member countries, which raise problems in terms of access to foreign markets and competition in the EU single market.

A second group of answers concerns support measures and proposed changes to the system aiming at an overall improvement of HACCP. As pointed out above, a first relevant issue is related to the need for a more standardized approach to compliance. One suggestion is about the appointment of a national HACCP board with the task of coordinate several sectoral committees in charge of defining and upgrading standard HACCP manuals (including actions to be carried out) for different plant typologies: this should create a more suitable reference in the compliance process. A second suggestion is about the standardization of supervising process by public authorities: one of interviewed managers suggested to base this process on checklists agreed by public officials and companies.

Others suggested to organize compulsory and possibly uniformly designed training courses about HACCP and related issues (like improvement of analytical tools, new production technologies and so on) for both private companies and public bodies staff. Finally, some requests are about getting subsidies for training programs and the upgrading of quality assessment technology at plant level.

¹ A more general issue stressed by one of the interviewed managers refers to the lack of a training and qualification of officials, both within private institutions and in the public bodies.

On the research side, a first proposal is to carry out an assessment on the feasibility of replacing supervisors with licensed technical evaluators, following the same approach of voluntary forms of quality certification. There is also a demand for more information about HACCP issues at the interface between industry and distribution: this issue was emphasized not only with reference to the current situation, but also looking forward to the enlargement of EU market to new member states. A last remark is about the definition of compliance standards according to product typologies: such contribution might promote the efficiency of compliance process, above all for small companies. Too often the lack of suitable guidelines for the operative implementation of HACCP norms, leads firms to design and implement HACCP systems with low costs effectiveness. The following quotation, from one of the interviews, depicts this point of view, that truly seems to emerge by experiences in the concrete application of HACCP principles: “in the quality control it is not always true that cheapest is dearest”.

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