OBSTACLES TO INNOVATION:

WHAT HAMPERS INNOVATION IN FRANCE AND ITALY?

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Abstract:

This paper aims at understanding if the national innovation system affects the perception of obstacles to innovation by innovators, firms engaged in innovative activities that have introduced technological innovation. The research objective is reached by comparing the perception of obstacles faced by French and Italian firms and by analyzing the differences in the determinants of barriers to innovation during the period 2002-2004 using CIS4. Descriptive statistical analysis highlights that the perception of obstacles varies across countries. In particular, French innovators are more affected by barriers to innovation. A multivariate probit model allows us to study simultaneously the different barriers taking into account their potential interdependence. The main results imply that policy makers aimed at lower the barriers to innovation, beyond common policy objectives, should design country-specific public subsidies that target the specific determinants of obstacles highlighted at country level.

Keywords: Obstacles to innovation, Innovators, National Innovation System, France, Italy

JEL codes: O31, O32, O33, O38

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1. Introduction

Innovation is a fundamental driver of local economic development. As a consequence, for a number of years Governments have invested considerable financial resources to promoting research and development (R&D) activities by enterprises and to enhance the development of technological innovation. The European Commission sets out a strategic approach to innovation and develops many policy tools to help companies to perform better in R&D activities (e.g. financial supports such as Research Framework Programme or services for innovators such as IPR Helpdesk). These public policies aim at reducing the perception of obstacles to innovation, that is to say the factors that discourage firms in investing in R&D, those that hamper the achievement of tangible results or that slow down the development of technological innovation. At the same time, nowadays public intervention emphasizes the promotion of the development of an effective local innovation system since the innovative performance of firms is strictly affected by external opportunities and external operative context.

Taking into account the objectives of industrial policies and the relevance of a systemic viewpoint of innovation activities, this study is interested in understanding what are the determinants of the obstacles to innovation and if they vary across countries. Thus, this study contributes to the literature on the perception of hampering factors of innovation by investigating the role played by the national innovation system and by remarking possible implications for innovation policy makers.

In order to evaluate the national effect on the perception of obstacles and on the determinants of obstacles, the analysis used data collected by the Fourth Community Innovation Survey in two different countries: France and Italy. The comparison of these two countries means comparing national innovation systems characterized by different performance, especially in sup-

plying innovation inputs to firms that are engaged in innovation on its territory firms. In particular, France, an innovation follower country, should back firms with more resources for innovation than Italy, a trailing country. Thus, the perception of obstacles to innovation could vary across countries. Moreover, differences in the national innovation system could lead to divergence in the factors that hamper firms' innovative activities.

The analysis is focused on the perception of obstacles and related determinants of innovators *i.e.* firms that are active in R&D activities and have introduced new products to the market or process innovation over 2002-2004. The attention paid towards only one innovative profile[1] is due to the findings of a previous study (Mancini, 2011) that highlights similarities in the perception of obstacles but differences in factors that generate them. Thus it is driven by the awareness that an overall study can lead to a distorted vision. The use of this specific innovative profile is due to the consensus of previous literature in remarking that more the firm is involved in R&D and innovative activities, the greater the importance it is likely to attach to obstacles to innovation (Baldwin and Lin, 2002; Mohnen and Rosa, 2000; Galia and Legros, 2004).

The structure of the paper is as follows. Section 2 provides a summary of previous empirical evidence on the nature of determinants of obstacles to innovation for innovators. Section 3 reports and comments on the findings of the statistical analysis that compares the perception of obstacles in France and in Italy, and the results of the econometric estimation studying determinants of obstacles across countries. The last section provides some concluding remarks and policy implications.

2.   Literature review: obstacles to innovation and National System of Innovation

Companies perceive several obstacles which may discourage them from undertaking innova-

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[1] Firms can be subdivided according to their attitudes towards innovation into three groups: innovators, innovative active and no-innovative active. Innovators are firms that develop product and/or process innovation. Innovative-active firms are firms that, although engaged in R&D activities, have not introduced innovation.Non-innovative active are firms that aren't engaged in any innovative activities.

tive activities or make it more difficult for them to achieve expected results from their engagement in R&D activities. During innovation development it could happen that financial resources are not enough to cover the high level of investment required by innovation projects. Further hampering effects are related to the lack of information about technology and market that are relevant to address innovative activities but whose collection is time-consuming, expensive and difficult to use. Other impediments are linked to organizational rigidities within the enterprise and institutional constraints. Thus, four sets of barriers are identified and usually studied: cost factors, knowledge factors, market factors and regulation factors.

Previous studies on barriers to innovation are mainly aimed at understanding their impact on firm's attitude towards R&D activities, types of innovation, propensity to innovate, intensity of innovation, decision to abandon prematurely or not starting projects, occasional and persistent innovators (Asso and Vito, 2010; Blanchard et al., 2011; Mohnen and Röller, 2001; Savignac, 2006; Segarra-Blasco et al., 2007; Hyytinen and Toivanen, 2005; Mohnen et al., 2008; Wziatek-Kubiak and Peczkowski, 2011). Thus, minor attention has been paid to the determinants of obstacles to innovation (Baldwin and Lin, 2001; D'Este et al., 2008; Galia and Legros, 2004; Hölzl and Janger, 2011; Iammarino et al., 2007; Mohnen and Rosa, 2000; Schneider and Veugelers, 2008; Tourigny and Le, 2004). These last studies investigate specifically complementarities among obstacles, the importance of impediments to the technology adoption process and also the impact of obstacles to non-innovative firms, to young innovative companies or to multinational enterprises versus domestic firms.

Past studies usually investigated the impact of sectors, firm size, group affiliation, nationality of the group and engagement in R&D. An overall outline of the determinants to the perception of barriers explored is indicated in Table 1.

Table 1. Factors explaining obstacles to innovation in previous literature

AUTHORS	Sectors	Tech. use	Innovator	N.of innovation activities	Competit. pressure	Firm's age	Firm's growth	Nation. of the group	N. of employees	Group affiliation
Baldwin and Lin (2001)	✓	✓	✓ (1)		✓	✓	✓	✓	✓	
D'Este et al. (2008)	✓			✓					✓	✓
Galia and Legros (2004)	✓							✓	✓	✓
Iammarino et al. (2007)	✓		✓ (2)					✓	✓	✓
Mohnen and Rosa (2000)	✓				✓				✓	
Schneider and Veugelers (2008)	✓					✓				
Tourigny and Le (2004)	✓				✓				✓	
Hölzl and Janger (2011)	✓						✓	✓	✓	✓

(1) if any innovating activity is introduced.
(2) if the firm introduced a product ot a process innovation

AUTHORS	Intern. market	Barrier related non inn.	Non barrier related non inn.	R&D	Training	Coop.	R&D exp.	Financial support	Novelty of innovation
Baldwin and Lin (2001)									
D'Este et al. (2008)	✓	✓	✓						
Galia and Legros (2004)				✓	✓	✓			
Iammarino et al. (2007)							✓		
Mohnen and Rosa (2000)				✓					
Schneider and Veugelers (2008)				✓					
Tourigny and Le (2004)								✓	✓
Hölzl and Janger (2011)	✓	✓		✓					

Also, these studies frequently deal with only one innovation profile or estimate the drivers of barriers without discriminating firms in terms of their attitude towards innovation. For instance, Iammarino et al. (2007) and Schneider and Veugelers (2008) investigate the determinants of barriers to innovation perceived by firms that have introduced product or process innovation. On the contrary, D'Este et al. (2008) focus on firms that have not introduced technological innovation because they have not reached successful outputs or they were not engaged in innovative activities. Galia and Legros (2004) pay attention to firms who abandoned or postponed projects.

Authors find that the larger the firm is, the less financial constraints it has (Iammarino et al., 2007; D'Este et al., 2008;Schneider and Veugelers, 2008) but the higher is the likelihood of organizational rigidities (Iammarino et al., 2007). Yet, conflicting results are obtained in relation to the impact of firm size on the perception of regulation-related barriers (Iammarino et al., 2007; D'Este et al., 2008). Financial constraints depend also on firm age and on the level of firms' innovation efforts. Young firms lack financial resources more that old ones (Schnei-

der and Veugelers, 2008) whilst the more the involvement in R&D activities the more the firm is hampered by financial constraints (Iammarino et al., 2007; D'Este et al., 2008). Furthermore, the globalization of commercial exchanges according to D'Este et al. (2008), imply that firms perceive less knowledge-related obstacles and regulation-related obstacles, but perceive more market-related barriers.

In other papers, the analysis is carried out on the full sample and variables representing the innovation profile are included in the model, thus preventing a direct comparison of the determinants. For instance, this happens in Baldwin and Lin (2001), which distinguishes among technology users, non technology users, innovators and non-innovators. In Hölzl and Janger (2011), they distinguish among R&D innovators, non-technology innovators, non barrier-related non-innovators and barrier related non-innovators.

Although several empirical evidences highlight that the availability and the nature of resources at firms' disposal to develop innovation are related to the national innovation system in which they operate (Lam and Lundvall, 2007), the relationship between barriers to innovation and the national innovation system has been underinvestigated (Borrás, 2004). In fact, only Hölzl and Janger (2011) have carried out an international comparison of 18 European countries using CIS4 and CIS 2004-2006 concerning obstacles to innovation. They made this comparison among four country groups[2].

According to Hölzl and Janger (2011), innovation barriers affect non-technology innovators and barrier-related innovators in country group 1 (including France) more than in the other country groups. Financial barriers are more relevant for firms in the other country groups while for skill constraints and innovation partners the largest differences are reported for country group 1. This holds especially for non-technological innovators. With regard to R&D innovators, they seem to be affected most by innovation barriers in country group 2, with the

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[2] Country group 1: Belgium, Denmark, Germany, Finland, France, Iceland, Luxemburg, Norway, Sweden; Country group 2: Czech Republic, Estonia, Hungary, Slovenia, Slovak Republic, Ireland; Country group 3: Spain, Italy, Portugal, Greece; Country group 4: Bulgaria, Lithuania, Latvia, Romania, Cyprus, Malta.

exception of lack of innovation partners. Authors found that high growth firms in country group 1 (including France) report in general that they were affected less by innovation barriers than high growth firms in the other country groups. Moreover, export active firms in country group 1 report in general that they are affected less by innovation barriers than export active firms in other country groups. Consequently, it may be presumed that French exporting firms will report fewer obstacles than the Italian exporting enterprises.

Main implications from these results are the following. Barriers to innovation are not one-dimensional but there seems to be a systemic interrelationship between the different deterring barriers to innovation for barrier related non-innovators. Innovation barriers across the board are lighter in countries closer to the technological frontier, than for countries more distant from the frontier. Financing constraints to innovative activity are assessed to be more relevant in countries distant to the frontier, while skill constraints are more relevant in frontier countries.

3. Objective, data and context of the empirical analysis

The main research goal of the present study is to supplement literature about obstacles to innovation by giving some insights about the role played by the institutional and operative context of the firm, in particular by the national innovation system, on the perception of barriers and on the determinants of the hampering factors.

Our paper contributes to the existing literature with a detailed comparison and study of the obstacles to innovation between two single countries, France and Italy, which have never been specifically compared on barriers to innovation.

3.1.   Data, variables and methodology

The analysis based on data collected by the Community Innovation Survey 2002-2004 (CIS4), the main source for measuring innovation in Europe that ensures comparability across countriesby exploiting a standard core questionnaire and by following an harmonised data collection process. The CIS provides us with data on innovation activities of enterprises, as well as various aspects of the innovation process such as the effects of innovation, sources of information used, research expenditures, perception of barriers to innovation, firm's strategy for the protection of intellectual property rights.

The dataset of the study comes out of the merger of French and Italian CIS4 and from the restriction to observations about manufacturing and business service firms that introduced between 2002 and 2004 at least one product and/or process innovation. Thus, the sample is made up by 4969 observations.

The dataset allows us to measure the perception of nine obstacles to innovation: the lack of internal financial resources, the lack of external financial resources, the high costs of innovation process, the lack of qualified personnel, the lack of technological information, the lack of information on market, the difficulty in finding R&D partners, deterrents induced by the domination of the marked by established firms and deterrents induced by 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 but not to indicate whether these problems represented an actual barrier that prevented companies from pursuing innovative activities, or slowed them down, or pressed firms to abandon their activities (Baldwin and Lin, 2002; Galia and Legros, 2004). Thus, in line with D'Este *et al.* (2008), Mohnen and Rosa (2000) and Lim and Shyamala (2007), the present analysis assumed that an impediment is really perceived only when it is assessed as highly important[3].

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[3] For each hampering factor firms are asked to evaluate if their activities have been constrained by it and how much it has affected the innovation activities by rating on a three-step scale starting from low to high degree of importance.

The determinants of obstacles to innovation are investigated by a multivariate probit model[4] that allows us to take into account the possible interdependence between the perception of different types of obstacles.

The variables included as regressors in the model are presented in Table 2. Considering previous empirical studies, the analysis investigates for the impact of firm's structural characteristics such as size, group membership, industry, types of innovation activities in which the firm is involved, public subsidies. Moreover, the model examines the role played by the openness of the firm, that measures the attitude towards the exploitation of external sources of information during the innovation development, and by the ability to appropriate the results of innovative activities. The impact of the national innovation system is studied by including the dummy Italy that takes into account the country-specific effect. We will introduce also interaction variables built by multiplying the regressors with the dummy Italy that allows us to control whether the effect of the regressor is different for France or Italy.

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[4] 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).

Firm characteristics	
Size	Logarithm base 10 of turnover 2004
Group	=1 if the firm belongs to a group
Mnf	=1 if the firm is a manufacturing firm
HiMediumTech	= 1 if the firm belongs to high or medium tech manufacturing industries or knowledge-intensive service industry
Int_mkt	=1 if the firm sold goods/services on international market
High growth	= 1 1 if the firm's turnover in 2004 is the 20% higher than in 2002
Innovation activities and attitude	
Appropriability (IPR)	= 1 if the exploitation of intellectual property rights by the firm is higher or equal to the average exploitation at industry level
No-tech inno	= 1 if the firm introduced organizational or marketing innovation in 2002-04
Intra R&D	=1 if the firm is engaged in internal R&D
Openness	Number of 'important' or 'very important' sources of innovation: internal, suppliers, customers, consultants competitors, universities, public research institutes, conferences, scientific and trade publications, and professional and industry associations (0-10)
External innovation activities (external inno)	Number of external innovation activities in which the firm has been engaged in 2002-04; the external innovation activities taken into account are the acquisition of machinery and equipment, the acquisition of external know-how, training activities to implement externally developed innovation, activities for the introduction of innovation on market.
Co	=1 if firm cooperated in R&S with other organizations in 2002-04
Public subsidies	
Public funds	=0 if the firm did not receive a public financial support for innovation in 2002-04 =1 if the firm received a National or European public financial support for innovation in 2002-04 =2 if the firm received both National and European public financial supports for innovation in 2002-04
Country effect	
Italy	=1 if the firm is Italian
Interacted variables	
All predictors above described multiplied by the dummy Italy	

Sources: CIS 4 (France and Italy)

Table 2. Independent Variables

3.2 French and Italian innovation systems

Although the creation of the French and Italian innovation systems started in the same historical period (*i.e.* the post-Second World War period), and thereby in a similar industrial context, they are characterised by specific features that differentiate one from the other. France is characterized by a dual higher education system based on the "Grandes Écoles" graduates that makes available highly qualified personnel. Moreover, the French innovation system is characterised by the pervasive involvement of the State in the production not just of general scientific and technical knowledge, but often of technology per se in the form of patentable or usable products and production processes (Chesnais, 1993). The Italian system is based on two main components: the small firm network composed by a large population of small and medium firms which interact at a local level. These firms are engaged in rapid adoption of external generated technology and share their adaptation and continuous improvement. The core R&D system is composed of large firms, small high-technology firms, universities, public research institutes which perform fundamental research and develop new technologies (Malerba, 1993). Differences in members, structure and organization turn into differences in performance.

In the European Innovation Scoreboard (EIS) 2006, that provides a comparative assessment of the innovation performance of the EU Member States in the period investigated by our analysis, France and Italy belong to different country-groups. According to the value and the trend of the Summary Innovation Index (SII)[5], that provides an aggregate overview, France is an "innovation follower" country characterised by a SII score (i.e. 0.48) above the average EU25 and a performance growth below the EU25. Italy is defined as a "trailing" country with both SII score and growth rate below the EU25 (i.e. 0.34 and -1.0 respectively). The greatest difference is in the innovation drivers, the structural conditions required for innovation capacities. France and Italy mainly differ in the number of new S&E (science and engineering) graduates

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[5] The Summary Innovation Index (SII) is estimated as the arithmetic means of the 25 indicators' normalized values that measure innovation drivers, knowledge creation, innovation and entrepreneurship, applications and intellectual property rights at country level.

(22.0 against 10.1 per 1000 population aged 20-29) and in the percentage of population with a third level education (24.9 against 12.2). This underlines different the availability of advanced skills and, as a consequence, a different challenge in the recruitment of qualified personnel. France and Italy also differ in the allocation of financial resources to innovation activities as testified by data on public and private R&D expenditures. For example, in France public R&D expenditures are 0.79% of GDP whilst in Italy are 0.56% whilst business R&D expenditures in France are 1.32% of GDP against 0.55% in Italy. The data also testifies that investment in equipment and machinery, in acquisition of patents and licenses, and other activities of relevance to innovation differ (2.23% against 1.81% of turnover). France and Italy are dissimilar also in the exploitation of cooperation by SMEs and in the availability of venture capital funds. In particular, French SMEs are more prone to enjoy R&D cooperative agreements (i.e. 11.5% of French SMEs are engaged in R&D cooperation compared to only 4.3% of Italian SMEs). Early stage venture capital in France is 0.03% of GDP whilst in Italy is 0.002%.

Looking at innovation outputs and intellectual property rights, differences between France and Italy are not so significant. The percentage of sales of new-to-market products and new-to-firm products are very similar. The main difference is in exports of high tech products that are higher in France. Similarities are recorded in the exploitation of intellectual property rights. Yet, Italian appropriability strategy is based on trademarks and industrial designs while French enterprises protect their innovations mainly by patents.

3.2. Perception of obstacles by Innovators in France and Italy

Looking at the perception of obstacles to innovation by French and Italian Innovators and comparing it with the barriers experienced by other firms (i.e. firms that have not developed technological innovation although engaged in innovative activities and firms that are not involved in any innovative activities)[6], we find results that are not in accordance with the exist-

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[6] We have carried out statistical analysis that compare the perception of obstacles to innovation across innovation profiles in order to understand if firm's innovation attitude impact on barriers to innvation. The results of the comparative analysis and related test are available on request.

ing literature. The evidence shows that innovators group has not always the much higher share of firms assessing hampering factors as highly important. In particular, Italian innovators usually perceive less obstacles than other firms with the exception of external financial constraints. French innovators perceive market factors and lack of information as obstacles more often than other firms whilst are less affected by hampering factors related to innovation costs and financial resources, by the lack of qualified personnel and by the difficulty to find partners. Thus, these findings are not always consistent with the argument that innovators are more likely to experience barriers to innovation (Arundel, 1997; Baldwin and Lin, 2002; Iammarino et al., 2007).

By focusing only on innovators and comparing the perception of obstacles across the two countries (Table 3), we highlight that, while the less diffused obstacle to innovation both in France and in Italy is the lack of information on technology, the most hampering factor affecting Italian firms is different from the greatest obstacle perceived by French ones. For French firms the most frequent obstacle to innovation faced by firms is the lack of internal financial resources while Italian firms are more hampered by external financial resources and the perception of high innovation costs. The major role of external financial constraints is in line with the characteristics of the Italian national innovation systems that induce lack of venture capital funds.

However, it has to be remarked that Italian Innovators, compared to French ones, are less likely to face obstacles concerning the most part of impediments, except for external financial constraints, lack of information on technology and difficulty on finding cooperation partners. The difference in the absolute magnitude of the perception of obstacles between France and Italy seems to be in conflict with the idea that the national innovation system affects the perception of hampering factors as the Italian NIS provide less innovation inputs for firms than for the French one. However, by looking at each specific kind of impediment, the analysis highlights that factors that are lacking in the Italian national innovation system have an higher impact in Italy. This remarks the role of the NIS.

Table 3. Perception of obstacles by French and Italian Innovators

	France	Italy	chi2(1)	Pr
Internal financial constraints	30%	19%	91.298	0.000
External financial constraints	10%	22%	150.96	0.000
Innovation costs too high	26%	22%	7.9531	0.005
Lack of qualified personnel	14%	10%	16.614	0.000
Lack of information on technology	4%	5%	2.9855	0.084
Lack of information on markets	7%	6%	0.0742	0.785
Difficulty on finding cooperation partners	10%	11%	2.9518	0.086
Market dominated by established firms	18%	16%	7.3044	0.007
Uncertain demand for innovative goods or services	19%	13%	33.949	0.000

3.3 Determinants of obstacles to innovation in France and Italy

As the econometric analysis deals with the factors affecting perception of obstacles to innovation by innovators, our findings regard barriers that may slow but not prevent firm's engagement in innovation activity (i.e. revealed barriers).

The global output of the multivariate probit model estimation is reported in Appendix. In this section we re-organize the results of the econometric analysis in order to highlight the determinants that affect both French and Italian firms and those that affect them in different ways. In particular, we separate the interacted variables from the other regressors.

3.3.1 Factors that affect both French and Italian innovators

Structural characteristics of the firm influence the perception of cost, knowledge and market barriers. Large enterprises generally perceived less obstacles than other firms apart from the barriers related to the lack of information about technology and market. Thus, although the large size provide firms with more resources, they are not enough to collect information that is usually taken into account to direct innovation activities. The belonging to a group reduces the perception of internal financial constraints, the lack of qualified personnel and the difficulty to find valid R&D partners. This implies that the opportunities to share financial and human resources within the group as well as the cooperation at group level are valuable asset for innovators. Belonging to a manufacturing industry leads to an higher perception of high costs of innovation and an higher hampering effect of the presence of established firm in the market. This let us suppose that the R&D investments and efforts required to manufacturing firms to enter and succeed the market power of leading companies are higher than those required by service firms. Firms belonging to an high tech industry perceive less the lack of market information and obstacles due to the uncertainty of demand. This counterintuitive finding remarks that, although their innovation activities are uncertain and affected by the lack of information about market, high tech firms do not care about this as their goal is to bring forward customers' needs.

The commercialization of goods and services on international market provide companies with an access to qualified personnel. Firms with a turnover growth rate higher than 20% are less affected by the lack of technological information as they probably are well-established at financial level and less exposed to failure of product innovation introduction to the market.

Findings highlight also that innovation attitude affects the barriers to innovation. The ability to appropriate results thanks to intellectual property rights reduces the perception of high costs of innovation as it guarantees to the firms the recovery of their investments.

Table 4. Common determinants of obstacles to innovation in France and Italy

	Cost Factors			Knowledge Factors				Market Factors	
	Internal financial constraints	External financial constraints	Innovation costs too high	Lack of qualified personnel	Lack of info about technology	Lack of info about market	Difficulty in finding valuable R&D partner	Market dominated	Uncertain demand
Size	(-)***	(-)***	(-)***	(-)***			(-)***	(-)***	(-)*
Group	(-)***			(-)**			(-)***		
Mnf			(+)*					(+)***	
HiMediumTech					(-)***	(-)**			
Int Market				(-)*					
High growth					(-)**				
IPR			(-)**						
Openness	(+)**	(+)*				(+)*	(+)**	(+)***	
External inno			(+)**		(+)***		(+)**		
Cooperation							(+)**		
Public funds	(+)***	(+)***	(+)**						

Sources: CIS 4 (France and Italy)

The exploitation of external sources of information enhances the perception of financial constraints, the lack of market information and the difficulty in finding valuable R&D partners. An explanation of the impact on financial constraints is the large amount of resources needed to collect external information and to develop inter-organizational relationships that allow to access external sources of information.

External R&D activities, against internal ones, seem to enhance the barriers to innovation. In particular, it seems that the exploitation of open innovation strategies enhances costs of innovation development and do not reduce, as was expected, the lack of information about technology and difficulties in finding valuable R&D partners. This means that the acquisition of tangible and intangible know-how, training activities to implement innovation developed outside firms and efforts to launch new product into the market imply weak inter-organizational relationships that do not provide externalities like information sharing. Moreover, findings suggest that firms that cooperate in R&D, being more likely to experience the difficulty to coordinate R&D activities at inter-organizational level and to share research goals with other organizations, are more likely to recognize and perceive the difficulty to find valid R&D partners. Surprisingly, financial supports given by EU do not help firms in overcoming external financial constraints and high costs of innovation as well as the lack of information.

3.3.2 Differences between France and Italy

Looking at the results concerning interacted variables and the dummy Italy that control for the differences in the determinants of barriers to innovation between France and Italy, we find that the difficulty in finding valuable R&D partners and to overcome the troubles due to the uncertainty of market demand are caused by the same factors in France and Italy. The perception of all the other barriers is, instead, affected by different factors or in different ways by the same factors in the two examined countries. In particular, there is a factor (i.e. the engagement in non-technological innovation) that determine the perception of obstacles to innovation only in Italy, those that have an higher or lower influence in Italy (e.g. size, the belonging to a group and those that affect the perception of a greater number of obstacles (e.g. high-tech, cooperation). The only three factors that have the same impact across countriesare "international market", "openness" and "public funds". The greater difference in the determinants are observed in relation to external financial constraints, lack of information about technology and the deterrents exerted by the presence of leading companies in the market.

The country-effect, measured by the dummy Italy that in particular checks for the impact of the characteristics of the industrial structure and national innovation system that are not explicitly control by interacted variables is significant only for two barriers to innovation: external financial constraints and the lack of qualified personnel. This is not surprisingly since the availability of external financial resources for innovation and high skilled human resources are the two features in which the two countries mostly differ. Yet, whilst the results about external financial constraints are in line with our expectations, the ones regarding the lack of qualified personnel are not. Findings remark that Italian firms fall the difficulty in find external financial resources more than French ones. This is probably due to the lower availability of venture capital funds in Italy. Findings remark that Italian firms fell themselves less constrained by the lack of qualifies personnel, although educational statistics highlight a lower percentage of S&E graduates in Italy. This result let us suppose that the needs of high skilled human resources of Italian firms are lower.

Looking in more detail to factors with different impacts, we note that the engagement in non-technological innovation makes Italian firms perceive external financial constraints and deterrents created by the presence of market leading firms. Thus, investments and engagement in no-technological innovation interact with resources devoted to technological innovation by lowering available resources and lead to a greater perception of the lack of external resources.

Beyond the effect observed in the previous section, industry, practices of open innovation and the exploitation of IPR, impact also on the perception of external financial constraints, lack of qualified personnel and market information and the discouragement played by leading firms. In particular, innovation activities of Italian manufacturing firms are constrained also by the lack of market information whilst Italian firms specialized in high-medium tech industry limit their engagement in the development of innovation if they play in a dominated market. On the contrary, firms that exploit external modes of innovation are less affected by this barrier. In Italy, external financial constraints are more frequent in cooperative firms and firms that exploit IPR. The lack of qualified personnel is accentuated by the exploitation of cooperative agreements. The counter-intuitive findings about cooperation, that theoretically is a tool to

overcome internal barriers to innovation, can be explained taking into account the less propensity to cooperate by Italian firms that means a too low experience of Italian firms in cooperative agreements and consequently the ineffectiveness of cooperation and the inability to access to partners' resources or to exploit the synergies among partners' human resources.

As regards the different intensity in the impact of some determinants, it is interesting to highlight that Italian big companies less complain high costs of innovation than French ones although the turnover of French firms is higher on average of Italian firms, that is to say although French firms have more profit to invest in R&D. This could be mean that French and Italian firms may differ in the nature of R&D project with French firms involved in more challenging ones. The belonging to a group by Italian firms does not provide the same access to financial resources obtained by French firms. In fact, the impact of the variable "group" is lower for Italian firms. This is due to the smaller size of Italian group of firms.

Italian firms that exploit external R&D modes are less affected by the lack of information about technology than French ones. Firm's relationships inside Italian industrial districts probably make easier the access to this kind of information.

Table 5. Differences in factors determining barriers to innovation

	Cost Factors			Knowledge Factors				Market Factors	
	Internal financial cons-traints	External financial cons-traints	Innova-tion costs too high	Lack of qualified person-nel	Lack of info about technology	Lack of info about market	Difficulty in finding valuable R&D partner	Market dominated	Uncertain demand
Size*Italy			(-)***						
Group*Italy	(+)**								
Mnf*Italy						(+)**			
HiMediumTech*Italy					(+)*			(+)**	
High growth*Italy					(+)*				
IPR*Italy		(+)**							
No-Tech inno*Italy		(+)**						(+)*	
External inno*Italy					(-)**			(-)*	
Cooperation*Italy		(+)*		(+)*					
Italy		(+)**		(-)***					

Sources: CIS 4 (France and Italy)

4. Conclusion and policy implications

Exploring the determinants of obstacles to innovation faced by innovators in France and Italy permits to elaborate policy implications. Compared to previous literature, the novelty of the paper includes a detailed international comparison of two countries and an in-depth analysis of factors that influence barriers to innovation.

Main results from a multivariate analysis tend to show that two different public policies should occur in order to help firms in overcoming barriers to innovation. On the one hand, the ones that aim at correct for the common determinants of obstacles to innovation across coun-

tries. On the other hand, country-specific policies that focuses on the peculiar factors that enhance the perception of obstacles in each Country.

First, concerning policy implications that are similar in France and Italy, we found that structural characteristics of the firm influence the perception of cost, knowledge and market barriers. Large firm generally perceived less obstacles than other firms except the barriers related to the lack of information about technology and market. Belonging to a group reduces the perception of internal financial constraints, the lack of qualified personnel and the difficulty to find R&D partners. Firms in manufacturing industry perceive more the high costs of innovation and the presence of established firm in the market. Firms in high tech industry perceive less the lack of market information and obstacles due to the uncertainty of demand. Using intellectual property rights reduces the perception of high costs of innovation. Using external sources of information enhances the perception of financial constraints, the lack of market information and the difficulty to find R&D partners. External R&D activities, against internal ones, seem to enhance the barriers to innovation. Moreover, findings suggest that firms that cooperate in R&D are more likely to recognize and perceive the difficulty to find valid R&D partners.

As a consequence, France and Italy can create or foster policies that focus on SMEs. Government can enhance firms' communication concerning innovation activities including internal and external R&D, cooperation and group membership within clusters of innovation for example.

Second, France and Italy policies dedicated to innovators have to be specific and targeted. The greater difference in the determinants are linked to external financial constraints, lack of information about technology and the presence of leading companies in the market. Findings imply that Italian firms faced more the difficulty of finding external financial resources than French ones. Italian firms fell themselves less constrained by the lack of qualified personnel. We find that the engagement in non-technological innovation makes Italian firms perceive external financial constraints and deterrents created by the presence of market leading firms.

In particular, innovation activities of Italian manufacturing firms are constrained also by the lack of market information whilst Italian firms specialized in high-medium tech industry limit their engagement in the development of innovation if they play in a dominated market. In Italy, external financial constraints are more frequent in cooperative firms and firms that exploit IPR. The lack of qualified personnel is accentuated by the exploitation of cooperative agreements. Large Italian firms less complain about high costs of innovation than French ones. Italian firms by belong to a group does not provide the same access to financial resources obtained by French firms. Italian firms that exploit external R&D modes are less affected by the lack of information about technology than French ones.

As a consequence, Italian policies for innovation should target the improvement of a financial market for innovation more than French ones while Italian expenditures for the education and training of high-skilled human resources should be less than French ones. Moreover, the attention paid to helps for high tech manufacturing firms belonging to group should be higher in Italy than in France. Italy should help firms to improve their cooperative abilities.

Many questions remain, partly due to the amount of information contained in CIS4. First, our study relies on information from a single wave of CIS, and with the emergence of panels of CIS data for some countries including France and Italy, it will be possible to investigate these relationships between firms' profiles and obstacles to innovation with greater statistical precision and rigor. Second, a more disaggregated analysis of sectors distinguishing for instance manufacturing and services would be useful. This distinction will permit to investigate more deeply policies implication in each country. Third, it would be fruitful to link information focused on obstacles to innovation and cooperation. Furthermore, it would be worthwhile to study this link in order to explore the cooperation strategy as a factor that deters or enhance innovation. Of course, the greater the number of forms of innovation, innovation activities and related profiles, the more challenging it will be to make sense of the innovation policies that emerge between them.

However attempts to compare determinants of obstacles to innovation among countries offer the potential to learn more about innovation policies and provide lessons for managers and policy-makers.

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APPENDIX: Outputs of the multivariate probit model estimation on French and Italian Innovators

	Internal financial constraints	External financial constraints	Innovation costs too high	Lack of qualified personnel	Lack of info about technology	Lack of info about market	Difficulty in finding valuable R&D partner	Market dominated	Uncertain demand
Firm characteristics									
Size	-0.294(0.041)***	-0.159(0.050)***	-0.149(0.041)***	-0.251(0.051)***	-0.097(0.073)	-0.077(0.059)	-0.221(0.053)***	-0.160(0.044)***	-0.076(0.043)*
Group	-0.206(0.064)***	-0.030(0.079)	-0.038(0.066)	-0.156(0.076)**	-0.165(0.113)	-0.057(0.094)	-0.227(0.082)***	-0.039(0.071)	-0.100(0.070)
Mnf	0.022(0.077)	-0.036(0.093)	0.140(0.080)*	0.122(0.095)	-0.082(0.149)	-0.162(0.109)	0.076(0.099)	0.312(0.089)***	0.040(0.084)
HiMediumTech	0.022(0.056)	-0.005(0.071)	-0.035(0.056)	-0.091(0.067)	-0.379(0.101)***	-0.185(0.081)**	-0.112(0.073)	-0.003(0.060)	-0.134(0.059)**
Int_mkt	0.005(0.072)	0.009(0.091)	-0.064(0.073)	-0.148(0.082)*	0.075(0.132)	0.010(0.105)	-0.133(0.091)	0.077(0.082)	-0.012(0.077)
High growth rate	-0.048(0.082)	0.039(0.098)	-0.061(0.083)	-0.125(0.102)	-0.367(0.193)*	0.065(0.112)	-0.010(0.104)	-0.187(0.094)	-0.109(0.090)
Innovation attitude and activities									
Appropriability (IPR)	-0.085(0.057)	-0.088(0.071)	-0.111(0.058)**	0.089(0.069)	-0.002(0.103)	-0.130(0.081)	-0.013(0.075)	-0.020(0.063)	-0.046(0.062)
No-technological inno	0.027(0.062)	-0.103(0.075)	-0.021(0.062)	0.137(0.075)	0.116(0.116)	-0.050(0.089)	0.125(0.084)	0.030(0.068)	-0.014(0.066)
Intra R&D	0.134(0.095)	0.113(0.123)	-0.090(0.093)	-0.104(0.104)	0.188(0.177)	0.060(0.140)	0.111(0.127)	-0.024(0.102)	-0.057(0.098)
Openness	0.028(0.062)**	0.027(0.016)*	0.013(0.013)	-0.007(0.016)	0.019(0.023)	0.036(0.018)*	0.034(0.017)**	0.055(0.014)***	0.020(0.014)
External inno activities	-0.008(0.020)	0.130(0.252)	0.045(0.020)**	0.018(0.024)	0.095(0.036)***	0.029(0.029)	0.067(0.026)**	0.033(0.022)	0.013(0.021)
Co	0.036(0.057)	0.261(0.072)	0.034(0.057)	-0.029(0.068)	-0.081(0.100)	0.081(0.082)	0.188(0.074)**	-0.011(0.062)	0.064(0.060)
Public subsidies									
Public funds	0.129(0.044)***	0.190(0.052)***	0.090(0.045)**	-0.049(0.056)	-0.100(0.087)	0.030(0.063)	0.002(0.056)	-0.011(0.049)	0.034(0.048)
Country effect									
Italy	-0.370(0.277)	0.607(0.301)**	0.369(0.272)	-1.042(0.340)***	-0.069(0.467)	-0.296(0.397)	-0.137(0.344)	-0.168(0.296)	0.072(0.300)
Interacted variables									
Size*Italy	-0.050(0.071)	-0.100(0.075)	-0.191(0.069)***	0.032(0.085)	0.006(0.113)	-0.118(0.100)	-0.039(0.086)	-0.028(0.074)	-0.075(0.077)
Group*Italy	0.240(0.104)**	-0.152(0.112)	-0.067(0.103)	0.004(0.123)	0.101(0.167)	0.080(0.148)	0.057(0.126)	0.063(0.111)	0.006(0.114)
Mnf*Italy	-0.125(0.127)	0.056(0.135)	0.093(0.128)	0.128(0.157)	0.240(0.223)	0.372(0.185)**	0.177(0.158)	-0.044(0.139)	-0.099(0.138)
HiMediumTech*Italy	0.002(0.092)	0.084(0.100)	-0.008(0.089)	0.127(0.108)	0.244(0.145)*	0.167(0.128)	0.047(0.110)	0.247(0.097)**	0.148(0.099)
Int_mkt*Italy	0.068(0.109)	-0.060(0.120)	0.026(0.107)	0.100(0.127)	-0.020(0.180)	-0.117(0.154)	0,120(0.130)	-0.143(0.118)	-0.037(0.117)
High growth rate*Italy	-0.097(0.127)	-0.083(0.134)	-0.166(0.126)	0.229(0.148)	0.396(0.237)*	-0.300(0.184)	-0.092(0.153)	0.188(0.137)	-0.041(0.141)
IPR*Italy	0.044(0.911)	0.178(0.098)*	0.037(0.090)	-0.062(0.108)	0.051(0.145)	0.373(0.127)***	0.150(0.110)	0.110(0.097)	0.046(0.099)
No-technological inno*Italy	0.082(0.098)	0.232(0.105)**	0.179(0.096)	-0.150(0.117)	0.107(0.165)	0.123(0.141)	0.121(0.124)	0.184(0.106)*	-0.116(0.104)
Intra R&D*Italy	-0.031(0.133)	0.018(0.154)	-0.061(0.127)	0.208(0.155)	-0.251(0.222)	-0.193(0.191)	-0.026(0.169)	-0.011(0.141)	0.046(0.139)
Openness*Italy	-0.001(0.021)	-0.005(0.023)	0.023(0,021)	0.034(0.025)	0.022(0.033)	0.019(0.029)	-0.003(0.025)	0.010(0.022)	0.010(0.023)
External inno activities*Italy	-0.016(0.034)	-0.018(0.037)	-0.026(0.033)	0.039(0.041)	-0.131(0.055)**	0.063(0.049)	-0.049(0.041)	-0.070(0.364)*	-0.047(0.038)
Co*Italy	0.069(0.099)	0.197(0.106)*	0.077(0.097)	0.233(0.115)**	0.020(0.157)	-0.064(0.139)	-0.021(0.118)	0.052(0.105)	-0.014(0.109)
Public funds*Italy	-0.043(0.076)	-0.110(0.079)	0.013(0.074)	-0.004(0.093)	0.154(0.125)	-0.100(0.107)	-0.018(0.091)	0.039(0.081)	0.056(0.083)

Sources: CIS 4 (France and Italy)

Standard error in parenthesis; *p<0.10; ** p<0.05; ***p<0.01

No. total observations 4969; Log likelihood= -15749.512 Wald chi2(243)=1063.70***

Likelihood ratio test
rho21=rho31=rho41=rho51=rho61=rho71=rho81=rho91=rho32=rho42=rho52=rho62=rho72=rho82=rho92=rho43=rho53=rho63=rho73=rho83=rho93=rho54=rho64=rho74=rho84=rho94=rho75=rho85=rho95=rho76=rho86=rho96=rho87=rho97=rho98
=0 chi2(36)=2478.02 prob>chi2=0.000