

## Obstacles to innovation and firms innovation profiles: are challenges different for policy makers?

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### **Abstract**

*Technological innovation can be hampered or slowed down by several factors related to its challenging nature in terms of costs and risks. Using French and Italian Community Innovation Survey (CIS 4), this paper contributes to the understanding of the determinants of these obstacles in order to suggest how the development of innovation could be stimulated or facilitated. By grouping firms according to their attitude towards innovation*

*Innovators, Innovative active and Non-innovative active - and comparing their perception of obstacles to innovation, the analysis highlights that the nature of the most perceived hurdles is similar across innovation profiles. However, the characteristics of the firms determining the perception of obstacles vary across innovation profiles. Thus, public policies aimed at supporting innovation development should differ from the ones targeted to encourage innovation activities.*

**Keywords:** *Obstacles to technological innovation, Innovation profiles, Innovators, Innovative active, Non- innovative active, Innovation policies*

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### **Introduction**

Technological innovation is widely recognized as a key competitive advantage for manufacturing and service firms, and consequently is an important driver of their economic performance. Nevertheless, several firms do not engage in innovation activities. This attitude depends on the uncertain, challenging and expensive nature of the innovation development process that makes firms consider themselves unable to engage innovative activities. Currently, the development of technological innovation requires qualified personnel and considerable resources beyond the abilities to face the several difficulties and unexpected events that usually characterize it.

The low rate of technological innovation draws the attention of scholars towards outlining obstacles to innovation and understanding their consequences. Literature aims at helping the development of effective public subsidies for innovation or at helping managers in designing corporate strategies oriented to overcome the obstacles to innovation (Asso and Vito, 2010; Blanchard et al., 2011; Borrás, 2004; Galia and Legros, 2004; Hyytinen and Toivanen, 2005; Mohnen and Röller, 2001; Mohnen et al., 2008; Savignac, 2008; Segarra-Blasco et al., 2007; Wziątek-Kubiak and Peczkowski, 2011).

This paper tries to address the lack of literature on obstacles to innovation that has attracted scant attention towards the heterogeneous nature of innovative and non-innovative firms. Apart from very few contributions (D'Este et al., 2008, 2011; Hözl and Janger, 2011), previous studies mainly focused on firms engaged in innovative activities without differentiating them according to the performance of their innovative efforts. This paper investigates the perception of obstacles across three different innovation

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profiles: Innovator, the firms that have introduced product or process innovation; Innovative active, the firms engaged in failed or postponed innovative projects; Non Innovative active, the firms indifferent to innovative activities altogether.

## **Literature review**

Thanks to the particular attention of scholars towards the factors that could lower firms' innovative efforts or could hamper the introduction of technological innovation we have an extensive list of barriers to innovation. As suggested by Patier (1984), impediments to innovation could be both internal and external to the firm (e.g. resource and environment related). Most of them are due to the uncertainty that affects the development of technological innovation that usually involves the unpredictability over which creation path has to be followed in order to reach promising and marketable discovery and application (Castellacci et al., 2005). The overcome of such obstacles asks for a wide collection of information about technology and market that, being not easy to carry out, can discourage firms or can make the project fail. Moreover, hampering factors are related to the large amount of financial and qualified human resources required by R&D projects (Baldwin and Lin, 2002; Frenkel, 2003; Hadjimanolis, 1999). The lack of internal resources and the difficulty to integrate them with external ones, because of difficult access to them or the difficulty in the management of the integration process, make the development of innovation more difficult. Other impediments are based on organizational rigidity caused by excessive bureaucracy, the inability to unlearn and the break through the barriers of conventional thinking or simply resistance to change by employee (Assink, 2006; Zwick, 2002). Others are linked to the lack of infrastructure or government supports (Hadjimanolis, 1999; Rush and Bessant, 1992). Previous studies remark that these obstacles could be interrelated that is to say that they could reinforce each other's (Galia and Legros, 2004; Mohnen and Rosa, 2002; Shiang and Nagaraj, 2011; Wziatek-Kubiak and Peczkowski, 2011). Yet, complementarities among obstacles differ according to the attitude of firms towards innovation and their innovative performance. In particular, obstacles show a higher propensity to be combined with others as regards firms not engaged in any innovation activities (Shiang and Nagaraj, 2011).

According to previous studies on the determinants of obstacles to innovation, apart from the belonging to group that lower all kinds of obstacles, impediments are determined by different factors. The identification of financial constraints as obstacles to innovation is higher in high-tech manufacturing industries and increases if innovation activities involve R&D activities, in particular basic research, and when firms are confronted to new competitors entering the market. On the contrary, the cumulativeness of knowledge involved in innovation activities lower the perception of lack of financial resources (Canepa and Stoneman, 2008; Hölzl and Janger, 2011; Iammarino et al., 2007; Rahmouni, 2011; Tourigny and Le, 2004). The high costs related to the development of technological innovation are usually more perceived as obstacles by firms engaged in internal R&D activities aimed at radical innovation and when firms have to face competition of new products introduced by competitors. On the contrary, costs are not hampering factors the more the firm is engaged in export activities and if it is foreign- owned (Galia and Legros, 2004; Hölzl and Janger, 2011; Iammarino et al., 2007; Mohnen and Rosa, 2002; Rahmouni, 2011; Tourigny and Le, 2004). Skill shortage is perceived more by innovative high growth rate firms facing high competition and engaged in external R&D whilst is not a barrier for firms engaged in basic R&D activities based on cumulative know-how (Baldwin and Lin, 2002; Bascavusoglu-Moreau and Simonetti, 2011; Galia and Legros, 2004; Hölzl and Janger, 2011; Iammarino et al., 2007; Rahmouni, 2011; Tourigny and Le, 2004). The lack of information on technology is more likely to be a hindering factor the more the firm experiences high growth rate and is engaged in external R&D and export activities. The cumulativeness of knowledge exploited in innovation activities and the status of "start-up" lower the perception of this barrier (Bascavusoglu-Moreau and Simonetti, 2011; Galia and Legros, 2004; Hölzl and Janger, 2011; Iammarino et al., 2007; Rahmouni, 2011). The lack of market information is an obstacle

when firms are engaged in the introduction of technological innovation to the market or is experiencing organizational changes (Bascavusoglu-Moreau and Simonetti, 2011; Galia and Legros, 2004; Hölzl and Janger, 2011; Iammarino et al., 2007; Rahmouni, 2011). Uncertainty about market reaction to new products is a deterrent for large firms that are also involved in managerial and organization transformation whilst it is not a real barrier for start-up firms and companies with high export rate (Bascavusoglu-Moreau and Simonetti, 2011; Galia and Legros, 2004; Hölzl and Janger, 2011; Iammarino et al., 2007; Rahmouni, 2011).

To underline divergences in the determinants of barriers across firms with different attitude towards innovation and different innovation performance, more recent studies include in the analysis the innovation profile as a potential determinant of the perception of barriers (Bascavusoglu-Moreau and Simonetti, 2011; D'Este et al., 2008, 2011; Hölzl and Janger, 2011). This highlights that the level of engagement in innovation activities affects the perception of obstacles to innovation. The share of innovators, enterprises that introduced technological innovation, who experience barriers to innovation is higher than the share of no-innovators, regardless of the type of barrier considered (D'Este et al., 2008). Moreover, the consequences of different types of impediments diverge (D'Este et al., 2011).

## **Data and constructs**

This paper exploits data collected by the French and Italian Community Innovation Survey 2002-2004 (CIS 4) that provide us information about firm's structural characteristics and firm's innovation activities and performance for 20,747 French and Italian firms.

CIS is a valid data source for the analysis of barriers to innovation since it collects a widespread set of data about hampering factors of technological innovation's development by asking for the perception of cost-related obstacles (lack of internal financial resources, lack of external financial resource, costs too high), knowledge-related obstacles (lack of qualified personnel, lack of information about technology, lack of information about market, lack of partners) and market-related obstacles (market dominated by established firms, demand uncertainty). Yet, the formulation of the CIS questions on obstacles generally leads firms to evaluate the problems they have faced in carrying out innovation activities (Baldwin and Lin, 2002; Galia and Legros, 2004). Thus, in line with D'Este et al. (2008), Mohnen and Rosa (2002) and Lim and Shyamala (2007).

CIS database allows to identify three different innovation profiles: Innovator, Innovative active and Non-Innovative active. A firm is defined as an Innovator if, during the period 2002-2004, it introduced at least a new or significantly improved product or a new or significantly improved process. A firm is defined as Innovative active if, during the period 2002-2004, it did not introduce a new or significantly improved product nor any new or significantly improved process, but it was engaged in innovative activities that it abandoned or were still on-going at the end of 2004. Non-Innovative active firms are defined as enterprises simply indifferent to innovative activities altogether. Our sample consists of 31% of Innovators; 5% of Innovative active firms and 64% of Non-Innovative active firms.

## **Methodology**

The study consists in three distinct analyses on each innovation profile. In each analysis the determinants of the nine obstacles to innovation are investigated by using multivariate probit models<sup>1</sup> that allow to take

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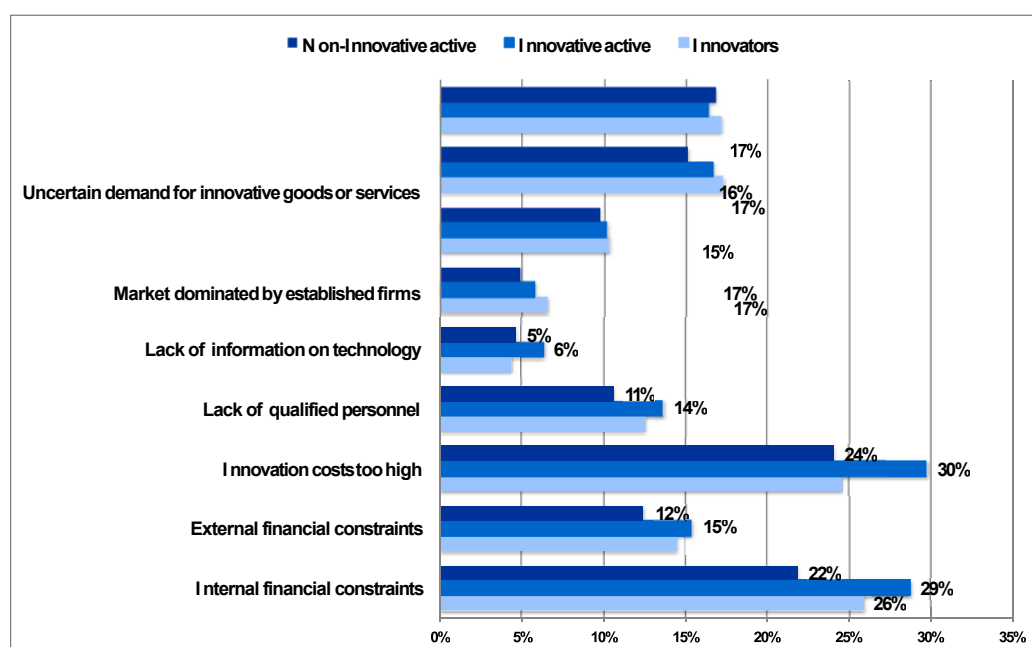
<sup>1</sup> The results were obtained with a Stata routine as specified by Cappellari and Jenkins (2003) based on the "GHK" simulator. Further information about the "GHK" simulator is available in Greene (2003).

into account the possible interdependence between the perception of different types of obstacles<sup>2</sup>. Considering previous empirical studies on the relationship between the perception of obstacles to innovation and firm's characteristics, the analysis checks for the impact of firm's structural characteristics (e.g. size and belonging to a group), industry sectors, types of innovation activities in which the firm is involved (e.g. internal R&D, external R&D, acquisition of equipment, acquisition of knowledge and training for innovation) and public subsidies at the national and European level<sup>3</sup>. Moreover, the model looks at the role played by sources of information exploited during the innovation development. Finally, the estimation controls for country specific effect in order to take into account the impact of national innovation system.

## Results

Innovation profiles do not widely differ in the perception of the nine obstacles. In particular, the types of obstacles most perceived by firms are quite similar across innovation profiles (Figure 1).

Figure 1. Innovation profiles and perception of barriers



Sources: CIS 4 (France and Italy), 20,747 firms.

Note: Statistical tests highlight a significant difference across profiles only for "innovation costs too high".

For each innovative profile the predominant impediments are internal financial constraints, innovation costs that are too high, market dominated by established firms and uncertain demand for innovative goods or services. The only evident difference among innovation profiles is the entity of economic barriers perceived by Innovative-active firms that suggests that the high costs involved in innovation projects and the lack of internal financial resources have a strong probability to delay or abandon the innovation development.

<sup>2</sup> Perception of obstacles may depend on which innovation activities the firm is engaged in or on the information sources the firm is exploiting. This would require correcting for the presence of potential endogeneity bias in the estimation. However, due to the lack of appropriate instruments (Mohnen and Roller, 2001; D'Este et al., 2011), we do not try to correct for endogeneity. In our view, the presence of endogeneity is not likely to affect the nature of our findings.

<sup>3</sup> Explanatory variables have been selected in accordance with previous literature on determinants of obstacles to innovation.

Findings of the multivariate probit estimations investigate in detail the determinants of obstacles to innovation for Innovators, Innovative active firms and Non-Innovative active firms. In the following sections comments on results are re-arranged in order to identify similarities and divergences of the determinants of obstacles (costs, knowledge and market related obstacles) across innovation profiles.

As regards costs barriers, the multivariate probit estimation highlights few common determinants across innovation profiles. The only one factor that reduces the perception of all different economic obstacles is the size. The higher the firm's turnover the lower the likelihood that the firm lacks internal and external financial resources and is hampered by high project costs. Moreover, for all the innovation profiles, the perception of high costs of innovation is lowered also by belonging to a group. The further similarities between Innovators and Innovative active firms consist in national variations, in the role of intra-mural R&D activities and the exploitation of conferences as information source. Italian firms engaged in innovation activities, independently from their innovation performance, perceive less than French ones the lack of internal financial resources and barriers due to innovation costs too high but are more hampered by the lack of external financial resources.

Differences of determinants across innovation profiles emerge also in knowledge barriers. Currently, very few factors have the same impact on the perception of these obstacles across profiles. Turnover is a reducing factor with the only exception for the perception of lack of information on technology by Innovative active firms. Also firm's localization matters in the same way across innovative profiles. In particular, Italian firms are less affected by the lack of qualified personnel independently from their innovation profiles. Since French indicators on graduates in science and engineering disciplines and population with tertiary education are higher than Italian ones, this result suggests that in France the lack of qualified personnel is more due to the misalignment of human resources' specialization with industry needs than a question of how many.

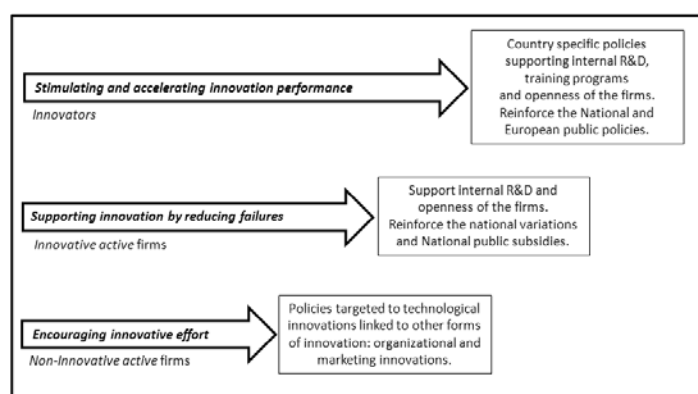
As regards market-related factors that could deter innovative efforts or hamper the development of innovation, we don't find common determinants in all three profiles but commonalities between Innovators and Innovative active, between Innovators and Non-innovative active and between Innovative and Non-innovative active. Both Innovators and Innovative active firms who exploit competitors as a source of information are more hampered by market factors whereas large-sized Innovators and Non-innovative active firms are less affected by market-related obstacles. Belonging to a group leads both Innovative and Non-innovative active firms not to perceive the uncertain demand for innovative goods and services as an obstacle. Non-innovative active firms belonging to a group are not deterred also by a dominated market. The growth rate matters only for Innovators. In particular, high growth firms are less affected by market-related factors. Moreover, Italian Innovators are less constrained than French ones. The nature of innovation activities affects the perception of obstacles mainly in Innovative active firms.

## **Policy implications**

Empirical analyses carried out on the perception of obstacles and their determinants provide useful implications for innovation policies i.e. public supports that aim at stimulating innovation performance and at encouraging innovative efforts. On one side, descriptive statistics highlight that the extent of the perception of obstacles to innovation is similar across innovation profiles, apart from the hampering effect of innovation costs that is more evident for Innovative active firms. On the other side, results of the multivariate probit estimation outline that the drivers of the perception of hampering factors to innovation vary across different types of obstacles and, at the same time, across innovation profiles. For Innovators, being a large firm, its location and its industrial specialization matter as a determinant of all obstacles to innovation. Engagement in internal R&D and the exploitation of national and European subsidies increase the perception of costs and knowledge related obstacles. Openness of the firm increases the perception of

knowledge and market obstacles. Innovative active firms engaged in internal R&D and using diverse sources of information increase only the perception of costs related obstacles. Being a large firm reduces this perception of cost obstacles. National subsidies reduce the obstacle to knowledge. For Non-innovative active firms, being a large firm reduces the perception of all types of obstacles. Firms active in geographically diversified markets are more prone to face cost related obstacles. Involvement in other forms of innovation - organization and marketing innovations - play an important role as determinants of obstacles to technological innovation. Commitment in organizational and marketing innovation increases the perception of knowledge and market obstacles whereas organizational innovation efforts reduce the cost related obstacles.

**Figure 2. Main policy implications across innovation profiles**



## **Conclusion**

This paper contributes to a better understanding of obstacles to innovation and their determinants in order to suggest how innovation could be stimulated and facilitated. In contrast to previous research, this paper presents separate analyses on three different innovation profiles: Innovators, Innovative active and Non-innovative active. Main results tend to show that the nature of the most perceived obstacles is similar across the three innovation profiles except for obstacles linked to innovation costs. For all firms, the predominant impediments are internal financial constraints, innovation costs too high, market dominated by established firms and uncertain demand for innovative goods or services. However, the hampering effect of innovation costs is more evident for Innovative active firms. The comparison of determinants of obstacles to innovation across innovation profiles highlights several differences. This suggests that government policies should be specific according to the innovation profiles beyond the obstacles targeted. Policies aimed at stimulating and accelerating innovation performance may differ from the ones aimed at encouraging innovation activities.

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