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The perception of obstacles to innovation. Multinational and domestic firms in Italy

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Abstract

This paper looks at the perception of obstacles to innovation of both multinational enterprises (MNEs) and domestic firms located in Italy. Drawing on data from the firm-level Italian CIS3, we first explore to what extent innovative behaviours are both firm- (i.e. foreign- versus nationally-owned multinationals, MNEs versus single domestic firms) and region-specific. We then examine whether the perception of obstacles to innovation varies among types of firms and regions.

JEL Classification: **O3, F23, R3**

Keywords: **obstacles to innovation, multinational firms, innovation processes, regional location.**

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1. Introduction

The intense debate on the globalisation of innovation has focused attention on multinational enterprises (MNEs) as major creators of innovation across national boundaries. The development of cross-border corporate integration and intra-border, inter-company sectoral integration makes it increasingly important to examine the link between multinational expansion and innovativeness, and where and how innovative activities are internationally dispersed and regionally concentrated. Notwithstanding the ongoing and lively debate on the role of MNEs in systems of innovation, little information is available on the (sub-national) location and innovation behaviours of foreign MNEs relative to those of domestic firms, and on the (beneficial or detrimental) interplay between MNEs' innovative activities and host contexts.

This paper aims to produce some fresh insights on these issues, which are crucial for an advanced economy such as Italy with relatively weak multinationality and attractiveness for foreign firms. We focus on firm and regional differences in the perception of obstacles to innovation. These latter may have a key role in shaping the characteristics of the local technological environment. We first explore to what extent innovative behaviours are firm- (i.e. foreign- versus nationally-owned multinationals, MNEs versus single domestic firms) and context-specific. We then specifically address the following research questions: Does the perception of the importance of obstacles to innovation vary among types of firms and regions? And is this perception influenced by firms' innovativeness?

The paper is structured as follows. The next section summarises the literature background to the interaction between multinational expansion, innovative processes, and the characteristics of local environments. Section 3 briefly refers to the (few) empirical contributions that focus on the nature and relevance of obstacles and factors that slow down innovation activities. Section 4 provides a description of the third Community Innovation Survey (CIS3) firm-level sample, and of firms' innovative activities in the Italian macro-regions; descriptive evidence on the perception of the obstacles to innovation across areas and type of firm is reported. The model used to explore the factors affecting the probability of perceiving the obstacles as important is also specified here. Section 5 discusses the results of the econometric tests for

both the whole sample, and the sub-samples of firms. Finally, Section 6 summarises the empirical evidence and highlights some general implications.

2. Multinational firms, innovation and local environments

Innovation has been long recognised as a crucial factor in determining the growth and competitiveness of firms. In trying to understand which factors affect firms' propensity to innovate and their ability to source external knowledge, the theoretical and empirical literature has shown that there is a tight link between multinational expansion and the innovative activities of firms, and that MNEs may influence host locations in terms of both competition and technological advantages. The interpretations of the link between multinationality and innovativeness have been pointed to by different theoretical approaches.

According to traditional industrial economics, based on the 'linear' model of technological processes, the degree of internationalisation or multinational expansion is seen as a function of the firm's R&D-intensity, which basically serves as a proxy for the level and complexity of accumulated competence (underlying a narrow definition of technology and innovation)In the conventional industrial organisation view R&D leads to cost reduction and higher quality, increased corporate competitiveness and larger market shares, and stronger multinational expansion (e.g. Dunning, 1958, 1970; Markusen, 1984). Within the transaction cost theories of the firm, R&D activities generate more intensive knowledge flows and a greater complexity in transactions, which in turn leads to a greater degree of vertical integration, industrial concentration, and multinationality (e.g. Buckley and Casson, 1976; Hennart, 1977, 1982; Rugman, 1981).

Schumpeterian approaches emphasise instead the two-way relationship between multinational expansion and innovation. High R&D-intensity and internationalisation are both handmaidens to the accumulation of technological competence. This is partially tacit, and provides firms with inherent capabilities through learning in production; more effective learning creates greater competence, increased market shares and multinationality (e.g. Cantwell, 1989, 1995; Patel and Pavitt, 1991; Kuemmerle, 1999; Petit and Sanna Randaccio, 2000). More recently, following the developments of the evolutionary theory of the firm (Nelson and Winter, 1982), increased attention has been devoted to the importance of the characteristics of local innovation systems in attracting foreign investments in innovative activities. It has been shown that the external technological environments generating spillovers are an important

pull factor attracting foreign firms and affecting the propensity of firms to innovate. MNEs have been increasingly regarded as evolving organisations strongly interacting with socio-economic environments in both the home and the host locations (e.g. Teece, 1977; Dosi et al., 1990; Dunning, 2000; Frenz and Ietto-Gillies, 2007).

Beyond the different interpretations of the relationship between multinational expansion and innovation, it still remains true that R&D functions (part of a wider innovation process) gain in importance as technological progress becomes more complex. MNEs, which on average have relatively high levels of accumulated competence, tend to be more research-intensive than other (domestic) firms in the same industry.

In current times, technological accumulation is frequently organised by modern MNEs in international networks of technological activity; such networks represent the strategic integration of geographically distinct paths of innovation (Cantwell, 1995; Dunning and Wymbs, 1999). Attention has therefore shifted from the MNE as a mere vehicle of technology transfer towards its crucial role as a cross-borders creator of innovation and technical knowledge (e.g. Chesnais, 1988; Pearce, 1989; Cantwell, 1989; Granstrand et al., 1992; Birkinshaw, 1996; Niosi, 1999; Ietto-Gillies, 2001). Firms establish integrated networks of affiliates in different locations in order to build up sustainable competitive advantage based more on capabilities and dynamic improvements than on static efficiency criteria (e.g. Malmberg et al., 1996; Zanfei, 2000; Frost, 2001; Castellani and Zanfei, 2002; Veugelers and Cassiman, 2004).

The extent to which MNEs engage in innovative activities depend upon both their technological strategy, and the characteristics of the host environment (e.g. Blomström et al., 1994; Pearce and Papanastasiou, 1999; Cantwell and Piscitello, 2002; Cantwell and Iammarino, 2003; Sanna-Randaccio, 2002). The importance of contextual factors and systemic interactions is a logical consequence of the interactive model, which puts emphasis on the relations with knowledge sources external to the firm. Such relations – at inter-firm level, between firms and the science infrastructure, between the business sector and the institutional environment, etc. – are strongly influenced by spatial proximity that favours cumulative processes (e.g. Lundvall, 1988; von Hippel, 1989; Boschma and Lambooy, 1999; Garofoli, 2003; Simmie, 2003).

Obstacles to innovation – of different nature, i.e. economic/financial, organisational, institutional, etc., and largely context-specific – may have a key role in shaping the

characteristics of the external technological environment, and thus also in determining the attractiveness of a region for MNE and local firms. The decision of (both nationally-owned and foreign-owned) firms to locate in particular areas and to engage in innovative activities might be affected, ceteris paribus, by their evaluation of the difficulties that will be encountered in the process of innovation.

This might be the case in a country such as Italy, which historically has been characterised by strong territorial imbalances that are among the sharpest in the European Union. The empirical literature has in fact shown that the territorial distribution of innovation in Italy turns out to be highly concentrated in a very few regions (among others, Silvani et al., 1993; Iammarino et al., 1998; Evangelista et al., 2001, 2002). Regional innovation patterns differ not only with respect to the specific strategies and technological performances of firms, but also in terms of the relevance of systemic interactions and contextual factors favourable (or unfavourable) to innovation (i.e. obstacles). Proper regional systems of innovation are found only in a few (northern) areas: in most regions, systemic interactions and knowledge flows between the relevant actors are simply too sparse and weak to show systems of innovation at work (Evangelista et al., 2001).[1]

In this paper, the main conjecture is that, other things being equal, the perception of obstacles to innovation depends on the type of firm by ownership and organisational structure. Further, firms tend to face different types of problems depending on their socio-economic and institutional context. Should the evidence support this conjecture, it will have important implications in terms of regional and innovation policy, and public intervention.

3. Obstacles to innovation in innovation surveys

The empirical literature drawing on the evidence provided by the European CIS and exploring the nature and characteristics of technological innovation across firms and sectors is large and

[1] In line with these results, Cantwell and Iammarino (2003) found that the technological activities of foreign-owned MNEs tend to be even more agglomerated at the sub-national level than those of their domestic counterparts (large nationally-owned MNEs), and that a geographical hierarchy of regional centres in Italy could be established on the basis of different types of agglomeration forces across the national space. These findings again support the fact that the majority of Italian regions lag behind, not only in terms of domestic innovative activity, but also, and even more, in terms of the absolute level of foreign-owned innovation that they are able to attract.

consolidated (for the Italian CIS see, among others, Archibugi et al., 1991; Evangelista et al., 1997).

However, rather fewer contributions have analysed the role of obstacles, the extent to which they actually hamper or slow down innovation, and the factors affecting their perception, at least as (qualitatively) assessed by the firms themselves. The contributions of Arundel (1997), Mohnen and Rosa (2000), Mohnen and Röller (2001), Baldwin and Lin (2002), Galia and Legros (2004) and Tourigny and Le (2004) are based on Canadian and French innovation survey data. Most of this work focuses on differences in firms' characteristics that may affect the perception of obstacles, and the extent of complementarities among individual obstacles, which are claimed to be crucial in drawing policy implications.

The empirical evidence provided by these contributions is surprisingly unanimous in showing that the more a firm is involved in research and development (R&D) and innovative activities, the greater the importance it is likely to attach to the obstacles to innovation. For instance, Baldwin and Lin (2002), building on Arundel (1997), examined whether the perception of obstacles does discriminate between innovators and non-innovators (adopters of advanced technologies *vis à vis* non-adopters in the case analysed by Baldwin and Lin), and then estimated whether such perception affects the intensity of innovation amongst the sub-population of innovators. They found that a larger proportion of innovators than non-innovators evaluated the obstacles as relevant in affecting their innovative activities. Furthermore, in the sub-set of innovators, the perception of obstacles was more relevant for firms displaying characteristics usually conducive to both high innovation intensity – i.e. bigger and older firms in high tech sectors – and R&D investment *tout court.*

Mohnen and Rosa (1999) carried out a similar empirical analysis in the case of Canadian services over the period 1996-1998, confining their test to innovators only, and using R&D intensity as a proxy for innovation intensity. Galia and Legros (2004) conducted an analysis based on CIS2 data for French manufacturing firms in order to identify complementarities amongst obstacles and derive policy implications regarding *sets* of obstacles rather than single obstacles. Also these contributions point to a positive association between the propensity/intensity of innovation and the likelihood of perceiving as very relevant the obstacles to innovative activities.

The empirical stylised fact of a positive link between innovation propensity/intensity and the likelihood of evaluating as crucial the barriers to innovation calls for interpretation. The

empirical literature tends, to some extent, to discard the original interpretation of an obstacle in the CIS questionnaire – i.e. a factor hampering or slowing down innovation – and to consider firms' assessment of these obstacles as a measure of their ability to overcome them. More particularly, Baldwin and Lin (2002) and Galia and Legros (2004) offer a dual interpretation. First, the mere fact of carrying out innovation activity increases firms' awareness of the difficulties that will likely be encountered, without necessarily preventing them from pursuing innovation projects. Secondly, the actual formulation of the CIS question on obstacles generally leads firms to evaluate the problems they have faced (and overcome) in carrying out innovation activities, but not to indicate whether these problems represented an actual barrier, and prevented them from pursuing innovative activities, or slowed them down, or pushed them to abandon their activities. These two interpretations might explain why the more innovative a firm is, the higher is the probability of attaching relevance to the problems faced (and overcome) when carrying out innovation. In other words, as Baldwin and Lin (2002) and Tourigny and Le (2004) put it, the 'obstacles to innovation', at least as measured in innovation surveys such as the CIS, should not be interpreted as factors preventing innovation or technology adoption. Rather, they should be more generally considered as indicating how successful the firm is in overcoming them.

However, none of the empirical contributions mentioned above has investigated the specific factors affecting the perception of obstacles. In the light of the literature background summarised in Section 2, the perception of obstacles to innovation may well be influenced by both the type of firm (by organisational structure and ownership) and the regional location. In this regard, we believe that more in-depth empirical support should be provided also to check the actual generalisability of the (positive) relationship between innovativeness and assessment of relevance of obstacles.

4. Data source and econometric specification

4.1 The structure of the Italian CIS3 sample

The CIS is based on a European (EUROSTAT) standardised questionnaire, with which each National Statistical Institute must conform. The Italian CIS3 questionnaire in line with the EUROSTAT standardised questionnaire, contains a section devoted to questions about the factors hampering or slowing down innovative activities, which all respondent firms are

required to answer.[2] The types of obstacles are grouped according to whether they are of an economic/financial nature; are related to the internal and organisational structures of the firm; and other.[3] All respondent firms are asked to rate the importance of each of the obstacles as they affect their innovation activity, on a 4-point Likert scale, from 0 (not relevant) to 3 (very important). The micro-data used in the empirical analysis were provided by the National Institute of Statistics (ISTAT) from the Italian CIS3, and cover the period 1998-2000. The sample is composed of 15,512 firms stratified by industry and size.[4]

[Table 1 about here]

Table 1 provides a general picture of the structure of the CIS sample. The table reports the total number of sample firms, in absolute values and as a percentage of the general total by:

(i) type of firm (firm belonging to a foreign group, to an Italian group, or single domestic);[5]

(ii) location (firm located in the North-west, North-east, Centre or South);[6]

[2] It should be noted that most of the sections in the CIS are only required to be answered by the sub-sample of innovative firms – those that claimed to have introduced at least one product or process innovation over the three years 1998-2000. The question on obstacles to innovation, however, is addressed to the whole sample of respondent firms, whether innovative or not.

[3] More particularly, the CIS questionnaire includes: excessive financial risk, excessive innovation costs, lack of financial sources (economic/financial obstacles); lack of organisational flexibility, lack of qualified personnel, lack of information on technology, lack of information on markets (organisational/internal obstacles); rigidities in regulation and normative standards; lack of customer responsiveness to new products and services (other obstacles).

[4] The sample is not stratified by region. ISTAT has simply conformed to the (standardised) sampling criteria imposed by EUROSTAT, according to which sample stratification by region is not compulsory, and is left to the preference of the individual national statistical offices. The descriptive frequencies by macro-region reported in Table 1 and Table 2 must therefore be interpreted with caution, as the numbers may not be completely representative.

[5] For the definition of statistical unit in the CIS, see the EEC Council Regulation on statistical units (no. 696/93). Although not all Italian firms belonging to groups are multinationals, and not all single Italian firms are uni-national, it is reasonable to assume that the proportion of firms which are multinationals is considerably higher in the case of firms belonging to groups than in the case of single firms. We thus consider Italian firms belonging to groups as a proxy for Italian MNEs. Unfortunately, our dataset does not allow a distinction between Italian groups entirely located in Italy and those who have affiliates/subsidiaries located abroad. See Frenz and Ietto-Gillies (2007) for the more detailed categories of firm types in the case of the UK CIS.

[6] The location refers to the enterprise's legal headquarters in the national territory, and not to other locations (in the case of multi-plant firms).

(iii) sector (19 sectors, both manufacturing and services).

Table 1 also reports the number of innovative firms and their relative percentage in relation to the total number of firms by category. The distribution of firms by type of ownership shows that a large proportion (77%) of respondents do not belong to groups. About 23% of the respondent firms belong to a group, and less than 6% of the total belong to a foreign group, reflecting the relatively marginal foreign presence in Italy. Yet, in line with the theoretical models and with the bulk of empirical evidence reported in Section 2, in the Italian case the percentage of innovators among foreign MNEs (57.5%) is almost the double that of single domestic firms (31%),[7] and higher than that of Italian MNEs (50%).

CIS3 data on the distribution of respondent firms by type across the macro-regions broadly confirm the typical Italian imbalances. Foreign groups are strongly concentrated in the North-west (almost 60% of the total foreign presence in the country). The North as a whole accounts for almost 80% of foreign MNEs, with location in the south being marginal. Italian groups' territorial distribution is slightly more balanced (although the North hosts around 65% of the nationally-owned MNEs). The southern part of the country fares better in terms of single domestic firms, whose geographical location is by far the most evenly distributed across the four geographical areas here considered. The Independent Chi-square test for the distribution of firms by type across the macro-regions is significant at the 1% level, indicating that foreign groups locate in the North-west of Italy significantly more than expected on the basis of a perfectly random distribution. The test also shows that foreign groups tend to locate in the other Italian macro-regions significantly less than expected.

[Table 2 about here]

Table 2 reports the percentages of innovative firms by type and by macro-region. These percentages relate to the weighted sample (whereas the values reported in Table 1 refer to the unweighted sample). The evidence confirms both the 'innovation divide' in Italy – with central and, more especially, southern regions showing substantially lower innovation propensity compared to the North, irrespective of the type of firm – as well as the 'innovation gap' between foreign MNEs and overall domestic firms, irrespective of location. It should be noted that the share of innovative firms in the North of Italy (just under 35% in both North-

[7] It should be noted that in previous rounds of CIS, relating to the 1992-1994 and 1994-1996 periods, only about one third of Italian (single) firms declared having introduced at least one product or process innovation over the period in question. This might thus represent a sort of threshold in the Italian industrial structure.

west and North-east) is definitely higher than for the Centre (29%) and the South of the country (20%). Thus, we can already see that the territorial distribution of foreign MNEs reflects the Italian regional divide taking into account size and sectoral effects. This evidence gives support to the view that innovation has a particular association to multinationality and shows context-specific features.

As far as the obstacles to innovation are concerned, the sectoral and regional distribution of the share of sampled firms that perceived as important or very important (2 and 3 on the Likert scale) each of the obstacles shows some interesting features.

Firstly, economic/financial obstacles are more frequently indicated as important than those related to internal organisation or to institutional rigidities. The lack of skilled personnel also appears to be a significant obstacle, whilst the least problematic factors are related to information to innovate (e.g. lack of information on technology or markets).

Secondly, as far as sectoral specificities are concerned, there is a quite systematic difference in the perception of obstacles in manufacturing and in service activities. In particular, service firms rank the obstacles listed in the questionnaire as less important in the case of finance-related barriers, lack of skilled personnel, and lack of information on technology and markets. In relation to problems related to internal organisation flexibility, regulatory system or lack of customer response to innovative products and services, on at least a merely descriptive level, there was no outstanding difference between services and manufacturing. The manufacturing sectors that perceive the greatest difficulties are machinery and equipment, and electrical machinery, electronics and optical, while in the service industry computers, R&D and KIBS (Knowledge Intensive Business Services) are more aware of the obstacles to innovation. At first glance, the descriptive results on the perceived importance of obstacles by sector are pretty much in line with the main findings in the empirical contributions reviewed in Section 3, according to which higher evaluation of obstacles is more frequent in firms belonging to the most innovative sectors, or to those with higher R&D and technology adoption.

Thirdly, in terms of the perception of obstacles by macro-region, some peculiar features were uncovered for the sample of firms as a whole. Rather surprisingly, the respondents located in the North-east of the country attributed the highest importance to most types of obstacles. However, lack of financial resources and regulatory rigidities were perceived as more relevant in the South than in other parts of the country, while, without exception, firms in the North-west and in the central regions attributed the least importance to the obstacles to innovation.

This descriptive evidence calls for more in-depth exploration of the data, in particular to check whether there is a systematic difference in the perception of obstacles to innovation between (MNEs vs. single domestic, foreign-owned vs. nationally-owned) firms, and among macro-regions, and between innovators and non-innovators.

4.2 The econometric model

We estimate the probability of the event 'firm evaluating the obstacle(s) as important or very important' occurring as a function of a series of regressors, including firm size, sector, type of ownership and organisational structure, geographical location and innovativeness (that is, whether the firm has introduced or not an innovation).[8] The dependent variables relate to the perception of the obstacles to innovation as indicated by firms (section 12.3 of the Italian CIS questionnaire) based on the 4-point Likert scale. Following Baldwin and Lin (2002) and Galia and Legros (2004), a dummy variable was created, which takes the value 1 if firms responded 2 (important) or 3 (very important), and 0 otherwise.[9]

It is important to bear in mind that this variable is qualitative and represents the *evaluation* of the respondents to the *perceived* factors hampering innovation activity. The formulation itself of section 12.3 of the questionnaire[10] does not indicate a direct causal effect between the perception of the obstacle and the choice of introducing or not an innovation.

In the CIS questionnaire nine obstacles are listed, grouped according to their characteristics. This influences the model specification and the estimation method, as firms might tend to assess similarly obstacles belonging to the same category.[11] The matrix of correlation coefficients amongst obstacles shows that this is the case. However, we are interested in assessing the association of the chosen regressors for *each* single obstacle, on the basis that

[8] The limits of the CIS and of the variables available from the survey are well known and are not rehearsed here. See, among others, Silvani et al. (1993) and Iammarino et al. (1995).

[9] The use of the dichotomous variable as the dependent variable gives similar results to those obtained using the (discrete) values of the obstacle evaluation (i.e. the multinomial ordered probit model).

[10] Firms were asked to "grade the importance of any hampering factor to technological innovation activity which the enterprise has experienced".

[11] In other words, the model specification and the estimation method should account (and control) for the fact that the obstacle ratings are correlated due to both the formulation of the questionnaire and the nature of the variables considered.

each has an informative potential *per se*, controlling for the possible presence of an unobserved structure which correlates obstacles amongst themselves.[12]

Hence, the nature of the dependent variable and the structure of the questionnaire drive the choice of econometric specification. We estimated the model using a Multivariate Probit Model (MPM) for the nine obstacles.[13] The MPM allows the error terms to be freely correlated across equations, similar to seemingly unrelated least square regressions (so-called SUR models). The use of MPM in this work, therefore, allows us to account (and control) for the fact that the nine obstacle ratings are correlated with one another (see Greene, 2000, and more particularly Cappellari and Jenkins, 2003).

The general specification of the MPM is:

(1) $$y_{ij}^{*} = a_j + b_j^{'} x_{ij} + u_{ij},$$

where

$y_{ij} = 1$, if $y^{*} = \{2,3\}$ and 0 otherwise

with $i = 1, \ldots\ldots\ldots n$ (observations)

and $j = 1, \ldots\ldots\ldots 9$ (obstacles, i.e. equations)

[12] An alternative method would involve a regrouping of the obstacles according to their nature (i.e. economic/financial; organisational; other) as in Galia and Legros (2004), Mohnen and Rosa (2000) and Mohnen and Roller (2001), all of which point to the complementarities amongst obstacles. We believe, however, that exploring complementarities among sets of obstacles which are already grouped in sets within the questionnaire could be tricky and could produce biased results.

[13] We checked the consistency of the specification chosen against alternative specifications, namely the standard (univariate) probit model (not controlling for unobserved correlation amongst the obstacles); the logit model; and the multinomial ordered probit model, which uses the ordinal variable of the Likert scale. The results of the MPM estimation were consistent with all of these alternatives.

The equation's disturbances u_{ij} have a multivariate normal distribution with mean vector 0 and variance-covariance matrix V, where the leading diagonal elements of V are equal to 1 and correlation $\rho_{jk} = \rho_{kj} \; \forall \; j,k \in [1;9]$ are off-diagonal elements.[14]

Table 3 displays the list of variables included in the estimations.

[Table 3 about here]

The set of regressors included in the estimation procedure relate to:

(i) firm specific characteristics;

(ii) geographic location;

(iii) industry sector.

The first set (i) of regressors includes a proxy for size (log value of the number of employees in 1998); three dummies identifying the type of firms, namely whether the firm belongs to a foreign group, an Italian group or whether the firm is a single (Italian) enterprise. Further, a dummy (innovativeness) is included for those firms that have introduced at least one product and/or a process innovation over the period 1998-2000 (which assumes the value 1 for firms responding positively, and 0 otherwise). The list also includes a proxy for innovation intensity, provided by the (log) value of total R&D expenditure per employee, and a control dummy for firms that declared having introduced a product or a process innovation over the period 1998-2000, yet not investing in R&D.[15]

The second set (ii) of independent variables accounts for the firms' location. Four dummies were constructed, based on whether the firm is located in the North-west of Italy (Piemonte, Val d'Aosta, Lombardia, Liguria,); in the North-east (Veneto, Friuli, Trentino, Emilia); in the Centre (Marche, Umbria, Toscana, Lazio); or in the southern regions of Italy (Abruzzo, Molise, Campania, Basilicata, Calabria, Puglia, Sicilia, Sardegna).

[14] The Maximum Likelihood Estimation of the MPM was conducted using the Cappellari and Jenkins (2003) mvprobit program in STATA. Cappellari and Jenkins build up the STATA algorithm to calculate multivariate Normal probability distribution functions using simulation Maximum Likelihood.

[15] In making the MPM estimation on the sub-sample of innovative firms we included a control dummy for firms that claimed to have innovated but also claimed to have spent nothing on R&D (either in-house or external); this produced a sub-sample of 3,167 firms (out of 5,500). The sub-sample of firms which are innovative *but* are not R&D investors is therefore bigger than the sub-sample of firms that both innovated *and* invested in R&D. This peculiar feature of the Italian system should be also interpreted in the light of the literature review in Section 2.

The third set (iii) of independent variables includes the sector of activity of the firm. All sectors of the economy are covered, from extraction activities to business services. We took great care in defining the sectoral dummies, especially for the service sector, trying to preserve homogeneity both in terms of numerosity and, on the whole, of technological characteristics. For services, for instance, we constructed a dummy for firms belonging to Computer and related, R&D and KIBS, that is to say the (three digit level) sectors of architectural and engineering services and technical consultancy. Other business services include legal and accounting services, marketing, cleaning, security.

The first estimation was carried out on the full sample of responding firms. Next we estimated equation (1) on: the sub-sample of foreign MNEs; the sub-sample of Italian MNEs; and the sub-sample of single domestic firms, to allow a more in-depth exploration of regional differences within each type of firm. Finally, we carried out the estimation on the sub-sample of innovative firms, to check whether significant differences emerged for the sub-population of firms that had undertaken innovation investments.

5. Results

5.1 The perception of obstacles: results for the full sample

Table 4 reports the results of the MPM estimation on the full sample of 15,512 firms. It shows the results for the nine separate equations for each of the obstacles evaluated by the sampled firms, as a function of the regressors listed in Table 3. The reference categories for the coefficients are also reported in the table.

[Table 4 about here]

The specification of the model emerges as being quite effective in characterising the evaluation of obstacles by firms: the coefficients of the independent variables related to the location of firms are significant for certain types of obstacles (e.g. lack of financial resources); the dummy for innovativeness is systematically significant across different obstacles; the variables related to the type of firm also seem to be significantly associated with the evaluation of obstacles. All estimations include sectoral fixed effects.[16] Recall that the MPM allows the degree of correlations amongst different obstacle ratings to be controlled for.

[16] For reasons of space, the results at sectoral level are not discussed here. However, as was evident from both the empirical literature in Section 3 and our descriptive statistics, the relevance of sectoral specificities calls for in-depth analysis, which will be the focus of our next piece of research.

Therefore, the coefficients reported in Table 4 represent the actual association between the regressors and *each of the obstacles* evaluated by firms.

Overall, there was a visible 'innovation divide' pattern in terms of perception of obstacles, in which firms in the North and the Centre of Italy tended to perceive the obstacles to innovation as less significant than those located in the South. Firms in the North and the Centre of Italy tend generally to evaluate lack of financial resources as an impediment to innovative activity significantly less than firms located in the South. The result is the same in relation to information on technology and markets, and particularly for firms located in the North-west of Italy. While many obstacles are perceived as less important by firms located in the North-Centre of the country (as compared to the reference category of southern firms), the lack of skilled personnel was seen as a serious impediment for firms in the North-east (significance at 1%). Interestingly, the perception of regulatory rigidities was significantly lower for firms located in the North-west than for those based in the North-east and central regions, supporting the relevance of the role played by local institutional environments. Although not fully representative of the variety of regional innovation models (given the broad geographical aggregation in macro-regions), this result reinforces the traditional North-South distinction in the Italian innovation system.

The coefficients of the dummies for types of firm by organisational structure and ownership also give a robust and clear illustration of the differences in the perception of obstacles. Firms belonging to a foreign group tend to evaluate the obstacles to innovation as important, or very important, significantly less than the reference category. This holds across every type of obstacle, with the exception of lack of organisational flexibility. Interestingly enough, the coefficients of the dummy 'Foreign group' are also significantly lower than those for the 'Italian group'. This result holds also in the case of regulation rigidities, which one might have expected to be more of an obstacle for foreign-owned than for Italian-owned firms.[17] More generally, the major difference in the perception of obstacles occurs between firms belonging to a group (i.e. foreign and Italian MNEs), and single domestic firms, rather than between firms with different nationality ownership. The empirical estimations conducted on the sub-samples by type of firm provide further information on regional differences within each of these categories (see section 5.2 below).

[17] It seems that this factor, which is an important deterrent when firms are deciding whether to enter a foreign market, is not perceived as a problem by foreign MNEs once they are established in a country.

The structural association between the innovativeness of firms and their perception of obstacles emerges as being generally in line with the previous empirical literature. In particular, our results confirm that the more likely a firm is to introduce a product or process innovation, the higher the probability that it will evaluate the problems involved in innovation as relevant or very relevant. This relationship is strongest for economic/financial-related obstacles (coefficients between 0.35 and 0.36) and also significant for internal-organisational factors and regulatory rigidities (coefficients between 0.19 and 0.34). However, this does not apply to firms' evaluation of the importance of clients' lack of responsiveness to innovative products as an impediment to innovative activity (the coefficients being negative and significant). In other words, the market's response to the introduction of new products/services is a seen as a barrier by firms when deciding whether to innovate or not. This result, and the existing literature, leads to the interpretation that the risk of not meeting the clients' interest and, therefore, of failing to increase market share, actually prevents firms from carrying out innovation activities. At the micro-level of analysis, this result might be stylised in a 'Schmooklerian' framework, according to which the decision to invest in innovation is somewhat 'demand-led'. We checked whether this result holds when tested against different sub-samples of firm types.

With reference to the role of size, in line with most of the existing empirical evidence (see, for instance, Hyytinen and Toivanen, 2005) we find that while small rather than large firms see financial obstacles as significant barriers to innovative efforts, the reverse is true for impediments related to internal organisation.

5.2 The perception of obstacles: results for the sub-samples by type of firm

The estimations on the sub-samples of different types of firms by organisational structure and ownership were carried out to confirm the results in section 5.1. In particular, we wanted to check whether a clear regional pattern in terms of perception of the factors impeding innovation could be identified for each type of firm. Tables 5, 6 and 7 report the results of a MPM estimation of the factors associated with the evaluation of the (same nine) obstacles as important, or very important for firms belonging to a foreign-owned MNE, an Italian-owned MNE and single domestic firms.

[Tables 5 and 6 about here]

Tables 5 and 6 report some very similar results. When the estimation is restricted to the sub-samples of foreign and Italian groups, the dummy for the location of firms loses significance.

This suggests that no clear (macro-) regional pattern emerges in the perception of obstacles to innovation when the firm belongs to a group, regardless of whether it is foreign- or Italian-owned. The exceptions are the perception of financial obstacles (excessive financial risk and excessive innovation costs) by Italian groups in the North-east of the country (Table 6), which emerges as higher with respect to domestic groups located in the South and other areas of the country; and the lack of financial resources by Italian groups located in the North-west, which is perceived as lower than the average for all groups.

The only independent variable that is significant is the dummy 'innovativeness'. The strong positive association between innovativeness and the firm's perception of factors hampering innovation as being relevant or even very relevant holds across different types of firms. In line with other empirical analyses, awareness of the problems encountered when innovating depends on the mere fact of actually engaging in innovative activities. The coefficients for the sub-sample of foreign MNEs are significantly higher than those for the Italian groups. This suggests, therefore, that the most innovative firms, particularly among MNEs, are also those that are more aware of the problems encountered when innovating, most likely due to their being exposed to such problems when introducing innovations.

Further, foreign and Italian (innovative) groups seem to be more sensitive to problems related to the internal organisation (and mainly those linked to the lack of skilled personnel) than to financial obstacles. The opposite is true, even when controlling for size effects, for single (innovative) Italian firms (see Table 7), which see financial obstacles as more relevant than organisational ones. In the next section we check whether this structural difference holds for the sub-sample of innovative firms.

[Table 7 about here]

Table 7 reinforces the results of the full sample estimation (Table 4), in terms of identification of geographical patterns of perception of obstacles. When tested on the sub-sample of single domestic firms, the probability of major relevance being accorded to obstacles to innovation turns out to be significantly lower in the North-Centre of the country than in the southern areas for many organisational-related obstacles, to lack of financial sources and to regulation rigidity.[18]

[18] It should be noted that the available empirical evidence does not allow us to infer any causal relationship between the occurrence of belonging to a group or being located in a region, and the firm's perception of the obstacles to innovation. The MPM estimation measures the structural association between the frequency of

5.3 The perception of obstacles: results for the sub-sample of innovative firms

Given the findings presented in 5.1 and 5.2 above on the positive association between the propensity to innovate and probability of perceiving the obstacles to innovation as more relevant, it is interesting to carry out an empirical test on the sub-sample of innovative firms. The purpose of this last MPM estimation is to check whether there is a structural difference between innovative and non-innovative firms' perceptions of obstacles to innovation, thus providing an answer to a complementary research question: is the perception of obstacles influenced by firm innovativeness? If there is, there should be a significant difference in this case between the coefficients reported in Table 4 (on the full sample) and those indicated in Table 8 (on the sub-sample of innovative).

[Table 8 about here]

We added to the regressors both a proxy for innovation intensity and a control dummy for innovative firms without R&D expenditure. The decision to include this control dummy was dictated by two factors:

(i) first and foremost, to obtain a further counter-factual control with respect to those firms than had introduced an innovation, but declared themselves to be non-R&D investors. This allows us to account – *within the sub-sample of innovators* – for differences between 'committed innovators' (that is, those firms that do invest in R&D) and 'non committed innovators' (those firms that made no R&D investment despite being innovators);

(ii) secondly, the inclusion of a control dummy seemed to be imperative insofar as innovative non-R&D investors account for more than 3,000 of the 5,500 innovative firms. Hence, it is reasonable to expect that the coefficient of the control dummy is

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occurrence of evaluation of the obstacles as important or very important, and the frequency of the dummy indicating different types or locations of firms, compared to the reference category. In other words, although we can observe that there are regional differences in the perception of obstacles to innovation, and that these differences also occur across different types of firms, the evidence in this section (namely the results of the analysis conducted on the sub-samples by type of firm) does not allow us to conclude that the regional differences in the perception of obstacles emerging from Table 4 are due to a significantly higher presence of foreign groups in the North of Italy. Rather, what the evidence tells us is that the perception of obstacles is significantly affected by location only in the case of single domestic firms, although we cannot infer any direct causal relationship between the perception of the obstacles and the decision to locate in particular areas.

driving the sign of the coefficient of the R&D intensity variable in explaining the relationship between obstacle perception and the extent of innovative effort.

Turning to the results of the MPM estimation reported in Table 8, we observe that, overall, there is no structural difference in the perception of obstacles between the full sample and the sub-sample of innovative firms. Thus it is reasonable to infer that innovative and non-innovative firms tend to show the same structural differences in their perception of obstacles as far as context- and firm- specificities are concerned.

Indeed, the findings related to the full sample are here confirmed for the obstacles related to lack of financial resources (which is confirmed to be less relevant for innovative firms located in the North) and lack of skilled personnel (again, more relevant for innovative firms located in the North-East). However, interestingly, some of the regional differences that emerged in the full sample lose their significance when only innovative firms are considered. This applies to obstacles related to the lack of information on technology and markets, as well as the perception of regulatory rigidities. We could assume, therefore, that the systematic regional differences in the perception of obstacles are pulled mainly by non-innovative firms. Or, that the evaluation of problems related to lack of information and regulatory standards are more region-specific amongst non-innovative firms, while those firms that have innovated perceive these obstacles more homogeneously across regions.

The influence of firm-size on the assessment of the factors hampering innovation amongst innovative firms turns out to be confirmed, both in sign and significance. The relationship between size, and the kind of problems encountered when innovating, is therefore structural.

Further, the specificities related to the results for type of firm are confirmed, and even reinforced in terms of the coefficients' absolute values.

Table 8 also reports the coefficients of the variables related to R&D innovation intensity, and the control dummy for innovators but non-investors in R&D. The proxy for innovation intensity turns out to be positively and significantly related to the perception of financial obstacles. More particularly, the perception of excessive financial risk and lack of financial resources as hampering factors seems to be higher for firms with higher R&D expenditure. The picture is the same for the problem of excessive innovation costs, though this latter relationship emerges from the negative sign of the control dummy (i.e. innovative firms with nil expenditure on R&D perceive very high innovation costs as less relevant).

In terms of internal and organisational obstacles, the picture is more fragmented. The coefficients for innovation intensity are all negative, but not statistically significant (except in the case of lack of skilled personnel and lack of information on technologies). On the other hand, the coefficients for the control dummy of non-R&D investors are all negative and statistically significant, confirming the picture that emerged for financial obstacles. However, for lack of skilled personnel and information on technology the coefficients are also negative, which is rather puzzling, as it means the coefficients go in opposite directions.

This might be due to the fact that these two specific obstacles do represent an actual impediment (or the perception of them is ranked very high) for 'medium R&D investors', but not those firms that are at the extremes of the R&D investment distribution. In other words, neither the 'non-committed innovators' nor the 'very committed innovators' seem to consider these obstacles as very relevant. Yet, they do represent a problem for those firms that *do* invest in R&D, and would probably commit to investing more had they easier access to skilled personnel and information on technology.

It can be conjectured, therefore, that the relationship between obstacle perception and R&D intensity is non-linear. Both the non-investors and the large investors in R&D tend to consider these two obstacles as less relevant, implying that their decision to invest (or not) in R&D is not affected by their perceptions of these problems, while for those firms that are located around the average of R&D spending, removing these obstacles would probably lead to increased financial investment in R&D and innovation.

Note that the coefficient for R&D intensity in the case of lack of client responsiveness is not significant (in contrast to Table 4), confirming our interpretation that this factor contributes to explaining why firms do not engage in innovative activities.

6. Conclusions

This study has shown that important differences in firms' perception of obstacles to innovation occur both across types of firms and across locations. Overall, firms located in the North and in the Centre of Italy and which belong to (either foreign- or Italian-owned) MNEs tend significantly less frequently to perceive obstacles to innovation as relevant. On the one hand, this result offers support to the typical North-South divide that exists in the Italian innovation system. On the other hand, when the estimation is carried out on sub-samples of firms by type, geographical specificities in the perception of the obstacles to innovation are

shown to characterise only single domestic firms. In other words, the perception of obstacles to innovation does not significantly differ across regions, unless the firm is a single domestic firm.

The structural association between firms' perception of obstacle and their innovation propensity is shown to be positive, leading us to conclude that evaluation of obstacles as relevant is a symptom of the higher awareness of innovative than non-innovative firms, of the problems encountered when engaging in innovation activities. The perception of obstacles is clearly related to the experience and learning processes of firms when they actually carry out innovation. Such learning processes are relatively faster in MNEs, as they have the advantage of experiencing various business cultures and institutional environments, and also face different types of barriers to innovation, leading to higher awareness of potential and actual problems.

However, the fact that the evidence suggests that innovative firms – relative to non-innovative ones – seem to have a higher awareness of the factors, which, in principle, should be a deterrent to innovation, does not, in our view, imply that this greater awareness can be taken as a measure of ability to overcome such obstacles. This would entail a radical reformulation of the original CIS questionnaire design and, therefore of its designers' main objectives. The rationale for the inclusion of the section on obstacles was to identify potential areas for policy intervention and to draw the attention of policy makers to the barriers to innovation. Hence, the starting point of any assessment of the importance of the obstacles to innovation should align with the objectives of the CIS questionnaire designers.

This study provides further support for the crucial role of foreign MNEs in creating new knowledge; they emerge as the most innovative firms, regardless of their geographical location. To disregard MNE transition and its evolution may lead to short-sighted policies, which fail to recognise the possibilities for mutual knowledge enrichment for both MNEs and the host systems, and therefore miss out on fundamental opportunities for local growth. This is all the more crucial in the light of the lagging process of integration of the Italian productive and innovation system into the global economy, particularly in terms of research intensity and technological competences.

Important implications could also be inferred from the evidence of region-specific behaviours of single domestic firms, whose high perception of obstacles point to the actual constraining pressure exerted on innovative investment by such barriers. Furthermore, as emphasised by

many in the current political and academic debates, the familiar national model of ‘innovation without R&D’, which has once more emerged as a typical feature of the Italian industrial structure, is neither a feasible nor a sustainable driver of economic growth and greater social cohesion.

Our future research steps will follow two main directions. Sector-specific factors that might differentiate MNEs innovative behaviour from that of domestic firms will be investigated more in depth. Along with further analysis of the relationship between MNEs and innovation processes at the sub-national scale, normative policy implications should be carefully considered, avoiding simplified prescriptions which often appeal to policy-makers wishing for easy answers to complex problems. How to attract asset-seeking and knowledge-producing foreign investment, and how to promote innovation-conducive environments is still not obvious, and further research is needed to provide sounder bases for public intervention.

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Table 1 - Italian CIS3: structure of the sample and percentage of innovative firms

Variables	Number of firms	% of total	Number of Inn. firms	% of innovative
Type of firm				
firm belonging to an Italian group	2595	16.73%	1301	50.13%
firm belonging to a foreign group	905	5.83%	520	57.46%
single domestic firm	12012	77.44%	3683	30.66%
Total sample	*15512*	*100%*	*5504*	*35.48%*
Location of firm				
firm located in the North-west of Italy	4852	31.28%	1939	39.96%
firm located in the North-east	4503	29.03%	1804	40.06%
firm located in the Centre	2979	19.20%	980	32.90%
firm located in the South	3178	20.49%	781	24.58%
Total sample	*15512*	*100%*	*5504*	*35.48%*
Sectors				
Extraction	232	1.50%	48	20.69%
Food, beverages and tobacco	627	4.04%	229	36.52%
Textiles, clothing and leather	1186	7.65%	278	23.44%
Wood, Paper, printing and publishing	1502	9.68%	508	33.82%
Coke, oil, nuclear, chemicals	617	3.98%	351	56.89%
Plastic and non metal products	1071	6.90%	451	42.11%
Metals	1061	6.84%	440	41.47%
Machinery and equipment	697	4.49%	433	62.12%
Electrical machinery, electronics and optical	1124	7.25%	618	54.98%
Transport goods	525	3.38%	221	42.10%
Other manufacturing	624	4.02%	194	31.09%
Energy, gas and water	212	1.37%	58	27.36%
Trade	1722	11.10%	408	23.69%
Hotels and restaurants	529	3.41%	89	16.82%
Transport services and communication	1321	8.52%	254	19.23%
Financial services	770	4.96%	409	53.12%
Real estate	187	1.21%	29	15.51%
Computer, R&D, KIBS*	740	4.77%	353	47.70%
Other business services	765	4.93%	133	17.39%
Total sample	**15512**	**100.00%**	**5504**	**35.48%**

* KIBS include engineering and technical consultancy

Table 2 - Distribution of innovative firms by type and macro-region - weighted sample

Macro-regions	Type of firm: % innovative firms in Italian groups	% innovative firms in foreign groups	% innovative firms in single domestic firms	*Total by macro-region*
North-west	44.9	53.2	31.5	*33.7*
North-east	48.4	59.0	32.5	*34.4*
Centre	44.1	49.4	26.8	*29.0*
South	33.2	46.0	19.1	*20.3*
Total by type	44.3	53.5	28.8	*30.9*

Table 3 - List of variables included in the empirical analysis

Variables	*Notes*
Dependent Variable	
Excessive financial risk	Dummy for firm evaluating the obstacle as important or very important*
Too High innovation costs	
Lack of appropriate sources of finance	
Lack of organisational flexibility within the enterprise	
Lack of qualified personnel	
Lack of information on technology	
Lack of information on markets	
Insufficient flexibility in regulation and normative standards	
Lack of customer responsiveness to new goods and services	
Independent variables: firm specific	
Size	Number of employees in 1998 (log value)
Foreign group	Dummy for firm belonging to a foreign group
Italian group	Dummy for firm belonging to an Italian group
Single Italian firm	Dummy for firm not belonging to a group (Italian)
Innovativeness	Dummy for firm introducing a product or a process innovation during 1998-2000 (yes=1; no=0)
Total R&D expenditure per employee	Total R&D expenditure per employee (log value)
Innovative firms with no R&D expenditure	Dummy for firm introducing an innovation during 1998-2000 and no R&D expenditure (yes=1; no=0)
Independent variables: location of firm	
North-west	Dummy for firm located in the North-west (Piemonte, Val d'Aosta, Lombardia, Liguria)
North-east	Dummy for firm located in the North-east (Veneto, Friuli, Trentino, Emilia)
Centre	Dummy for firm located in the Center (Marche, Umbria, Toscana, Lazio)
South	Dummy for firm located in the South (Abruzzo, Molise, Campania, Basilicata, Calabria, Puglia, Sicilia, Sardegna)
Independent variables: sectoral affiliation	
Extraction	Dummy for firm belonging to each sector
Food, beverages and tobacco	
Textiles, clothing and leather	
Wood, Paper, printing and publishing	
Coke, oil, nuclear, chemicals	
Plastic and non metal products	
Metals	
Machinery and equipment	
Electrical machinery, electronics and optical	
Transport goods	
Other manufacturing	
Energy, gas and water	
Trade	
Hotels and restaurants	
Transport services and communication	
Financial services	
Real estate	
Computer, R&D, KIBS**	
Other business services	

* Evaluation on a Likert scale: 0 (not relevant); 1 (low importance); 2 (medium importance); 3 (high importance).
Dummy variables have been created which take value 1 for evaluation 2 and 3 and 0 otherwise
** KIBS include engineering and technical consultancy

Table 4 - Multivariate Probit - Full Sample
Dependent variable: Dummy variable for firms perceiving obstacles as important or very important

	Excessive financial risk	Innov. costs too high	Lack of financial sources	Lack of org.[a] flexibility	Lack of skilled personnel	Lack of info Tech.	Lack of info markets	Regulat. rigidities	Lack of clients' responsiv
Independent variables: location of firm									
North-west	-0.025	-0.012	-0.148	-0.022	0.015	-0.116	-0.122	-0.081	-0.02
	[0.033]	[0.031]	[0.032]***	[0.036]	[0.033]	[0.035]***	[0.035]***	[0.034]**	[0.034]
North-east	0.008	0.05	-0.122	0.067	0.13	-0.023	-0.023	-0.043	0.035
	[0.033]	[0.030]*	[0.032]***	[0.035]*	[0.032]***	[0.034]	[0.035]	[0.034]	[0.033]
Centre	-0.075	-0.023	-0.113	0.022	0.026	-0.089	-0.098	-0.046	-0.005
	[0.036]**	[0.033]	[0.035]***	[0.039]	[0.036]	[0.038]**	[0.039]**	[0.037]	[0.037]
South	ref	ref	ref	ref	ref	ref	ref	ref	ref
Independent variables: firm specific									
Innovativeness	0.358	0.347	0.357	0.194	0.332	0.343	0.308	0.258	-0.103
	[0.025]***	[0.023]***	[0.024]***	[0.027]***	[0.024]***	[0.026]***	[0.026]***	[0.026]***	[0.026]***
Size	-0.01	-0.01	-0.042	0.065	0.01	0.018	0.003	0.029	0.036
	[0.011]	[0.010]	[0.011]***	[0.011]***	[0.011]	[0.011]	[0.012]	[0.011]***	[0.011]***
Italian group	-0.083	-0.109	-0.105	-0.098	-0.134	-0.069	-0.072	-0.057	-0.108
	[0.033]**	[0.031]***	[0.033]***	[0.036]***	[0.033]***	[0.035]**	[0.036]**	[0.034]*	[0.035]***
Foreign group	-0.152	-0.12	-0.261	0.066	-0.122	-0.102	-0.018	-0.15	-0.121
	[0.053]***	[0.048]**	[0.054]***	[0.053]	[0.052]**	[0.055]*	[0.055]	[0.055]***	[0.055]**
Single Italian firms	ref	ref	ref	ref	ref	ref	ref	ref	ref
Independent variables: sectoral affiliation (coefficients not reported)									
Constant	-1.016	-0.845	-0.678	-1.502	-1.388	-1.538	-1.425	-1.26	-1.168
	[0.110]***	[0.100]***	[0.104]***	[0.120]***	[0.118]***	[0.126]***	[0.125]***	[0.115]***	[0.112]***
Observations	15,512								
Log Likelihood	-47470.083								

Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 5

Multivariate Probit – Sub Sample of foreign groups

Dependent variable: Dummy variable for firms perceiving obstacles as important or very important

	Excessive financial risk	Innov. costs too high	Lack of financial sources	Lack of org.[a] flexibility	Lack of skilled personnel	Lack of info Tech.	Lack of info markets	Regulat. rigidities	Lack of clients' responsiv
Independent variables: location of firm									
North-West	-0.061	-0.12	0.086	0.078	0.17	0.131	0.027	-0.219	0.171
	[0.224]	[0.214]	[0.237]	[0.226]	[0.230]	[0.243]	[0.243]	[0.233]	[0.246]
North-East	-0.175	0.001	0.248	0.082	0.272	0.153	0.123	-0.131	0.11
	[0.240]	[0.226]	[0.251]	[0.241]	[0.242]	[0.258]	[0.257]	[0.249]	[0.263]
Centre	0.024	-0.048	0.011	0.15	0.081	0.378	0.22	-0.095	0.254
	[0.246]	[0.233]	[0.263]	[0.247]	[0.256]	[0.265]	[0.267]	[0.258]	[0.268]
South	ref	ref	ref	ref	ref	ref	ref	ref	ref
Independent variables: firm specific									
Innovative	0.441	0.414	0.346	0.276	0.64	0.493	0.609	0.571	-0.039
	[0.111]***	[0.099]***	[0.119]***	[0.109]**	[0.111]***	[0.120]***	[0.127]***	[0.125]***	[0.114]
Size	0.016	0.015	-0.046	-0.013	-0.048	-0.021	-0.006	0.033	0.049
	[0.039]	[0.036]	[0.042]	[0.038]	[0.038]	[0.040]	[0.041]	[0.041]	[0.041]
Independent variables: sectoral affiliation (coefficients not reported)									
Constant	-0.328	-0.27	-5.078	-1.106	-1.552	-1.643	-1.589	-1.508	-1.51
	[0.622]	[0.676]	[81.297]	[0.819]	[0.956]	[1.139]	[0.810]**	[0.966]	[0.839]*
Observations	905								
Log Likelihood	-2659.3088								

Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 6

Multivariate Probit – Sub Sample of Italian groups

Dependent variable: Dummy variable for firms perceiving obstacles as important or very important

	Excessive financial risk	Innov. costs too high	Lack of financial sources	Lack of org. [al] flexibility	Lack of skilled personnel	Lack of info Tech.	Lack of info markets	Regulat. rigidities	Lack of clients' responsiv
Independent variables: location of firm									
North-West	0.028	-0.034	-0.182	0.004	-0.046	-0.059	-0.046	-0.046	-0.061
	[0.089]	[0.080]	[0.087]**	[0.097]	[0.088]	[0.092]	[0.097]	[0.090]	[0.091]
North-East	0.184	0.134	-0.072	0.138	0.115	0.095	0.105	0.054	0.047
	[0.090]**	[0.081]*	[0.088]	[0.097]	[0.089]	[0.092]	[0.097]	[0.092]	[0.092]
Centre	0.039	0.01	-0.002	0.045	-0.119	-0.131	0.086	0.026	-0.145
	[0.099]	[0.090]	[0.095]	[0.108]	[0.100]	[0.105]	[0.107]	[0.100]	[0.104]
South	ref	ref	ref	ref	ref	ref	ref	ref	ref
Independent variables: firm specific									
Innovative	0.383	0.37	0.326	0.283	0.42	0.361	0.337	0.205	-0.013
	[0.062]***	[0.057]***	[0.063]***	[0.067]***	[0.063]***	[0.066]***	[0.069]***	[0.064]***	[0.065]
Size	0.013	-0.005	-0.044	0.004	-0.036	-0.041	-0.042	0.004	0.015
	[0.021]	[0.019]	[0.021]**	[0.022]	[0.021]*	[0.022]*	[0.023]*	[0.021]	[0.022]
Independent variables: sectoral affiliation (coefficients not reported)									
Constant	-1.013	-0.96	-0.812	-1.447	-1.002	-1.315	-1.259	-0.825	-0.999
	[0.372]***	[0.377]**	[0.382]**	[0.433]***	[0.403]**	[0.433]***	[0.432]***	[0.369]**	[0.392]**
Observations	2595								
Log Likelihood	-7819.6703								

Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 7

Multivariate Probit – Sub Sample of single Italian firms

Dependent variable: Dummy variable for firms perceiving obstacles as important or very important

	Excessive financial risk	Innov. costs too high	Lack of financial sources	Lack of org.[a] flexibility	Lack of skilled personnel	Lack of info Tech.	Lack of info markets	Regulat. rigidities	Lack of clients' responsiv
Independent variables: location of firm									
North-West	-0.033	-0.01	-0.164	-0.036	-0.0001	-0.131	-0.132	-0.091	-0.029
	[0.036]	[0.034]	[0.035]***	[0.040]	[0.037]	[0.039]***	[0.039]***	[0.038]**	[0.037]
North-East	-0.002	0.042	-0.145	0.052	0.126	-0.034	-0.027	-0.05	0.033
	[0.036]	[0.033]	[0.035]***	[0.039]	[0.036]***	[0.037]	[0.038]	[0.037]	[0.036]
Centre	-0.091	-0.02	-0.12	0.018	0.054	-0.08	-0.116	-0.049	0.014
	[0.040]**	[0.037]	[0.038]***	[0.043]	[0.040]	[0.042]*	[0.043]***	[0.041]	[0.040]
South	ref	ref	ref	ref	ref	ref	ref	ref	ref
Independent variables: firm specific									
Innovative	0.346	0.338	0.358	0.176	0.306	0.327	0.286	0.254	-0.121
	[0.028]***	[0.026]***	[0.027]***	[0.031]***	[0.027]***	[0.029]***	[0.030]***	[0.029]***	[0.030]***
Size	-0.033	-0.029	-0.047	0.1	0.037	0.037	0.011	0.029	0.024
	[0.014]**	[0.013]**	[0.014]***	[0.015]***	[0.014]***	[0.015]**	[0.015]	[0.014]**	[0.014]*
Independent variables: sectoral affiliation (coefficients not reported)									
Constant	-0.933	-0.723	-0.601	-1.487	-1.34	-1.512	-1.373	-1.143	-1.049
	[0.130]***	[0.114]***	[0.118]***	[0.136]***	[0.131]***	[0.145]***	[0.142]***	[0.130]***	[0.129]***
Observations	12012								
Log Likelihood	-36786.899								

Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 8

Multivariate Probit – Sub Sample of innovative firms

Dependent variable: Dummy variable for firms perceiving obstacles as important or very important

	Excessive financial risk	Innov. costs too high	Lack of financial sources	Lack of org.[a] flexibility	Lack of skilled personnel	Lack of info Tech.	Lack of info markets	Regulat. rigidities	Lack of clients' responsiv
Independent variables: location of firm									
North-West	-0.027	-0.039	-0.122	0.059	0.096	-0.005	-0.013	-0.087	0.003
	[0.058]	[0.055]	[0.057]**	[0.065]	[0.059]	[0.061]	[0.062]	[0.060]	[0.064]
North-East	0.01	0.002	-0.156	0.077	0.169	-0.023	-0.015	-0.088	0.009
	[0.057]	[0.055]	[0.057]***	[0.065]	[0.058]***	[0.061]	[0.062]	[0.060]	[0.064]
Centre	-0.065	-0.033	-0.114	0.089	0.065	-0.071	-0.047	-0.054	-0.008
	[0.064]	[0.061]	[0.064]*	[0.072]	[0.066]	[0.069]	[0.070]	[0.067]	[0.072]
South	ref	ref	ref	ref	ref	ref	ref	ref	ref
Independent variables: firm specific									
Total R&D expenditure per employee	0.08	0.042	0.071	-0.007	-0.066	-0.061	-0.009	-0.007	-0.025
	[0.032]**	[0.031]	[0.032]**	[0.035]	[0.032]**	[0.034]*	[0.033]	[0.034]	[0.036]
Innovative firms with no R&D exp.	0.014	-0.1	-0.044	-0.105	-0.266	-0.277	-0.263	-0.165	-0.085
	[0.054]	[0.051]*	[0.054]	[0.059]*	[0.054]***	[0.056]***	[0.057]***	[0.056]***	[0.060]
Size	0.022	0.008	-0.029	0.063	0.007	0.001	0.003	0.038	0.038
	[0.016]	[0.015]	[0.016]*	[0.017]***	[0.016]	[0.017]	[0.017]	[0.017]**	[0.018]**
Italian group	-0.134	-0.142	-0.154	-0.086	-0.147	-0.084	-0.092	-0.12	-0.086
	[0.049]***	[0.046]***	[0.049]***	[0.053]	[0.048]***	[0.051]*	[0.052]*	[0.051]**	[0.054]
Foreign group	-0.22	-0.192	-0.391	0.027	-0.144	-0.153	-0.09	-0.193	-0.132
	[0.070]***	[0.065]***	[0.073]***	[0.073]	[0.069]**	[0.073]**	[0.074]	[0.073]***	[0.078]*
Single Italian firms	ref	ref	ref	ref	ref	ref	ref	ref	ref
Independent variables: sectoral affiliation (coefficients not reported)									
Constant	-0.183	-0.08	-0.356	-1.124	-0.814	-1.128	-0.701	-0.473	-0.926
	[0.248]	[0.246]	[0.253]	[0.276]***	[0.269]***	[0.300]***	[0.260]***	[0.258]*	[0.271]***
Observations	5504								
Log Likelihood	-20124.87								

Standard errors in brackets. * significant at 10%; ** significant at 5%; *** significant at 1%.

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