The Role of Innovations in the Competitive Strategies of Italian Agri-Food Enterprises

Adele Coppola and Stefano Pascucci
Department of Agricultural Economics and Policy (DEPA) - University of Naples Federico II, Italy
coppola@unina.it ; stpascuc@unina.it

Paper prepared for presentation at the 1st International European Forum on Innovation and System Dynamics in Food Networks
Officially endorsed by the European Association of Agricultural Economists (EAAE), Innsbruck-Igls, Austria
February 15-17, 2007

The Role of Innovations in the Competitive Strategies of Italian Agri-Food Enterprises

Adele Coppola and Stefano Pascucci
Department of Agricultural Economics and Policy (DEPA) - University of Naples Federico II, Italy
coppola@unina.it ; stpascuc@unina.it

Abstract

The aim of this work has been to inquire into possible connections between competitive strategies and inclination to innovation, through an analysis of a sample of Italian agri-food enterprises behaviours. Particularly, some firm's innovation strategies have been analysed, inquiring into a set of characteristics that at a theoretical level are considered as potential factors of innovation adoption: economic and financial dimension, organizational structure, productive specialization, productive process and the location context.
The results of the study have underlined the existence of a great variety of behaviours among the examined agri-food enterprises, which have revealed a highly varied inclination to innovation. The data indicate that the stimulus to innovation is the result of a set of factors that jointly act on the decisional nucleus of the enterprises. Moreover, the results point out that the processes of "organizational" innovation are gaining a more and more relevant role in Italian agri-food enterprises, while very strong elements of weakness seem to characterize the processes of technological innovation, above all because of a reduced inclination to both public and private investments in R&D.

1. Introduction

The Italian agri-food system is facing new challenges asking for relevant reorganization processes and changing of structural features and economic and financial strategies.
The driving factors of such processes are related to a number of conditions that depend, on one side, on the effects of globalization and the growing presence of international competitors in the internal agri-food market, while on the other side, they depend on national conditions, especially on the change in the customers' food preferences and at the same time in relationships inside the agri-food system.
The most relevant effects of such changes have been the increase of competition inside the agri-food system so as the development of new organizational models at firm level and a deeper integration among subjects operating in the agri-food supply chains.
Strictly related to the search for strategies to increase competitiveness, we should take into account the actions aiming to increase the innovation abilities, both as regards the process and the product and as regards the organizational level. Many factors could influence the firm innovation capacities. In some cases they are related on internal features, as the structural and economic dimensions, in other cases they are related on external features, as the location and the capacity to manage relationships with other agents, sharing technologies and "know-how".

In many cases the innovation possibilities depend on the degree of investment in R&D activities which cannot always be adopted by single agri-food enterprises, especially when they are of small or medium dimensions.

In this perspective, the aim of this work has been to inquire into possible connections between competitive strategies and inclination to innovation, through an analysis of a sample of Italian agri-food enterprises behaviour. Particularly, some firm's innovation strategies have been analysed, inquiring into a set of characteristics that at a theoretical level are considered as potential factors of innovation adoption.

This paper is structured in the following way: in section 2 the theoretical background of the analysis is briefly presented; in section 3 the analytic methodology is described. The main results, the related comments and the policy implication are showed in section 4 and 5.

2. Theoretical background

The theoretical perspective of this work is deeply influenced by the idea that the innovative behaviour, considered as the development and application of new technologies and new organizational forms, is related both to the internal governance system of the agri-food firms and to the exogenous institutional environment (Teece, 1996).
Faraway from the neoclassical view of innovation as a simple technological change, a great number of theoretical and empirical approaches indicate that the firm innovation behaviour has to be connected to a wider number of potential driving factors, both internal and external (Galende and de la Fuente, 2003). For example, in the Schumpeterian view of innovations a great attention was given to the industrial organisation and specifically to two factors, mainly due to the external conditions: the firm size and the market concentration (Schumpeter, 1934 and 1942). The studies following this theoretical perspective emphasised the role of financial resources and the firm capacity to allocate them to development of new technologies and products and R&D activities. In this sense large firm operating in a contest of a strong market power should show a higher intention to invest in innovation activities then the small ones, due to their cash flow generated by monopolistic power and better access to capital market (Teece, 1996; Gumbau, 1997; Arundel and Kabla, 1998).

For other authors higher large firm capacity of innovation is deeply contested, according to the idea that the small and medium firms are better adaptable to the market conditions, more opened to "innovation joint-venture" with other firms and less conditioned by "bureaucratical" and managerial structures (Williamson, 1975; Mansfield 1981; Teece, 1996). Other arguments supporting small and medium size firm innovation capacities are linked to their attitude to show a better internal flexibility (related to the organization of production and decision making processes), a higher possibilities of internal communication, greater specialisation possibilities and informal and strategic control (Galende and de la Fuente, 2003). According to these considerations we consider "size" as one of the principal factor to be considered in our analysis, not only in the sense of "economic-size" but more in general as a proxy of a wider range of firm's attributes and attitudes.

Other driving factors to explain firm innovative behaviour are related on the internal resources, such as the quality of human capital, financial and organizational structures, information sharing and "know-how" accumulation (Jensen e Meckling, 1976; Wernerfelt, 1984; Barney, 1991; Dosi 1991). These kind of features could be considered as firm internal "intangible" resources, and in this sense it is underlined the difficulties to provide an objective measurement (Cohen, 1995). However both theoretical and empirical literature highlight the relevance of these resources in the process of creation and application of innovations at the firm level (Galende and de la Fuente, 2003), which could give a better interpretation of what we call the "organizational size and structure".

In this perspective three types of factors were considered: the presence and the importance of R&D department and activities; the age of the firm as a proxy of the organizational resources; the relevance of knowledge accumulation activities and information sharing as part of the professional formation end education.

The influence of the R&D activities on innovative behaviour is highly recognized both theoretically and empirically. Even if the direction of influence is in general considered as potentially positive (Teece, 1996; Galende and Suarez, 1999; Cohen and Levinthal, 1989), it has been showed that R&D expenditure intensity could not be sufficient to influence future prospects of innovation projects, in particular if we consider small and medium size enterprises (Bougrain and Haudeville, 2002). This is due to the influence of the specific characteristics of the innovation process (Galende and de la Fuente, 2003) and the rate of innovation of the specific sector in which the firm is operating (Pavitt, 1984). In any case it has to be taken into account.

The age of the firm is considered as a possible measure of its organisational resources, potentially representing the experience and the knowledge accumulated throughout its history and more in general the "learning" process of the firm (Galende e de la Fuente, 2003). Some articles showed the higher inclination to innovate by "old" firms (Gumbau, 1997; Kuemmerle, 1998) while some other considered "young" enterprises as more active in the direction of innovation (Molero and Buesa, 1996). In this sense the age remains a controversial factor of innovation. The third type of internal "intangible" factors is the one related to the information sharing attitude of the firm and the "know-how" transmission and accumulation process. We look at this kind of factor as the rate of economic and financial resources dedicated and oriented to the professional formation and its organisation inside the firm. From a theoretical point of view we aspect a positive impact of such expenditure and organisation on the innovative behaviour of the firms (Freeman, 1973; Rothwell, 1986).

A second group of potential driving factors of innovative behaviour is related to the socio-economic and institutional conditions in which the agri-food enterprises operate. We looked at these "external" factors in two ways: on one hand we considered the external linkages that the firm shows with the other actors of the agri-food chains (agriculture, distribution operators, etc.) and the attitude to enter in formal association network (consortia, manufacturing jont-ventures, cooperatives, etc.). The positive influence of such "association" strategies on the innovation capacities is given by the possibilities of sharing information and "know-how", reduction of uncertainty and increasing economies of scale that "external" alliance could get for the firms involved (Teece, 1996). On the other hand we looked at the external factors in an indirect way, as the results of their influence on the main "coordination" strategies of the firm on the markets, such as the internationalisation and the export-orientation, the product-diversification or the product-specialization (Williamson, 1985; Meisel and Lin, 1983; Hoskisson and Hitt, 1988; Richardson, 1990).

In the case of the export-orientation the empirical literature shows a positive relationships with innovations (Meisel and Lin, 1983; Lunn and Martin, 1986; Kumar and Saqib, 1996) while in the case of product-diversification or specialisation these relationships are not clearly recognised and they remain still controverse (Hitt and Hoskisson, 1991; Hoskisson and Johnson, 1992; Link, 1982; Chen, 1996).

3 The analytic methodology

The empirical analysis was based on the information obtained from a field survey carried out on a sample of 63 Italian enterprises operating in four sectors of the agri-food industry (wine, oil, dairy, fruit and vegetable industries).
Collected data were referred to firms structure and organization, so as to some aspects of innovation and development processes. With regard to these last ones, information were collected on the innovations recently adopted, on the motivation that brought to adopt them, on relationship between the firm and the R&D structures, on labour training activities and on the financing of R&D activities. It should be underlined that the innovation term was here used in a rather wide sense; it includes both changes in technology and in the characteristics of produced goods, and changes in the set of final products, often implying the use of new processing lines and some change in production techniques, as well as changes in the production and labour organization.
Data analysis has been carried out through a factorial analysis technique (Principal Component Analysis) followed by a hierarchical cluster analysis. As a first step, a set of variables, selected on the base of the theoretical indications, was used to identify and classify firms structures and features. Then, cluster analysis results were crossed with data related to information of the firm innovation processes in order to characterize firms innovative behaviours.
Starting from 14 variables, we extracted 6 principal components that explain the 73% of the whole variance. In table 1 there is the factor loading matrix, where correlation coefficient higher than 0.10 in absolute value were indicated. The matrix is the basis to interpret the meaning of each principal component representing the main interfirm differentiation factors.

Table 1. Factor loading matrix

Variables	Component					
	1	2	3	4	5	6
Percentage of revenue from sales in traditional market channels	-0.87				0.15	
Percentage of revenue from sales to modern organised distribution	0.86		0.18		0.10	0.14
Percentage of regional agricultural input	-0.58	0.37		0.36	0.15	0.24
Number of associative and co-operative links		0.89		-0.15		
Firm's age	0.11	0.77		0.19		-0.23
Percentage of imported agricultural input	0.35	-0.54	-0.25	-0.42	-0.11	
Total tangible and intangible fixed assets			0.90			
Number of employees	0.14		0.90	-0.11		
Percentage of revenue from regional sales				-0.75		
Percentage of revenue from exports	-0.17		-0.15	0.69	0.27	0.19
Percentage of revenue from the first product	0.17				-0.84	
Number of processed products				0.20	0.80	
Training expenses as percentage of revenue	0.10			0.32		0.82
R&D expenses as percentage of revenue	-0.12			-0.34	0.14	0.64

The first component explains 21% of the total variance and allows to distinguish firms according to their different market channel. As the first component increases, moving from negative to positive values, market channels change from traditional ones, where retailers and wholesalers prevail and the agricultural inputs mainly have a regional provenience, to situation where modern distribution becomes a more important firm production buyer. More information on input market and on linkages between within the food supply chain are synthesized in the second component (13,8% of explained variance). When positive, the second component identifies

firms that are operating by a longer time, that have intense associative and co-operative links, that buy agricultural input from the local market; on the contrary, negative values of the component occur when territorial linkages are slight and import of agricultural inputs become more important.

The third component (12% of the total variance) is positively correlated with the number of employee and with the level of total assets and allows to differentiate the firms according to their size. The fourth and the fifth factors show aspect referring to market strategies. Negative values of the fourth component (10% of the total variance) identify those firms where the export orientation is higher; while, if the component value is positive, output market is mainly regional. The degree of diversification can be read on the fifth component (8% of the total variance). In the sixth and last component (8% of the total variance) the effort in training and in R&D is synthesised: moving from negative to positive values, the firm innovative intensity (in terms of percentage on revenue) increases.

The factor scores, that is the coordinates of the observations (the investigated firms) with respect to each of the 6 principal component axes, were used to group firms into clusters.
Based on agglomeration schedule 6 final groups were considered. Table 2 reports cluster centres that allow to draw the main features of each cluster and to better understand the relationship among the differentiation factors analysed in PCA.

Table 2. Cluster centers

Cluster	Number of firms	Component 1	Component 2	Component 3	Component 4	Component 5	Component 6
Cluster 1	19	**0,617**	-0,434	-0,115	**-0,849**	-0,285	0,112
Cluster 2	18	**-1,023**	**0,509**	-0,020	-0,210	-0,146	-0,055
Cluster 3	2	0,382	-0,310	0,154	**1,226**	**-0,793**	**4,190**
Cluster 4	15	-0,146	**-0,562**	-0,144	**0,894**	**0,856**	-0,252
Cluster 5	8	**0,942**	**1,108**	-0,324	0,494	-0,452	**-0,663**
Cluster 6	1	**0,579**	**-0,741**	**6,979**	0,094	0,399	-0,428

4. Main results

The factorial graphs and the values of the cluster centers can help to analyse the link between firms innovative behaviour and some of the potential driving factors of innovation processes emphasized in the theoretical and empirical literature.
Graph 1 highlights the relationship between the innovative effort (component 6) and firm size (component 3), relationship that has been widely investigated in literature and that generated controversial findings. By the graph, two first indications can be drawn:

- With respect to smallest firms, there is a positive relationship between size and innovative effort. When firm dimension reaches the sample average level, this relation is not more visible and innovative effort is independent from firm size.
- Some behaviour differences among industries could be highlighted. Generally speaking, oil sector shows a lower propensity to spend in R&D and training, while dairy sector seems to be the more innovative one.

In graph 2 innovative effort is crossed to the strength of territorial linkages of the firm (component 2). In this case very different situations occurs, even if it is possible to state that when backward linkages are slighter and relationship within the food supply chain are less intense, firms

show a lower inclination to innovate. In graph 3 the relationship between the innovation intensity and the degree of diversification (component 5) shows a similar pattern. Even in this case, a higher diversification of the production is not associated to more innovation by itself, but when specialization degree is higher (negative values of the 5th component) a lower inclination to innovate seems to occur.

More information can be drawn from cluster analysis results. First of all, it should be underlined that component 6, that synthesises what we called the "innovative effort", has considerable high values only in one group. That occurs in group 3 which includes only 2 medium firms of the dairy industry, that, as labour training and R&D expenses are concerned, show very specific features in the sample. Both firms produce *mozzarella-cheese*, a product that in recent years showed a very dynamic market and an increasing demand; both have an internal research structure but operate with external structures, too; both in last 5 years carried out product as well as process innovations, driven by the widening of the production set and by quality improvement needs. They are among the younger firms, too.

Besides those two firms, behaviour, in term of innovation investments, is not very differentiated among firms, even if some positive and negative deviation from the average level could be underlined. The lowest levels of R&D expenses can be found in group 5 that includes 8 firms. In this group low values of the 6th component are associated to the highest level of the first two factors and indicate that those firms are characterized by a more intense link with modern distribution and, more generally, to not traditional market channels, but at the same time have strong roots in their territory, with regard to agricultural input supply, and intense links within the agri-food chain. They mostly are small co-operative firms, oil and wine producers and operate by a longer time with respect to the sample average (they are not less than 40 years old).

An important role of the modern GD as final market is evident for group 1, too. Though, here the associative linkages are less intense and specific features of the 19 firms in the group are the considerable high value of international exchanges, with respect both to import of agricultural input and export of final goods, and the product diversification. Group 1 includes firms with a larger number of employees than the average of the sample and that are younger than average, too. With regard to innovation effort, the average level is higher than in other group (besides group 3). An additional aspect to underline is that as the legal status is concerned, simple companies (as opposed to co-operative) are mostly prevailing.

Very low is the innovative effort in other groups. Firms in group 2 are mainly co-operatives characterised by small and medium size, in terms of number of employees, and by a high level of total assets (with regard to the sample as a whole). A strong role of traditional channel in final good market, some weight of exports on revenue (anyway, low as average), final production mainly directed to national market are some other specific features. In this group the percentage of R&D expenses on revenue gets higher than zero in few cases, mainly when the firm operates in the dairy industry. Anyway, most of the firms in group 2 are wine producer. Often null is the innovative effort in group 4 including 15 firms, most of them in the dairy industry, whose specific features are the small size, the diversification of the production and the higher importance of the regional market for final good. Last group (group 6) includes only one firm with outlier characteristics because of its size. It operates in the fruit and vegetable industry, has few and slight linkages within the territory and the agri-food chain, sells most of its production to GD. With regard to percentage of R&D and training expenses on revenue, this firm spends less than the average of the sample.

Some more information on firms innovative behaviour can be obtained by analysing innovation characteristics collected in the survey and by crossing them with results of cluster analysis. Some points can be highlighted:

Only few firms didn't adopt any type of innovation at all. No significant differences exist among groups with regard to innovation presence, while some distinction can be made according to the industry, with a lower percentage of firms adopting some innovation in the oil and in the fruit and vegetable industry. With regard to the category of innovation, 57% of firms made a change in their final goods: mainly they widened the set of supplied goods or adopted a new packaging and labelling. Innovation in production processes were counted in 86% of cases; for many firms innovation relates to the adjustment to certification or to quality systems and to the introduction of more advanced production lines. The category of innovation adopted in last 5 years is not significantly different by groups. On the contrary, some differences can be found when the way firms finance their innovations is taken into account. In particular, in groups 2 and 4 a larger number of firms uses self financing of innovation activity. In the case of the small firms that are included in group 4, self financing could hide difficulties in credit opportunities and could explain the low level of R&D expenses.

Differences among groups can be found when motivations that brought to adopt innovations are considered. Market motivations are the most important to push firms to innovate (95% of the firms adopting innovation). In particular, the need to reach new markets is a strong stimulus to innovate for firms in group 1, the most export-oriented group in the sample, and more generally, when firms are linked to GD innovation is mainly motivated by the requirement of distribution. Quality improvement is an important reason of innovation for the 55% of agri-food firms of the sample and seems to be less important for firms included in group 4. The reduction of production cost is the stimulus to adopt innovation in 64% of innovating firms, without significant differences among groups.

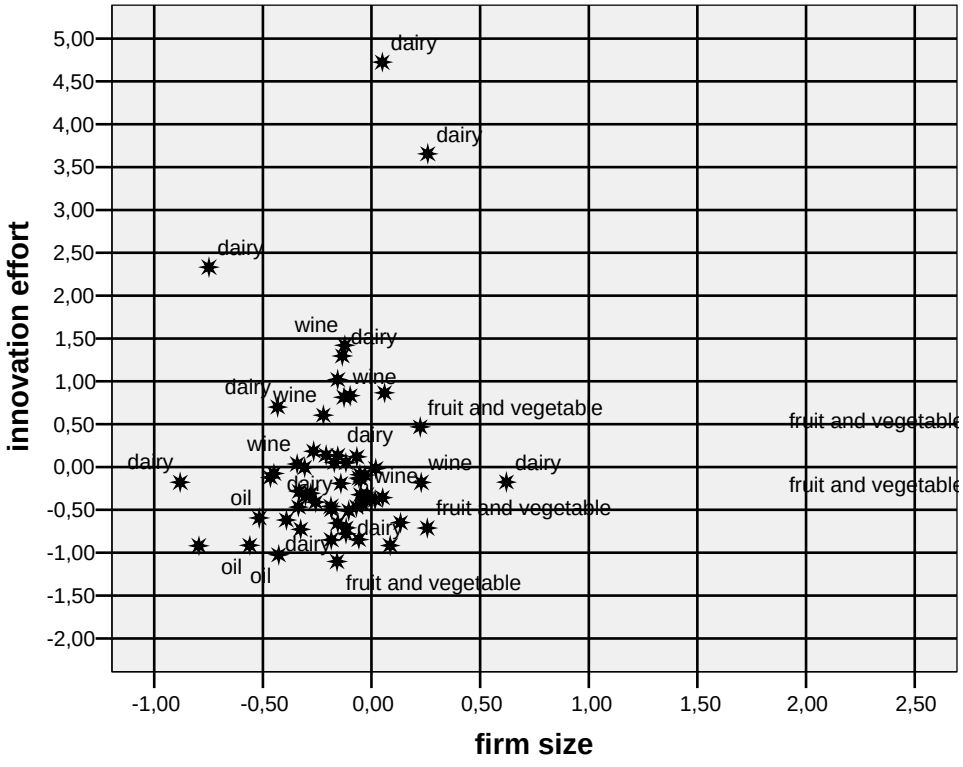
5. Some concluding remarks

Agri-food is generally thought as a mature and low innovative sector. Nevertheless within it very diversified situations exist and the propensity to innovate and the nature of innovation processes can depend on different factors. Given their generally small economic and financial dimension, the Italian agri-food firms are not able to allocate high percentage of their revenue to R&D expenses. However, firm size is not the only one limiting factor of innovation processes, and, on the contrary, the analysis showed that when the dimension reaches a minimum threshold level the innovative effort seems absolutely independent from size.

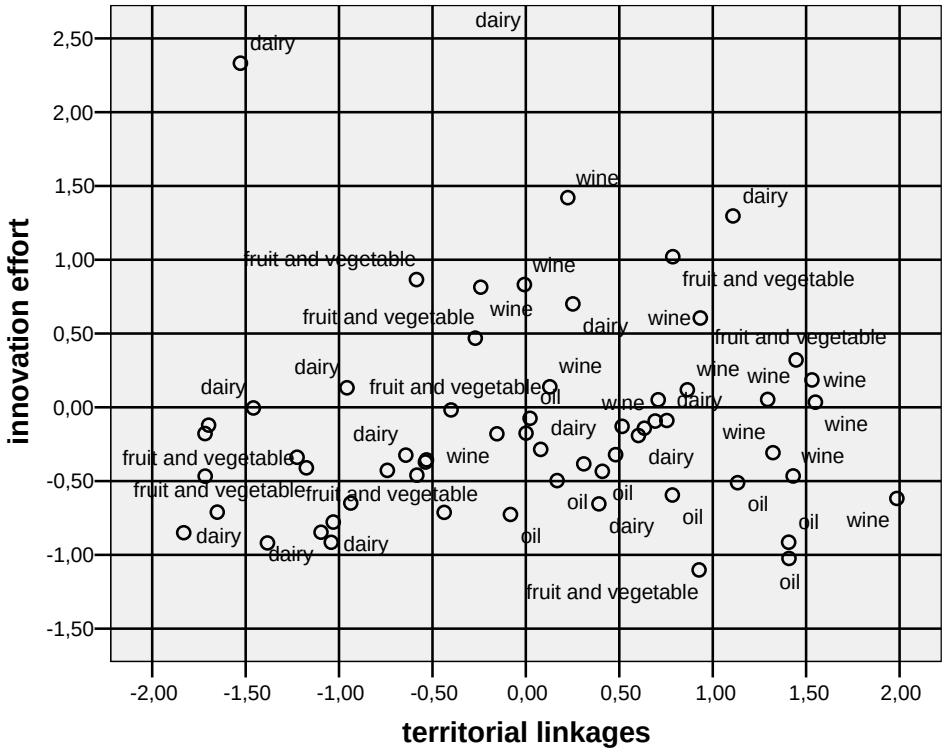
More important to explain the intensity of innovation are the specific industry and the network of relationship in which firms do operate.

The role of specific industry could be directly and indirectly connected to characteristics of demand. When demand increases at higher rate or quality requirements become stronger, the propensity to innovate and the innovative effort get higher. Market requirements are even more stringent when firms act on international market or face the Great Distribution; that can explain differences in propensity to innovation according to final goods outlet. In addition, the analysis pointed out that another key factor in innovation processes is the capacity to built durable relationships both on the input markets (agricultural sectors) and on the product markets. In this perspective the linkages between the firms and the international "environment" seems to have a central role to provide for both innovative and competitive strategies.

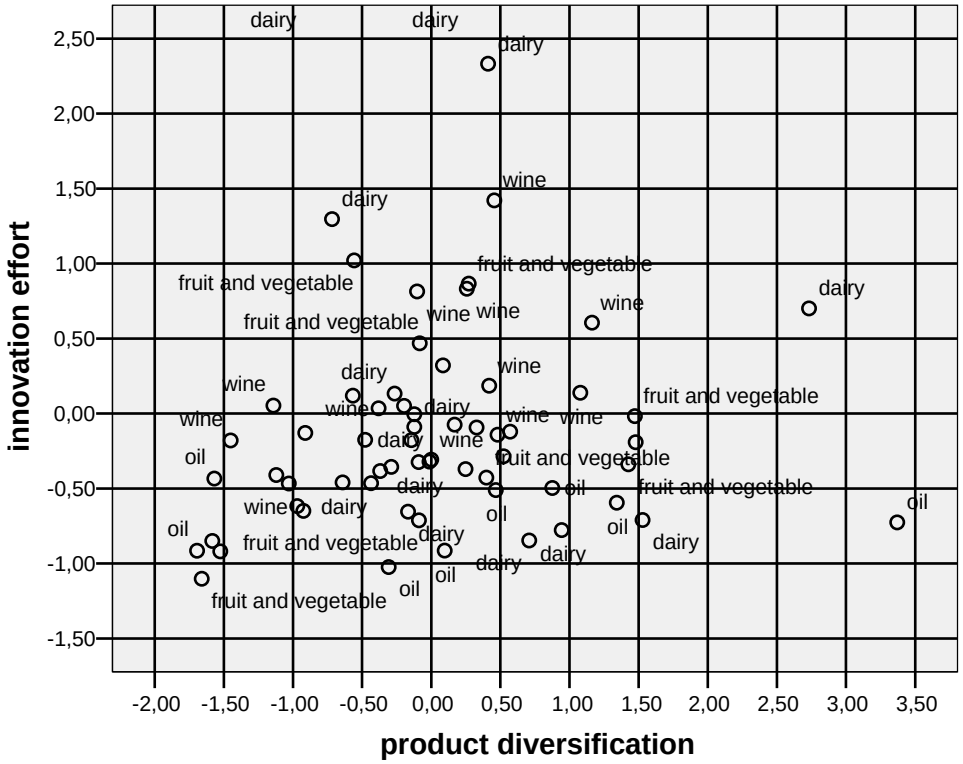
The research for higher quality standards seems to be the common field on which the innovative firms are challenging at the moment. Nevertheless the quality-oriented innovation strategies are implemented more through an imitative behaviour than a pro-active one, as many of the adopted innovations answer to the need of adjustment (to legislation or to demand changes), rather than to a longer term strategy. Many factor could be responsible for this behaviour. The structural weakness of the industry and the characteristics of the technology of production are some of them, but more study is also needed in order to better understand how production structure and power relationship among economic agents within the agri-food channel can influence innovative behaviour.



Graph 1.



Graph 2.



Graph 3.

References

Arundel, W.J., Kabla I., 1998, What percentage of innovations are patented? Empirical estimates for European firms. *Research Policy* 27, 127-141.

Barney, J.B., 1991, Firm resources and sustained competitive advantage, *Journal of Management* 17, 99 - 120.

Bougrain, F., Haudeville B., 2002, Innovation, collaboration and SMEs internal research capacities, *Research Policy* 31, 735-747.

Chen, R., 1996, Technological expansion: the interaction between diversification strategy and organisational capability, Journal of Management Studies 33, 649-666.

Cohen W., 1995, Empirical studies of innovative activities, in Stoneman, P. (eds.) *Handbook of the economics of innovation and technological change*, Blackwell.

Cohen W.M., Levinthal, D.A., 1989, Innovation and learning: the two faces of R&D, Tje Economic Journal 99 (9), 569-596.

Dosi, G., 1991, Perspective on evolutionary theory, *Science and Public Policy* 18, 353-361.

Freeman, C., 1973, A study of success and failure in industrial innovation, in Williams, B. (eds.) *Science and Technology in Economic Growth*, MacMillan, London, pp. 227-245.

Galende, J., de la Fuente, J.M, 2003, Internal factors determining a firms' innovative behavoiur, *Research Policy*, 32, 715-736.

Galende, J., Suarez, I., 1999, *A resource-based analysis of the factors determining a firm's R&D activities*, Research Policy 28, 891-905.

Gumbau, M., 1997, Analisis microeconomico de los determinantes de la innovacion: aplicacion a las empresas industriales españolas, *Revista Españolas de Economia* 14 (1), 41-66.

Hitt, M., Hoskisson, R., 1991, Strategic competitiveness, in Foster, L.W. (eds), *Advanced in Applied Business Strategy*, Greenwich, pp1-36.

Hoskisson, R., Johnson, R., 1992, Corporate restructuring and strategic change: the effect on diversification strategy and R&D intensity, *Strategic Management Journal* 9, 605-621.

Jensen, M.C., Meckling, W.H., 1976, Theory of the firm: managerial behaviour, agency costs and ownership structure, *Journal of Financial Economics* 3, 305-360.

Kuemmerle, W., 1998, Optimal scale for research and development in foreign environments: an investigation into size and performance of research and development laboratories abroad, *Research Policy* 27, 111-126.

Kumar, N., Saqib, M., 1996, Firm size, opportunities for adaptation and in-house R&D activity in developing countries: the case of Indian manufacturing, *Research Policy* 25, 713-722.

Link, A., 1982, An analysis of the composition of R&D spending, *Southern Economic Journal* 49, 342-349.

Love J., Roper S. 1999, The determinants of innovation: R&D, technology transfer and networking effects, *Review of Industrial Organization*, 15, 43-64.

Lunn, J., Martin, S., 1986, Market structure, firm structure and research and development, *Quarterly Review of Economics and Business* 26, 31-44.

Mansfield, E., 1981, Composition of R&D expenditures, relationship to size of firm, concentration and innovative output, Review of Economics and Statistics 63, 610 - 615.

Meisel, J., Lin, S., 1983, The impact of market structure on the firm's allocation of resources to research and development, *Journal of Industrial Economics* 26, 349-361.

Molero, J., Buesa, M., 1996, *Patterns of technological change among Spanish innovative firms: the case of Madrid region*, Research Policy 25, 647-663.

Pavitt, K., 1984, Sectoral patterns of technical change: towards a taxonomy and a theory, *Research Policy* 13, 343-373.

Richardson, G.B., 1990, *Information and Investment*, Oxford University Press, Oxford.

Rothwell, R., 1986, The role of small firms in technological innovation, in Curran, J., Stanworth, J., Watkins, D. (eds.), *The Survival of the Small Firm*, Vol.2, Gower, London, pp.114-139.

Schumpeter, J.A., 1934, *The Theory of Economic Development*, Harvard University Press, Cambridge, MA.

Schumpeter, J.A., 1942, *Capitalism, Socialism and Democracy*, Harper & Row, New York.

Teece, D.J., 1996, Firm organization, industrial structure, and technological innovation. *Journal of Economic Behavior & Organization* 31, 193-224.

Wernerfelt, O.E., 1975, A resource-based view of the firm, Strategic Management Journal 5, 171-180.

Williamson, O.E., 1975, *Markets and Hierarchies: Analysis and Antitrust Implications*, Free Press, New York.

Williamson, O.E., 1985, *The Economic Institutions of Capitalism: Firms, Markets, Relational Contracting*, Free Press, New York.