



Innovation in the agro-industrial poultry meat companies of Paraná

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Abstract

The goal of this study is to analyze the decision of poultry meat companies in the state of Paraná to innovate. The methodological procedures involved field research that gathered information on innovative behavior from a questionnaire about innovative behavior and descriptive statistics. The companies were grouped by similarities in export behavior, size and innovation in products and processes. The results showed that medium-large and large companies are innovative, have an R&D sector and export their products. Small and medium companies make innovations by purchasing machinery and equipment, and meet the domestic demand. In most cases, the process of innovation is new to the company, but only the great enterprises make innovations that will be considered new to the market. The main sources of innovations are of foreign origin and most companies make decisions by manager coalition - Carnegie's and Incremental models. Large companies use defensive technology strategy, invest up to 0.38% of sales in innovations and use public funds to finance R&D.

Keywords: Innovation, decision, technology strategy, chicken agribusiness.

Introduction

The largest producers of poultry meat in the world are the United States (US), China and Brazil; they represent 50% of world production. The Brazilian production of poultry meat is concentrated in the southern region, which accounts for 62.4% - Para-

Paraná (31.1%), Santa Catarina (16.7%) and Rio Grande do Sul (14.6%). These states are also responsible for 29.3%, 24.1% and 18.3% of exports of Brazilian poultry meat, respectively. Brazil is the largest exporter of poultry meat (ABPA, 2014).

The production chain of poultry meat companies is probably one of the Brazilian agro-industrial chains with the highest level of coordination and competitiveness in the world market (CARLETTI FILHO, 2005). Brazilian agribusiness companies that produce poultry meat seek innovation to create new products and develop superior production processes. Innovation can arise from the process of conducting internal and external research that leads to the development of new products or processes. To develop the internal capacity for innovation, there must be investment in Research & Development (R&D) in order to generate new products or adapt products to customer needs. Therefore, the strengthening of R&D is critical in the formation of a portfolio of products, although the internal sources of innovation may come from other departments such as production, engineering and marketing (SBRAGIA et al., 2006).

The ability to develop and implement innovation is important for companies in all industries; however, scientific studies have concentrated in high-tech sectors. Low and medium technology industries have some segments or activities that may be based on high technology, even with products considered commodities. Companies in these sectors are innovative, but less than companies in other segments. They emphasize process, marketing and organizational innovation, and perform less product innovations.

A significant portion of low and medium-technology companies performs R&D in-house. The smaller impact of product innovation in low-medium technology companies is reflected in fewer patent applications. Trademark and design are two other forms of intellectual property protection that prevail. This is observed in the case of Sadia, whose brand is highly valued in Russia and the Middle East (STAL; CAMPANÁRIO, 2010). This article discusses the innovation processes based on decision models.

The objective of this study is to analyze the decision to innovate as well as the main sources and benefits of innovation in the poultry meat companies in Paraná. Specifically, we aim to identify decision models, types of innovation, strategies for product launch and the size of these companies. The research methodology is based on field research on the adoption of innovation and statistical and descriptive analysis of the poultry meat companies in the state of Paraná in 2010. The research advances over previous work by analyzing the determinants of the decision to innovate and discussing the decision models of innovative companies and exporters of poultry meat.

The article is structured in four parts: introduction, literature review addressing innovation, empirical strategy - encompassing methodology, analysis and discussion of results - and final considerations.

Literature review

For Schumpeter (1984), innovation is a new combination of means of production, which is central to the economy. The concept of technological innovation covers the introduction of: new product; new production process; new market opening; new

source of feedstock, and the establishment of new industrial organization. After the first innovative effort is released, other companies will seek to do the same, expecting to have higher profits or forced by increased competition. Block investments resulting from these imitating movements induce economic growth and contribute to the change in production structure.

Innovation: Characteristic, Sources and Strategies

The innovative activity may result from the search, discovery, experimentation, development, imitation and adoption of new products, new processes and new organizational techniques. It involves a high degree of uncertainty and depends on the activity of R&D and experience accumulated by individuals and organizations (DOSI, 1982).

When it comes to intensity, innovations may be radical or incremental. Incremental innovations present gradual technological changes and include improvements to the design or quality of the product, improvement in layout and processes, new logistical and organizational arrangements, as well as new sales and supply practices. This kind of innovation is more frequent and generates growth of technical efficiency, productivity and quality, cost reductions and also changes that enable the expansion of the applications of a product or process (LEMOS, 2000). They are related to market demands and user experiences.

Radical innovations break the existing technological trajectories, inaugurating a new route; they also involve the development and introduction of a new product, process or an entirely new form of organization of production (LEMOS, 2000). By promoting structural break with the previous standard technology these innovations originate new industries, sectors and markets; they can reduce costs and increase the quality of existing products. Innovations follow a model or standard of solutions of a number of technical problems, which is selected based on the scientific knowledge and production practices (DOSI, 2006).

A technological paradigm is characterized by the nature of technological knowledge that guides the design of innovative activities and organizational procedures, searching and exploring innovations (DOSI; NELSON, 1994). The technological paradigm results in a number of technical and economic choices made by the companies, according to industry characteristics and the institutional environment in which they are located. These choices, when contained in a technical-productive framework, are recognized as technological trajectories (DOSI, 2006).

The technological trajectory is defined by the technological paradigm and evolves within paradigms. Technological change may occur at regular periods with rupture and qualitative changes, or in stages in which the process happens in a regular and ongoing basis. At this point, there may be a new technological paradigm and the establishment of a new technological trajectory (POSSAS, 1989).

Pavitt (1984) proposes technological trajectories that differentiate the industrial sectors based on striking differences and similarities, and also sources of technology and direction of technological change. Its taxonomy classifies the sectors into five types: sectors dominated by suppliers, intensive sectors in scale, science-based industries, information-intensive industries and specialized suppliers sectors. Given the

characteristics of the study, the discussion will be focused on the sectors dominated by suppliers.

According to Christensen (1995) and Cabral and Traill (2001), in sectors dominated by suppliers, such as the food sector, technological change is based on investment in innovation and use of equipment and inputs developed and manufactured by suppliers. Innovations can be opened or closed. For Chesbrough (2003), the logic of closed innovation that involves massive investment in internal R&D was considered until the 1990s an appropriate strategy to bring new ideas, processes or products to market and to bar the entry of competitors in the market. Since 2000, the concept of open innovation has been developed based on the search of specialized cognitive sources that are external to organizations, such as databases, public and private research and development centers, and others. Due to the high cost of R&D and shorter life cycle of products, companies find it increasingly difficult to justify the investment in innovation and open business models seek to solve both problems. Regarding the cost, they attack the problem by boosting research and development from external resources, to save time and money in the innovation process.

Generally, companies do little internal R&D and innovations, which mostly occur in processes, are absorbed in order to reduce costs. The appropriability regime is weak, offset by the creation of trademarks, advertising strategies and mainly based on marketing resources. This trend is present in the textile manufacturing companies and in agriculture, where most innovation comes from machinery industries, chemical equipment and supplies (TIDD; BESSANT; PAVITT, 2008). So, they are users of innovations developed in other sectors to strengthen their competitive advantages.

Meat agribusiness companies are preferably inserted in the technological trajectory of the sector dominated by suppliers of machinery, equipment and chemical inputs. Companies in this sector make little investment in R&D; they dominate the innovation process and its absorption arises from cost reduction and increased efficiency of factors.

Companies in sectors dominated by suppliers, in principle, do not contribute substantially to the innovative process, because the process technology is bought from other companies and the products are generally traditional or show less innovation. A modification applied to the production process of the company can be implemented and even if all machines and equipment are purchased from suppliers, there may still be room for activity related to the innovation process, such as the production system design, the approach of human resources and quality control performance (CHRISTENSEN, 1995).

According to Freeman and Soete (2008), companies follow technological strategies linked to the objectives of their managers and shareholders, whose choice may affect the search for investment returns in the short term or in building a technological base for the future. Decisions depend on the financial and human resources, as well as on the characteristics of the market, technological dynamics of the sector and the overall strategy of the company.

Companies that adopt an offensive innovation strategy aim to achieve technology and market leadership, placing themselves ahead of competitors to introduce new products, processes and business models and also in the form of provision of services, the relationship mode with the customer in distribution logistics or the development of

original designs. Companies are intensive in research, they give considerable importance to patents, seeking greater profits to cover the high R & D costs; they have long-term view and are prepared to incur high risks (FREEMAN; SOETE, 2008).

Companies with defensive strategy do not want to take chances on the market; they have intensive areas in R&D and/or partnerships with universities and hope to learn from the mistakes of pioneers. The defensive strategy is typical of oligopolistic markets and is associated with product differentiation (FREEMAN; SOETE, 2008).

The traditional strategy is used by companies that hardly change their products over time, as the market demand does not require that and competitors do not innovate, so small changes in design can be observed based on the employees' experience. These companies may operate under strong competition to be efficient in cost but fail to invest resources that in the long term can bring advantages, such as training people (FREEMAN; SOETE, 2008). The companies that adopt the opportunistic strategy are concerned in finding temporary opportunities or market niches not filled by competition and that do not require large investments in research.

Decision Models

According to Eisenhardt and Zbaracki (1992), the rational model assumes that the agents come in decision situations with known goals and gather the appropriate information, develop a set of alternative actions and select the ideal alternative. However, the organization is a power coalition of people with conflicting interests. Decision-makers can enjoy common goals in the organization and often engage in political tactics, as the coalition formation, co-optation and the use of information from external experts, to ensure the supremacy of their decisions.

According to Cyert and March (1963), bounded rationality models consider that agents have limited cognitive ability, and only part of the knowledge and the necessary information can be processed individually. The pressure of time and the large number of internal and external factors affect the decisions, and the ill-defined nature of the problems makes it very difficult for the decision-maker to analyze them. The main decision models that use bounded rationality are: Carnegie, incremental, unstructured or trial and error, and "garbage can".

In the Carnegie model, the decision is made within the organization in a position of uncertainty and conflict, and the end result is based on a coalition of managers, in which everyone agrees with the organization's goals and priorities of the problems (CYERT, MARCH, 1963). To avoid the cost of obtaining information, managers perform limited information research to identify problems and alternative solutions rather than seek all possible information (JONES, 2001). To build the coalition, every person who has important information or interest in the outcome is consulted, and the decision is supported by all stakeholders (CYERT; MARCH, 1963).

The incremental model of Lindblom (1959) seeks to simplify the decision-making process and recognizes that the selection of objectives is not independent of values. Its implementation will be subject to all kinds of interference, because each agent can have a perception of the problem and suggest their own solution. The manager considers the fundamentals and previous experiences to establish priorities in the

selection of the options, choosing the most satisfactory solution. By adopting similar solutions with decisions implemented in the past, managers seek to avoid risks and errors and protect the logic of their previous choices.

Mintzberg, Raisinghani and Theoret (1976) developed the unstructured decision model, known as trial and error, which considers the events associated to decisions, in a structural sequence of the activities performed, from the discovery of a problem to its solution. Far-reaching decisions, such as expanding production, introducing new products or identifying new markets are strategic decisions that require time and information. The decision-making gradually adds a number of small decisions that combine to produce a more important one. The model is flexible and involves three major stages for the decision-making: the stage of identification of a problem and its diagnosis, the stage of development of the solution and the stage of choosing a solution.

The garbage can model explains the decision-making in organizations that coexist with large uncertainties, such as growth and constant change. It defaults to a stream of multiple and frequent decisions that are taken by managers in all areas of the company. Decisions are the result of the flow of independent events within the organization (COHEN; MARCH; OLSEN, 1972). The decision involves a concern to adjust the solution to the problem, which is not always possible at the desired time. The problem is not solved, but a decision is made in an attempt to solve it and the chosen solution may not be the most appropriate allowing the problem to persist.

Empirical strategy

Methodological procedures

This research seeks to characterize the poultry meat companies in Paraná based on information about the innovative behavior by applying a semi-structured questionnaire with 15 questions, investigating the general characterization and innovation in the enterprise, the perception of the decision-maker regarding the importance of factors influencing the decision to innovate, and benefits of the decision to innovate. The sample is intentional and includes information from production and processing plants in Paraná. The study is descriptive in nature depending on the number of responding companies. The companies were grouped by similarity in export behavior, size and innovative effort in products and processes. The group with similar standard for analysis consisted of 16 companies out of the 20 companies specialized in the production of poultry meat in the state of Paraná and the data collection was held in 2010. The systematic to stratify businesses in sizes followed the methodology used by BNDES which adopts arbitrary cuts on a scale based on annual revenues and classifies the companies into micro, small, medium, medium-large and large.

Results analysis

The agro-industrial poultry meat companies in Paraná are mostly exporters; the medium-large and large enterprises account for 87.5% of them. The global market

share has exposed national companies to large international competition. Increasing competition in these markets has led exporting companies from Paraná to invest in technological innovation and to modernize production processes and develop new products (Table 1).

Table 1 – Size of innovative companies, employees, financial performance, investment and exports in 2010.

Size Company	Business	Number of Employees	Revenues (R\$ thous.)	Exports (R\$ thous.)	Investment (R\$ thous.)	Exports (% rev.)	Investment (% rev.)
Medium	2	980	132,050	28,050	828	21.2	0.6
Medium-Large	7	8,366	1,328,520	479,840	4,680	36.1	0.4
Large	7	27,723	7,014,848	1,358,369	22,194	19.4	0.3
Overall	16	37,069	8,475,418	1,866,259	27,702	22.0	0.3

Source: Authors' research.

Medium-large companies focus on the export market; they export more than 36% and invest 0.4% of revenues, whereas medium-large and large companies export about 20%, and invest 0.6% and 0.3% of revenues, respectively.

Table 2 shows the embodiment of innovation, according to the size of the company. The main investments in companies for the development of innovations are the purchase of machinery and equipment - total adopters (100%), training (93.8%) and industrial designs (87.5%). The medium-large and large companies invest in R&D (31.3%), external knowledge acquisition (18.8%) and software (25%); they invest in industrial design, introduction of innovations and process automation. Only large companies make innovations by purchasing researches conducted externally, what corroborates the results of Edquist (2011), who reports the difference of support elements to innovation, depending on the size of the industrial sector and stage of evolution.

Table 2 – Size of the innovative businesses and investments in 2010 (%)

Investments	Medium	Medium-Large	Large	Overall
Investments	12.5	43.8	43.8	100.0
Purchase of machinery and equipment	12.5	43.8	37.5	93.8
Workout	6.3	43.8	37.5	87.5
Industrial design	0.0	25.0	31.3	56.3
Introduction of innovative technologies in the market	0.0	18.8	12.5	31.3
Internal R&D	12.5	6.3	12.5	31.3
Acquisition of other external knowledge	0.0	6.3	18.8	25.0
Software acquisition	0.0	0.0	6.3	6.3

Source: Authors' research.

The sample companies that adopt closed innovation relate to other external agents and exchange information that contribute to decision making on innovation. In

companies that follow the open innovation model, external sources are essential for decision-making and for the innovative process in the company. As found in this study, 31.3% of the companies stated to make innovations using the internal R&D area whereas other 6.3% hired external R&D. Most companies declared to make innovations in other areas.

The results obtained corroborate the findings of Sbragia et al. (2006), who considered the values low due to the small and medium enterprises not having financial conditions to maintain an R&D area. In this study, this should be a reason for the small representation of R&D areas in the companies. We also highlight the fact that the process innovation carried out through the purchase of machinery and equipment is more frequent, making it possible to generate new products for the company.

Table 3 presents the foremost sources of innovation used by companies, composed by three main groups: suppliers, customers and attendance at fairs and exhibitions; consultancy companies, universities and research institutes; and net of computerized information, competitors, and licenses and acquisition of patents.

The first and main group of external sources of information indicates that these innovations, in most companies of the sector, are market oriented and aimed to develop process innovations. The second group aims at product innovation mainly due to the presence of universities and research institutes. These external sources confirm the results obtained by Sbragia et al. (2006). The results reveal that suppliers, customers and attendance at fairs and exhibitions were responsible for the process innovation, what confirms the dominance of suppliers according to the taxonomy from Pavitt (1984) and the specialized literature (CHRISTENSEN, 1995; CABRAL; TRAILL, 2001). Most companies practice incremental innovation, using information from customers and suppliers, which are not freely available on the *internet*.

Table 3 – Size of innovative companies and sources of innovation (2010) (%)

Source innovation	Medium	Medium-Large	Large	Overall
Providers	12.5	37.5	37.5	87.5
Customers	12.5	31.3	37.5	81.3
Fairs and exhibitions	6.3	25.0	37.5	68.8
Consultancies	0.0	25.0	25.0	50.0
University and research institutes	0.0	6.3	31.3	37.5
Licenses and the acquisition of patents	0.0	12.5	12.5	25.0
Competitors	6.3	6.3	6.3	18.8
Information networks	0.0	6.3	12.5	18.8

Source: Authors' research.

External sources of information played an important role in the origin of the project of innovation of the sample companies, signaling their importance to the strategy adopted and to the development of the capacity of absorbing and combing information in large companies, as highlighted by Sbragia et al. (2006) and Chesbrough (2003). These external sources were divided into three groups: a) suppliers, customers and attendance at fairs and exhibitions (79.2%); b) consultancy companies, universities

and research institutes (43.7%), and c) net of computerized information, competitors, and licenses and acquisition of patents (21%).

The search for consultancy corroborates with the arguments presented by Edquist (2011), as it allows medium and large private companies to overcome obstacles and challenges in order to implement innovation. Medium and large companies search relations of higher technology complexity, such as technical knowledge in product development and professional management, besides patent acquisition and licenses of patents. Most of these product and process innovations are new to the company.

An innovation is considered new to a company even when it already exists in the market. Innovations new to a company account for 75% of innovation to process innovation and 56.3% to product innovation (Table 4). The innovation of a product or process existing abroad is characterized as new to the domestic market. If the innovation is unprecedented, it can be new to domestic and international markets, depending on the amplitude of the company in the market (OCDE, 2005).

Table 4 – Innovation and novelty (%)

Size Company	(% of companies)	Innovation in product		Innovation in process	
		New to company	New to market	New to Company	New to market
Medium	12.5	12.5	0.0	6.3	6.3
Medium-Large	43.7	25.0	18.7	37.5	6.3
Large	43.8	18.8	25.0	31.3	12.5
Overall	100.0	56.3	43.7	75.0	25.0

Source: Authors' research.

As to the type of innovation (product or process), results show they are different according to the size of the company and usually occur simultaneously to product and process - few companies implement only product innovation; what confirms results obtained by Quadros et al. (2001), Kannebley, Porto and Pazello (2004), Santini and Pigatto (2008), Dalla Costa, Petit and Bittencourt (2008).

Large-size companies lead the way in innovations to the market, as their production scale allow external gains and advantage in access to new technology, what does not occur in small companies. In general, company decisions are based in models of bounded rationality considering the complexity of the projects (LINDBLON, 1959, CYERT; MARCH, 1963, BATEMAN; SNELL, 2006, JONES, 2001).

Different companies have different decision-making process depending on the size of the company. In medium, medium-large and large companies, decisions are usually made by coalition of managers and based on the Incremental and Carnegie decision-making models due to the environment of uncertainty and risk (CYERT; MARCH, 1963, LINDBLON, 1959, JONES, 2001, BATEMAN; SNELL, 2006).

Innovations occur in every area of the company. Companies that adopt the Carnegie decision-making model implement innovations more intensely in areas of production and quality whereas companies that adopt the Incremental decision-making model, implement innovations also in R&D (Table 5).

Table 5 – Size of the innovative company, decision-making process model and areas of innovation (%)

Size company	Model of decision	Model of decision (%)	Innovation Areas				
			R&D	Engineering	Production	Quality	Outers
Medium	Carnegie	12.5	6.3	6.3	6.3	12.5	6.3
Medium-Large	Carnegie	43.8	6.3	12.5	37.5	37.5	6.3
Large	Carnegie	18.8	0.0	0.0	12.5	12.5	6.3
	Incremental	18.8	12.5	6.3	18.8	12.5	6.3
	Garbage can	6.3	6.3	6.3	6.3	0.0	0.0
Overall		100.0	12.8	12.8	33.3	30.8	10.3

Source: Authors' research.

Carnegie decision-making model was the most used by the sample companies (75.1%). Medium-large companies implement innovations mostly in areas of quality and product development. Large companies that adopt the garbage can decision-making model implement innovations in areas of R&D, engineering and production. Decisions are made based upon the coalition of managers that discuss possible solutions, consider important information and the interest in the results. Thus, decisions are backed up by the interested parts. (CYERT; MARCH, 1963; JONES, 2001). The Incremental decision-making model was adopted by 18.8% of the sample companies. In this model previous decisions are respected, the solutions are incremental and aim at avoiding risks and mistakes (LINDBLON, 1959, MINTZBERG; RAISIGNHANI; THEORET, 1976).

Table 6 presents the decision-making process and the product launch strategy adopted by companies and reveals that 37.5 % of the companies adopt defensive and opportunistic positions, respectively; the 25% left, adopt a traditional position when launching innovative products, demonstrating that the companies are contrary to risks, as they do not present offensive position. We did not verify a strict pattern among size of the company, decision-making model and product launch strategy.

Table 6 – Export companies, product and process innovation, size of the company, decision-making model and technology strategy

Size company	Decision's Model	Technological Strategy			Overall
		Defensive	Opportunistic	Traditional	
Medium	Carnegie	6.3	0.0	6.3	12.5
Medium-Large	Carnegie	6.3	18.8	18.8	43.8
Large	Carnegie	6.3	12.5	0.0	18.8
	Incremental	18.8	0.0	0.0	18.8
	Garbage can	0.0	6.3	0.0	6.3
Overall		37.5	37.5	25.0	100.0

Source: Authors' research

Most of large companies adopt the Incremental decision-making model (18.8%) and have a defensive product launch strategy. Companies that adopt the garbage can decision-making model have an opportunistic market strategy. Companies that adopt the Carnegie decision-making model do not have only one strategy for product launch. Medium size companies adopt a defensive and traditional strategy. Medium-large companies adopt every possible strategy, more commonly the opportunistic and traditional strategy. Large companies adopt opportunistic and defensive strategy in a smaller proportion (Table 6).

Government funds aimed at financing innovation were rarely used, as most companies (75%) used their own resources. Companies that used government funds used financing programs such as the BNDES¹ and BRDE² (Table 7).

Table 7 – Size of the innovative company, decision-making model, technology strategy and use of financial funds for innovation (%)

Size company	Not used	Decision's Model	Technological strategy	Source of financial resources		Overall
				BNDES	BNDES + BRDE	
Medium	12.5	-	-	0.0	0.0	0.0
Medium-Large	37.5	Carnegie	Traditional	0.0	6.3	6.3
Large	25.0	Incremental	Defensive	6.3	12.5	18.8
Overall	75.0	-	-	6.3	18.8	25.0

Source: Authors' research.

Part of the innovations in Brazil is financed by public resources, however few of the sample companies used the National Innovation System. There is little interaction with universities and research institutes to make partnership in R&D. Although there are innovation incentive policies, there is still little interest by companies in financing R&D projects and most innovations were financed by their own resources. All companies declared to be innovative. Many referred to incremental innovation or to process adaptation and to copying their competitors' innovations. It is likely that companies did not need public funds because they did not implement complex and costly innovations.

We verified that only a quarter of the researched companies used funds of government programs. Large companies participated more actively than medium and medium-large companies. The BNDES was the major financier, financing the 25% of the companies that used the funds. The use of government funds is not so little if compared to the data of a research about innovation in companies from Sao Paulo (FAPESP, 2010), in which several sectors reported to have used more than 90% of their own resources to finance expenses with internal and external R&D, mostly due to the bureaucracy involving getting the government financing.

Medium-large companies use government funds and adopt the Carnegie decision-making model as well as traditional product launch strategy whereas large com-

¹ BNDES – The Brazilian Development Bank (BNDES)

² BRDE – Far South Regional Development Bank (BRDE)

panies adopt the Incremental decision-making model and defensive strategy. As to the technology strategy, we used Freeman and Soete's classification (2008).

Table 8 shows that companies that used a defensive product launch strategy and opportunistic product launch strategy differ little in relation to exports (21.9% and 20.7%) but significantly in relation to revenue, investment and worker productivity. Companies that adopt traditional strategy are different than the others due to their smaller revenue, investment and worker productivity. However, the proportion of goods exported is higher than the others, 28.2%.

Table 8 – Product launch strategy, number of companies, gross revenue, exports and investment and worker productivity

Strategy	Company	Revenues (R\$ thousands)	Exports (% reven.)	Investment (% reven.)	Revenues/ Employees (R\$)
Defensive	7	5,097,627	21.9	0.37	280,151
Opportunistic	5	2,712,441	20.7	0.24	183,857
Traditional	4	665,350	28.2	0.34	161,493
Overall	16	8,475,418	22.0	0.33	228,639

Source: Authors' research.

Most of the sample companies (43.7%) adopted the defensive strategy that is associated to product differentiation. Such companies do not want to risk being the first one to innovate, but also do not want to be left behind in relation to technology. They aim at learning from the trailblazers' mistake and adapt to the changes introduced by competitors.

The opportunistic strategy is adopted by 31.2% of the companies, which are focused at supplying markets that appear temporarily or at opportunities that appear due to the constant and fast transformation of the market and do not need high investment in innovation. The traditional strategy is implemented by 25% of the companies, which are focused at incremental innovations of processes and at keeping the production standard.

As to investment in innovation, companies researched did not spend more than 0.37% of their annual revenue, what is considered low but justified as this sector is considered of low technological intensity compared to the 0.64% assessed by the Industrial Research on Technology Innovation (PINTEC) (2008) related to the transformation sector of the Brazilian industry (DE NEGRI; ALVARENGA, 2011). This result corroborates the results of Morceiro et al. (2011) for the national food industry (0.238%), and of Christensen (1995) and Cabral and Traill (2001), for the international food industry.

Companies presented different absolute values of revenue according to the strategy adopted. The ones that adopted defensive strategy account for 60% of the total revenue whereas the ones that adopted opportunistic strategy for 32% and traditional strategy for 8%.

Companies with opportunistic and traditional strategies do not significantly differ in relation to worker productivity (R\$ 183,000 and R\$ 161,000 respectively); com-

panies that adopt defensive strategy reached the highest worker productivity (R\$280,000).

Table 9 details the profile of companies according to size, decision-making model and product launch strategy. Regardless of the size of the company, Carnegie's (75%) and Incremental (20%) decision-making models were the most used.

Table 9 – Size of the company, decision-making model, technology strategy, average revenue, exports and investment, and work productivity

Size company	Decision's Model	Tecnological Strategy	Adopters companies	Revenues (R\$ thous.)	Exports (% reven.)	Investment (% reven.)	Revenues/ Employees (R\$) (R\$)
Medium	Carnegie	Defensive	1	62,550	36.5	0.40	189,545
		Traditional	1	69,500	7.6	0.83	106,923
Medium-Large	Carnegie	Defensive Opportunistic	2	365,705	55.9	0.34	182,853
			2	366,965	25.3	0.47	126,714
		Traditional	3	595,850	30.6	0.29	171,715
Large	Carnegie	Defensive Opportunistic	1	569,285	22.3	0.34	242,352
			2	814,415	14.1	0.14	138,036
	Incremental Garbage can	Defensive Opportunistic	3	4,100,087	18.6	0.38	303,328
			1	1,531,061	23.1	0.24	257,019
Overall			16	8,475,418	22.0	0.33	228,639

Source: Authors' research.

As to the exports dependency, medium traditional companies and large opportunistic companies present less participation of exports in their revenue whereas medium-large companies have a large dependency of exports (56%) in their revenue.

Investment in innovation ranges from 0.14% to 0.83%, as smaller companies compromise a higher part of their revenue, whereas in medium-large and large companies these values are more expressive. Worker productivity is higher in large companies, what can be considered a response to higher investment in innovation.

Medium-large and large companies are the ones that most invest in innovation due to their high revenue. Most of them invest up to 0.47% of their gross revenue in innovation. These results to the meat agro-industrial sector are in accordance with the study of Quadros et al. (2001), who also verified that large companies are more innovative and there is a positive relationship between company size and investment in innovation. Kannebly, Porto and Pazello (2004) also found results pointing to the same direction in studies about innovation in the Brazilian industry.

Agro-industrial companies are different in size and in the factors that influence the decision to innovate (Table 10). In large companies, government funds for R&D (53.8%) and "response to competitors' innovation" (50%) are the factors that influence

decision-making whereas in medium and medium-large companies these factors are less significant.

For medium-large companies, the factors influencing decision-making are related to meeting legal requirements and market rules, and to strategies of using their innovation capability. Medium companies are also influenced by these factors, though they play a smaller role in the decisions to innovate.

Table 10 – Importance of the factors that influence the decision to innovate (%)

Factors that influence the decision	Medium	Medium-Large	Large	Overall
Using government resources to support innovation	12.8	33.2	53.8	100.0
Respond to the action of competitors	10.0	40.0	50.0	100.0
Improve product quality	12.7	42.9	44.4	100.0
Increase the company's revenues	12.9	42.9	44.2	100.0
Meet the increased demand	12.2	43.9	43.9	100.0
Reduce costs in the company	13.5	44.6	41.9	100.0
Allow the opening of new markets	14.8	44.2	41.0	100.0
Enjoy the company's ability to innovation	15.9	44.4	39.7	100.0
Meet legal requirements and market regulations	15.9	46.0	38.1	100.0

Source: Authors' research.

Note.: As companies could choose several alternatives, the sum of each group individually in the columns surpasses 100%

Table 11 shows the different benefits of the innovation according to company size. This behavior was expected once companies direct their products to markets with higher economic return. The impacts of innovation are easily noticeable when the innovation is radical, as it provokes a rupture in the productive process and originates a new process or product. However, the incremental innovation is hardly noticed as it implements gradual changes, making the productive process more efficient (LEMOS, 2000). The benefits of innovation can be assumed from the results and changes in internal factors and in the relationship with the market (DE NEGRI; SALERNO; CASTRO, 2005).

Large companies are more present in the international market whereas medium-large and medium companies explore the opportunities of the domestic market. Although the innovations brought multiple benefits to companies, they experience different effects. In large companies, innovations had a higher impact in exports whereas in medium-large they promoted a productivity increase, access to new markets and facility in adapting to international norms.

Table 11 – Importance of the innovation benefits to companies (%)

Benefits of innovation	Medium	Medium-Large	Large	Overall
Increased exports	5.0	32.5	62.5	100.0
Facilitated the approach of the company to universities and research institutes	14.3	40.0	45.7	100.0
Increased production flexibility	15.0	41.7	43.3	100.0
Expanded the product grass offered to the market	12.1	44.8	43.1	100.0
Increased market share	14.7	42.6	42.6	100.0
Reduced development time and arrival of the product on the market	14.8	42.6	42.6	100.0
Increased productivity in the company	12.5	45.3	42.2	100.0
Provided access to new markets	11.7	46.7	41.7	100.0
Facilitating adaptation to national and international standards	13.3	46.7	40.0	100.0

Source: Authors' research.

Medium companies enjoy fewer benefits that are derived from the impact in the increase of production flexibility, decrease in time of putting the product in the market, thus leading to a higher participation in the market. These results are in accordance with the results of Bueno *et al.* (2007) about companies' efforts to introduce innovations, aiming at better results and positioning in the market (Table 11).

The most frequent types of innovations involve product and process. These innovations are usually triggered by machinery and equipment acquisition and by the option of internally developing technology projects, what might justify the little interaction between companies and universities.

Conclusions

Poultry agro-industries from Paraná are generally of medium-large and large sizes, have more than 2,500 employees and a revenue superior to 500 million reais (2010). The companies declare themselves as innovative and exporters. Medium and large-medium companies have merged into exporting companies, such as Unifrango.

Companies have implemented innovations in products and process simultaneously in the areas of production, quality and R&D; 12.8% of the companies exclusively implemented innovations in R&D. The main sources of external innovation are suppliers, customers and attendance at fairs and exhibitions.

The investment in innovation is relatively low compared to other sectors and it ranges from 0.3% to 0.6% of their gross annual revenue. The investment in innovation is higher among medium companies (0.6%) than in medium-large and large companies (0.3%). However, in absolute values, large companies were responsible for bigger projects. Most of the investment is directed at machinery and equipment acquisition, implementation of the industrial project, personnel training and marketing for product launch.

Few companies know about and use government funds aimed at innovation. From the funds applied in innovations, only 25% were from government resources

(BNDES and BRDE). They were mainly used by large companies which produced innovation aimed at the domestic market and more rarely at the international market.

The decision to innovate in these companies has privileged the adoption of new process technology that leads to the development of new products, although the emphasis is in the adoption of new productive processes. As the decision to innovate involves risks and uncertainties, companies have difficulties in implementing such innovations, though managers recognize the importance of innovation in future results. Decisions are usually based on the Carnegie and Incremental decision-making model. Medium-large and large companies depend upon the coalition of managers to decide the innovative solution.

The factors that influenced decision-making of the sample companies consist of two distinct groups, according to importance. The high and very high importance group is formed by the: utilization of government funds for R&D and response to competitors' actions - which were mentioned by over 50% of the researched companies. The medium importance group consists of: meeting legal requirements and market rules, possibility of new markets and utilization of innovation capability - which were mentioned by over 44% of the medium-large companies. Sample companies used mostly defensive, opportunistic and traditional technology strategies.

The benefits of the innovation were different according to the size of the company and its exports. The most important innovation benefits to large exporting companies are related to the increase in exportation and the approximation to universities and research institutes whereas to medium-large companies they are related to access to new markets and adequacy to legal norms. These benefits might be considered highly important for maintaining the competitiveness of companies, especially in the international market. Although there are several benefits to medium companies, these innovations failed to promote partnership of medium and medium-large companies with universities and research institutes.

The competitiveness of poultry agro-industries from Paraná is due to their efficiency and low prices, which are results of the implementation of new technologies in the productive process. Innovative companies have higher chances of entering international markets. Chances of becoming an exporter are increased when the company develops their own innovations in relation to the adoption of innovation of technologies already existing in the Brazilian market. Thus, the technology innovation of process plays a fundamental role in the insertion of Brazilian meat companies in the international market.

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