Understanding demand for innovation in the food industry

Abstract

This article investigates the demand for innovation in the food industry. It develops a theoretical model providing an attempt to interpret the complexity of firms' demand for innovation via a systematic analysis of firms' actual and potential needs in the food industry in the Apulia region (Italy). We argue that even in the case of SMEs operating in traditional industries, demand for innovation can be very diverse. We identify three main typologies of demand: Real demand, when firms are aware of their needs and know how to act in order to improve their products/processes; Latent demand, when firms have a limited capacity to translate their needs into potential innovation processes; Potential demand, when innovation needs are not yet explicated because there are no firms in the area capable of responding to certain innovation challenges. We test our theoretical framework with a survey of qualitative interviews to food firms located in the Apulia region in Italy.

JEL Codes: L21, L66, O32

Keywords: Demand for innovation, food industry, SMEs, dynamic capabilities

Paper type: Academic Research Paper

1 Introduction

In order to produce and successfully commercialize innovation, firms must synthesize a wide variety of expertise and knowledge produced by different complementary sources (Dosi, 1988; Malerba, 1992). Firms' collaboration with external organisations expands their range of expertise and can support the development of innovations (Chesbrough and Appleyard, 2007; Pisano and Verganti, 2008; Enkel et al., 2009).

Understanding business demand for knowledge and innovation is a difficult task that has probably been overlooked by both economists and policy makers. In fact, in the economic literature there is no real framework or taxonomy for the analysis of business innovation needs. The debate about the relative importance of demand-pull and technology-push innovations has raged since Schumpeter's seminal work on entrepreneurship and innovation (Schumpeter, 1934). A number of empirical studies have concluded that market demand is the dominant influence upon the innovation process, "calling forth" innovations in market economies (Mowery and Rosenberg, 1979). However, not enough attention has been paid to understanding business demand for innovation and therefore on our capability to understand business needs. We do not know yet how business demand for innovation is articulated and how to distinguish between different types of demand. This is especially the case of small and medium enterprises (SMEs), where innovation is often generated by not-formalised search processes, based on uncodified knowledge and intangible assets. We are particularly interested in the food industry, which is typically considered as a low-tech industry, based on SMEs. This industry is based on low R&D investment levels and mature, pervasive technologies, where – in general, but not always - static capabilities dominate over dynamic capabilities (Ghemawat and Costa 1993; Gruner et al., 1997; Lagnevik et al., 2003; Martinez and Briz, 2000; Nardone and Pilone, 2009; Zahra et al. 2006).

Building on these arguments, this article investigates the demand for innovation in the food industry. The paper develops a theoretical model providing an attempt to interpret the complexity of firms' demand for innovation via a systematic analysis of firms' actual and potential needs in the food industry in the Apulia region in Italy. The starting point of the analysis is therefore the analysis of firms' problems and the situations setting new challenges to their activities and new decisions to be taken in their innovative activity. We estimate the regional demand for innovation in the food industry, identifying relevant macro-areas of business needs and proposing technological solutions addressing these needs.

The paper is organized as follows: Section 2 presents a review of the literature on technology transfer and demand for innovation in the food industry; Section 3 describes the theoretical framework and the proposed methodology; Section 4 presents the empirical analysis and results; Section 5 comments on the empirical results; Section 6 presents some concluding remarks and some implications for policy.

2 Literature review

2.1 Introduction

Demand-side impact on innovation has received in recent years an increased attention among economists, business scholars and policymakers.

From one side, there is a growing consensus on the crucial role of demand on the technological paradigms (Andersen, 2007). New technological paradigms arise from advances in science and developments in technological knowledge. Demand influences the selection among competing paradigms representing a core force of selection that gives direction to the evolutionary process (Van den Ende and Wolfsma, 2005). Furthermore, demand also drives inventive activity and, presumably, innovative activity since the number of inventions are lagged reflections of changes in the level of demand (Schmookler, 1966).

From another perspective, the recent development in the business arena has enhanced the pace of innovation among firms. To stay competitive in the market, industries need to take advantage of the new technological opportunities to efficiently serve their target market and to respond to the needs of clients. In this regard, management must be able to purposefully search for innovation sources and opportunities (Utterback and Abernathy, 1975; Meeus and Oerlemans, 2000). In the end, the ability to face a sophisticated demand results not only in a direction towards more differentiated products but also in a competitive edge in global market (Porter, 1990).

The crucial role of demand as a key driver of innovation activity is also increasingly considered by policymakers (Edler and Georghiou, 2007). The European Commission (2006) proposes several policy actions to improve demand as a driver of innovation investments such as coordination or aggregation of demand needs in large orders, support for cluster formation, standard setting, regulations, and public procurement.

2.2 The demand for innovation in the food industry

Academic research greatly contributes to business innovation activity in several industries (Mansfield 1995). The study of technology transfer processes that involve collaboration between universities, research centres and firms has become an important issue for both economists and policy makers (Geuna and Muscio, 2009). While some countries are in the process of rethinking the role and the funding rationale of research institutions within their national innovation systems, there is increasing pressure for universities to raise research funding from industry and to contribute actively to industrial innovation. Industrial policy relies increasingly on technology transfer as a tool for the development of knowledge intensive economies and increased competitiveness (Bozeman, 2000). However, policy initiatives in the area of technology transfer have often been centred on a 'technology-push' approach overlooking the importance and the necessity to scout demand for innovation, especially at the local level. Whilst several regional and national innovation programmes have contributed through various measures to the enhancement of regional knowledge bases and to strengthening linkages between research performers and communities of local companies, only in very few cases regional and local authorities have promoted the identification of local demand for research, innovation and technology transfer services.

Despite having great innovative potential, the food industry is generally based on 'redundant technologies'. Science and technology offer wide opportunities to change and improve taste of products, preparation and nutritional characteristics, but the industrial structure is generally composed of SMEs with low R&D capacity. In fact, the introduction of innovations in the food industry is strongly influenced by demand conditions. Although final consumers are getting every day more interested in food characteristics and are showing greater willingness to pay for new and improved products, they do not change substantially their alimentary regime (Padberg and Westgren, 1979; Galizzi and Venturini, 1996). It follows that product innovations in the industry are hardly radical and much more often of incremental nature. This feature makes innovation dynamics in the food industry similar to those in other mature industries such as textiles, clothing and footwear and despite its relevant innovation potential, differentiates the industry from other science-based sectors where the contribution of scientific institutions to innovation is much more important (Pavitt, 1984). SMEs in the food sector face structural limits in their access to external information on innovation opportunities and necessary competencies. Two factors concur to limit their innovation potential:

- Firstly, even if they are aware of their business problems, they may find it difficult to understand how to solve them. Their cognitive limits hinders the emersion of clearly understandable business needs and

intelligible demand for innovation, making it difficult for the public sector to support them and promote the development of the industry.
- Secondly, their potential and real innovation needs must be interpreted and translated into innovation projects and collaboration programmes with external organizations.

While the former points to matters of cognition (Zahra et al., 2005; West, 2007) and learning (Zollo and Winter, 2002; Volberda et al., 2009), the latter affords scope for intermediaries in the innovation system (Howells, 2006; Yusuf, 2008). Further, there is likely to be heterogeneous bundling of resources and capabilities (Amit and Schoemaker, 1993; Peteraf and Barney, 2003; Teece, 2007).

3 Theoretical Framework and Methodology

In the analysis of technological change the exploration of the demand issue largely has been sidelined or confined to interpretive case studies (Hawkins et al., 2007). From one side, there are several studies that investigate the effect of the market demand on innovation but with a lack of systematic empirical investigation of demand factors. On the other, not enough attention has been paid to understanding business demand for innovation and to our capability to understand business needs. Authors have utilized different concepts of demand that often did not show any similarity with the rigorous definition of the economic theory (Mowery and Rosenberg, 1979).

Following Nardone (2008), we try to follow a closer path to the economic theory. In fact, consumers exert a demand to buy a quantity of a good or a service in such a way to satisfy specific needs. In this particular frame, demand-pull innovations are by definition requested by private companies. The demand for innovation can be expressed in terms of specific and unique applications of knowledge to food industry's products and processes. Finally, users face suppliers that develop exclusive technologies (experimenting new ones or tailoring existing ones) to meet their needs.

The consequence are the following. Firms can exert many individual demands for innovation. Each individual demand for innovation is identified by a specific couple "need-technology". This relation can be very complex since firms' needs and needed technologies are very different and not easy to systematize. Furthermore, not always a unique solution can be found and every need can be answered by different technologies. Also, an innovative solution that effectively solves a problem in a specific firm may work not so well in other firms with a different set of resource.

In such a theoretical model, a step further towards a deeper comprehension of the demand for innovation of the food firms lays on a clear taxonomy of the needs and technologies of this specific industry.

Entrepreneurial innovation **needs** may pertain to several areas of food business activity. In general, technological needs are addressed in terms of requests that affect firms' products and processes. Of course, firms' innovation needs can also be found in other areas of firms' activity such as managerial practices, commercial relations, logistics, finance, etc. In this instance, we focused our analysis uniquely on technology needs. For this reason, it was necessary to identify a suitable classification of business needs in the food industry in terms of improvements to firms' products and processes.

Newness of a product may be judged differently according to those who perceive it. In the context of food products Winger and Wall (2006) point out that different groups of actors - consumers, distributors, and producers - may have a different view of whether or not a product is new. Process innovations in the food industry are relatively easier to identify than product innovations because they mark those structural changes that permit increasing efficiency in the production of products (at lower costs and eventually prices). Table 1 indicates the main forms of product and process innovations adapted from Lerici (1996).

Table 1 Firms' innovation needs

Business innovation needs	Description
Product innovations	Guarantee the Food Safety
	Add functional properties and increase nutritional features
	Improve sensory features
	Increase the convenience
	Guarantee Credence Attributes
Process innovations	Reduce the impact on the environment
	Reduce water and energy consumption
	Increase yield and productivity

Source: Authors' adaptation from Lerici (1996)

In our theoretical framework the demanded innovation is seen as a **technology**, namely "the use of scientific knowledge through specific methods, materials, and devices, to solve practical problems" (The American Heritage, 2002). The diverse technologies implemented in the food industry can be organised in several ways. Following Istat (2005), we chose to

differentiate between food technologies and other specific technologies as represented in Table 2.

Table 2 Proposed technologies

Technologies	Description
Food Technology	Food Preservation
	Food Processing
	Food Extraction
	Food Structuring
Other Technologies	New Materials
	Machinery
	ICT
	Environmental
	Biotechnologies

Source: Authors' adaptation from Istat (2005) and Peri and Zanoni (2003)

The proposed taxonomy aims to shed light on the phenomenon of the technological convergence in the food industry, to see how strong is the impact of groups of technologies developed for one use and utilized in different contexts. For instance, some estimates show that the 28% of the food industry expenses in R&D refers to scientific domains different from the food one (MIUR, 2007:11).

To complete the theoretical framework, the demand for innovation can be identified not only by the combination of needs and technologies but also envisaging **its specific nature**. We argue that there are different kinds of demand for innovation and this is especially true in the case of SMEs operating in traditional sectors such as the food industry. Their limited rationality and information asymmetries may limit their understanding about who is the optimal provider of technologies and, sometimes, even in identifying their own specific needs. Therefore, following De Meo (2004), we identify three main typologies of demand:

- Real demand: firms are aware of their needs and know how to act in order to improve their products/processes
- Latent demand: firms have a limited capacity to translate their needs into potential innovation processes
- Potential demand: firms' innovation needs are not explicated because there are no firms in the area capable of responding to certain innovation challenges

Table 3 reports a description of each type of demand identified here.

Table 3 Firms' demand for innovation: a proposed taxonomy

Type of demand	Description	Firm's awareness about own technology needs	Firm's awareness about the required technology	Firm's capacity to translate innovation needs into innovative products/processes
Real demand	The firm has explicit needs and is aware of the technological solutions available on the market that address its needs	Aware	Aware	Autonomous
Latent demand	The firm has generic needs and is not aware of the technological solutions addressing its needs	Aware	Not aware	Dependent
Potential demand	The firm doesn't express a specific need while the general conditions of the scenario (legal, technological, market) requires it to do so	Not aware	Not aware	Unconscious

Source: Authors' adaptation from De Meo (2004)

The existence of a real demand implies that the management has a clear knowledge of "*what* should be done" and of "*how* it should be done". In this case, a firm is in complete control of its demand that can be transmitted directly to the market for innovation, to the specific provider of the required technology. Often, especially when the problem calls for a simple solution, innovation may occur within the firm itself through the use of its internal resources.

Especially in SMEs the lack of culture and qualified personnel makes it possible for a latent demand to emerge. In this case, the management knows which areas need to be improved but doesn't have a clear technological solution in mind. This situation calls for an adviser to address the management towards a proper supplier of technologies.

Finally, there may be the case of companies that do not express a specific need even if they should do so. The lack of information and knowledge may avert the management to anticipate a demand from their real or potential customers, to promptly react to a new and more severe set of rules, to exploit a suitable and attractive innovative technology. Clearly in these conditions, firms do not even propose themselves to the market for innovation.

4 Empirical Analysis and Results

We tested our theoretical framework with a survey of in-depth qualitative interviews (Eisenhardt, 1989; Eisenhardt and Graebner, 2007; Yin, 2003) with food firms located in the Apulia region (Italy) carried by consultants of the Apulian Food Technological District. The qualitative approach appeared to be more appropriate given the purpose to explore such a complex phenomenon (Daymon and Holloway, 2002). Without doubt this particular option also carries on together with the desired insights some drawbacks such as a partial bias from the interviewer and the not automatic translation of the results to a larger population.

We carried out focus groups with business representatives. This allowed the identification of the main thematic areas to be investigated during in-depth face-to-face interviews with company managers of a sample of 87 food firms during the period March-September 2008. We used a semi-structured open-ended questionnaire based on the theoretical framework illustrated in the previous section. The sample of interviews was stratified in order to be representative of the total population of food firms in Apulia. Interviews were carried at the manufacturing plants in such a way to have an idea of the actual technologies used by the firms. During interviews we collected qualitative information on firms' innovation needs and innovation strategy, benchmarking individual needs versus other firms' needs.

The chosen methodology allowed the collection of a wide array of information on innovation activity in the food industry and the definition of a taxonomy of different types of demand and business needs. To our knowledge, this attempt to map business needs has never been made before and sets new challenges for future research in the area, still being consistent with the call by Easterby-Smith et al. (2009) to extend research of this nature to more traditional industries.

The food industry and the entire agro-food economic system is much more important in Apulia than in other Italian regions. Unlike in the case of advanced economies (Malassis, 1980), in the case of Apulia the contribution of the food industry to regional economic performance is lower than the contribution of agriculture. This accounts on the one hand for the low industrialization rate and problematic industrial growth of Southern Italy and, on the other hand, for the good opportunities for the development of manufacturing activities in this area. Nevertheless, manufacturing of food products represents a large share of industrial activities, accounting for 11.6% of total value added of regional manufacturing activities (see Table 4), 12.7% of regional employment and 10% of manufacturing enterprises. Over the

period 2000-06 the agro-food system (agriculture plus food manufacturing) contributed 7% of regional GDP and only 4.5% national GDP.

The abundant production of agricultural produce has driven the emergence of a processing industry (olive oil, wine, pasta and dairy products) that even if not fully developed, still represents one of the most important examples of industrialization processes in the region. The greatest number of enterprises is found in the Manufacture of bread and olive oil (respectively 47% and 14.5%). The greatest concentration of enterprises with respect to the rest of Italy is found in the NACE sectors: manufacture of oils and fats (21.6%), processing and preserving of fruit and vegetables (12.0%), manufacture of wine from grape (11.4%) and manufacture of dairy products (10.4%).

Table 4 Contribution of the agro-food system to the National and Regional economy (2000-06)

Value added, average value at constant prices	% Apulia	% Italy
Contribution of agriculture to GDP	5,2	2,6
Contribution of the food industry to GDP	1,8	1,9
Contribution of the food industry to manufacturing industry GDP	11,6	8,6

Source: Authors' calculation on ISTAT data, Regional Economic Accounts 2000-2006

Figure 1 reports the geographical distribution of interviews to firms. The majority of interviews is concentrated in the province of Foggia and Bari, where the largest share of regional food industry is found. The remaining 23 interviews were conducted in the southern part of the region.

Figure 1 Geographical distribution of interviews

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The majority of firms interviewed has fewer than 20 employees (Table 5). The average turnover is 8,051 thousand Euros but wide differences in turnover levels exist between firms in different size classes (Std. deviation 14,302.28). 36.8% of firms does not have an R&D department but carries on a systematic basis experiments on new products. 25.3% of firms have an R&D department and 8% had one in the past (Table 6).

Table 5 Firms' distribution by size and turnover (2007)

	n.	turnover (thousand Euros)
1-5 employees	25	1,480
6-10 employees	17	2,469
11-20 employees	21	11,487
21-50 employees	12	10,473
more than 50 employees	6	26,733
n.a.	6	-
Total	87	

Source: Authors' calculation based on survey data

Table 6 Firms' R&D strategy

	n.	Per cent
Yes	22	25.3
No	18	20.7
No, but carries out experiments	32	36.8
In the past	7	8.0
n.a.	8	9.2
Total	87	100.0

Source: Authors' calculation based on survey data

5 Discussion

The first point of our discussion deals with the nature of the demand expressed by the surveyed Apulian firms. The main conclusion concerns the existence of a consistent and mostly latent demand for innovation.

We detected 285 different needs calling for an innovative solution over a sample of 87 firms. In more than the half of the cases firms show to have a clear understanding of the areas to be improved but don't have a clear technological solution in mind. In these cases, a problem-solving path has been identified with the contribution of the interviewers. Sometimes this solution could advise the implementation of a single technology. In other situations different technologies to be used in combination or as alternatives may have been recommended.

The general difficulties of SMEs in translating the desired changes in actual innovative processes in common throughout the food industry. As Figure 2 shows the latent demand is the most frequent in every division of the food industry. Less frequent is the detection of the potential demand but this result depends heavily on the interpretation of the interviewers about the technological and competitive conditions of the surveyed firms.

Figure 2 Firms' demand for innovation

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Figure 3 reports information about firms' innovation needs, showing the complexity and diversity of the demand in the food industry. Interviewees were asked what were their most relevant needs in terms of product and process innovations (and whether or not they have any need at all). Product innovation mainly concerns the sensorial features as well as the convenience. Looking at the process innovation side, firms are concerned overall on the reduction of water and energy consumption.

Wine and dairy industries are mainly worried about the increase of the sensorial features since they face more differentiated markets where consumers are very demanding about taste and flavours. The needs of new ready-to-eat (and other time-saving solutions) and of a longer shelf life for the existing goods are expressed with a higher frequency in the post-harvesting of fruit and vegetables as well as in the dairies. The attention to a more efficient use of water and energy can be explained by the growing impact of these strategic resources on production costs.

The attention to functional foods and nutritional features reflects a changing attitude of modern consumers that devote a growing attention to healthier eating styles. The supply of light and fortified products as well as food with healthy properties is a reaction to the diffuse concerns about eating disorders and food allergies. Such a demand shows up in almost every industry with a higher frequency in companies that produce preserved vegetables, dairy products, pasta and bakery.

The search for a higher food safety is more frequent in those industries where the fermentation may cause the undesired proliferation of different sort of toxins and pathogens (wine, preserved vegetables) while the quest for environmental measures is spread among olive oil firms. In this specific industry firms do no expect the market to adequately appreciate the quality of the extra-virgin olive oil so they are more willing to work on the by-products and the wastes of the production process.

Figure 3 Firms' innovation needs

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There are several technologies that can be useful to foster innovation in Apulian food industry. Figure 4 shows a large impact of technological domains developed in contexts others than the food industry giving the idea of a technological regime with high pervasiveness (Malerba and Orsenigo, 1997).

This is the case especially of environmental technologies, machinery, biotechnologies and new materials. Firms demand environmental technologies to reduce the use of energy and water but also to better utilise wastes and by-products. For instance, the post-harvesting activities are high energy consuming and require feasible solutions to cut the energy costs. On the other hand, in the olive oil industry, firms are interested in utilising the olive residues (sansa) and vegetation water to produce compost or fuel.

Biotechnologies appear to be attractive for wine, dairy and bakery industries especially in developing autochthonous microorganisms, such as yeast and other starters that may better colonise the specific cultivation media and help the fermentation process. The target is to realise products with unique and standardised sensorial attributes.

Among the specific food technologies, we found a growing potential interest of Apulian food firms towards the application of mild technologies and the development of new packaging techniques. An equivalent importance is assigned to the utilisation of innovative raw materials and ingredients and the developing of new products. These findings are coherent with the global trends in the food innovation (Boom et al., 2005).

Mild technologies are alternative or complementary preservation technologies that serve the scope to maintain the original sensorial attributes and often result to be energy saving or environmentally friendly. Among these we detected a specific interest in high pressure processing as well as in oscillating magnetic fields (especially ohmic heating and microwaves) from various industries, especially the preserved vegetables and the fresh pasta ones.

Innovative food processing technologies meet the needs of several industries. Especially, we refer to the study of new and more suitable packaging for fresh-cut produce, fresh pasta and dairy products with short shelf-life. Also, there is a clear interest in designing more effective food additives (using, for example, enzymes or mannoproteins), as well as, in processing techniques respectful of the original properties of the products (microfiltration, ultra filtration, reverse osmosis especially in dairy and wine industry).

The class of food extraction technologies appears to be very suitable to the specific need of developing natural food compounds with functional properties

to be used in the cosmetic and pharmaceutics industries. This approach clearly shows up in the olive oil industry as an alternative to exploit the potential value of the olive residues and the vegetation water. The grain-based product industries, instead, are potential users of extraction technologies leading to innovative ingredients for functional foods.

Finally, the food structuring technologies have a potential impact in the pasta and bakery industry but also may help the launch of innovative preserved vegetables on the market.

Figure 4 Proposed technologies

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6 Concluding remarks

We have created a taxonomy of firm's innovation needs based upon the level of internal and external recognition. This has several practical implications such as:

- Investing in those areas and technologies that allow greater returns or that have greater chances of responding to real business needs;
- Identifying strategic technologies that research institutions need to take into consideration if they wish to increase their interaction with local firms and contribute to the market-based development and implementation of their technology pushed innovations;
- Facilitating the definition and emersion of potential and latent demand for innovation and therefore providing useful indications for all those bridging institutions (TTOs, technology poles, etc.) with the mission of easing collaborations between research institutions and businesses.

The technological requirements identified in this paper can form the basis for interventions according to expressed market demand.

Our research is narrowly based in terms of geographic and industry scope. This constitutes a limitation to the generalizability of our results. The methodology, however, is readily transferable to other industries in the traditional sector and to the food sector in other geographic settings. Future research could therefore seek to apply the taxonomy to food markets in different regional settings, both within Italy and abroad. This could highlight differences due to resource endowments and firms' internal capabilities, as

well as policy, structural or cultural issues. Any commonality and variation in the results will strengthen the external validity of our model, while setting its boundary conditions.

This initial qualitative study could also act as a basis for surveys of a more quantitative nature, repeated longitudinally, in order to monitor progress and to establish causal relationships.

Another limitation of this study is that we did not investigate innovations with high technology content, that is, those emanating from public research institutions. In order fully to capture the complexities of technological innovation, we need to study the interaction between demand and supply sides of the market. Future research into regional public research organisations can serve to understand factors within those organisations that act as impediments or facilitators to purposeful university-SMEs interaction.

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