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THE PERCEPTION OF OBSTACLES TO INNOVATION. FOREIGN MULTINATIONALS AND DOMESTIC FIRMS IN ITALY (*)

Mots-clés : Obstacles à l'innovation, multinationales, innovation, localisation régionale.

Key words : Obstacles to Innovation, Multinational Firms, Innovation Processes, Regional Location.

I. — 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

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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 multinationals versus domestic firms belonging to a group and 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 background literature on the interaction between multinational expansion, innovative processes, and the characteristics of local environments. Section III refers to the (few) empirical contributions that focus on the nature and relevance of obstacles and factors that slow down innovation activities. Section IV provides a description of the third Community Innovation Survey (CIS3) sample, and of firms' innovative activities in the Italian macro-regions ; descriptive evidence on the perception of the obstacles to innovation across areas and types 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 V discusses the results of the econometric tests for both the whole sample, and the sub-samples of firms. Finally, Section VI summarises the empirical evidence and highlights some general implications.

II. — 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.

In traditional industrial economics and transaction costs-based views of the firm- 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 rather narrow definition of technology and innovation (*e.g.* Dunning, 1958, 1970; Buckley and Casson, 1976; Hennart, 1977, 1982; Rugman, 1981; Markusen, 1984).

Conversely, Schumpeterian approaches emphasise 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).

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). MNEs have been increasingly regarded as evolving organisations strongly interacting with socio-economic environments in both the home and the host locations (*e.g.* Dunning, 1970; Teece, 1977; Dosi *et al.*, 1990; Frenz and Ietto-Gillies, 2007).

Thus, 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 localised technological environments, contextual factors and systemic interactions in generating spillovers, attracting foreign MNEs and affecting firms' propensity to innovate, 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 in determining the performance of existing producers and also the attractiveness of a region for foreign MNE and domestic firms. The decision of (both nationally-owned and foreign-owned) firms to operate in particular areas and to engage in innovative activities may be affected, *ceteris paribus*, by their evaluation of the difficulties that will be encountered in the process of innovation.

This is likely to 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 northern regions, a phenomenon known as the Italian « innovative divide » (see 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 technological strategies and performances of firms, but also in terms of the relevance of systemic interactions and contextual factors favourable (or unfavourable) to innovation (*i.e.* obstacles) (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.

III. — OBSTACLES TO INNOVATION IN INNOVATION SURVEYS

The empirical literature drawing on the evidence provided by the European CIS and exploring the characteristics and economic impact of technological

(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 centers 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.

innovation across firms and sectors is large and consolidated (for the Italian CIS see, among others, Archibugi *et al*., 1991; Evangelista *et al*., 1997; Cainelli *et al*., 2006). However, much fewer contributions have analysed the role of obstacles, the factors affecting their perception – at least as (qualitatively) assessed by the firms themselves – and the extent to which they actually hamper or slow down innovation. We attempt in what follows to reclassify the few contributions on the role of obstacles according to the main research question and the consequent econometric tool chosen as appropriate.

Two strands may be identified in the literature dealing with perceived obstacles to innovation. One line of research focuses on how the perception of different types of obstacles is affected by various firm and industry characteristics, amongst which the propensity/intensity to innovate. The second stream of contributions focuses instead on how the propensity/intensity to innovate is affected by perceived obstacles (in particular financial obstacles), controlling for other firm- and industry-specific characteristics. The propensity/intensity to innovate becomes here the dependent variable, while perceived financial (and other) constraints become one of the explicative variables. These two approaches are related but quite distinct and require the use of different econometric strategies.

As to the first approach, Arundel (1997), Mohnen and Rosa (2000), Baldwin and Lin (2002), Tourigny and Le (2004) and Galia and Legros (2004), on the basis of Canadian and French innovation survey data, analyse why firms perceive the obstacles to innovation differently, and the extent of complementarities among individual obstacles, which are claimed to be crucial in drawing policy implications. Some common results emerge from these studies. For instance, the lack of financial resources appears to be perceived as more important by small firms, while organizational factors are more relevant for large enterprises (2). However, the results provided by these contributions seem to diverge with respect to other important issues, as, for instance, mixed evidence is obtained on the influence of foreign ownership (3). Another interesting finding is that individual hampering factors belonging to the same category (4) may have different roles. Thus, for example, Tourigny and Le (2004) and Mohen and Rosa (2000) find that while the lack of financial resources is less likely to be perceived as an important hampering factor by large firms (as compared to small ones), the opposite holds for the high costs of innovation. As

(2) See Mohen and Rosa (2000) p. 12; Baldwin and Lin (2002) p. 16.

(3) Baldwin and Lin (2002) p. 16 find no significant effect of nationality of ownership on the probability that an impediment is reported. Galia and Legros (2004), p. 1193 find that firms belonging to foreign groups are less affected by costs and financing obstacles than firms belonging to a national (French) group.

(4) See Mohen and Roller (2005) p. 1449 and Section IV below for a detailed list of the hampering factors included in the CIS questionnaire.

these two obstacles are generally included in the same category (financial obstacles), this suggests that carrying out a separate analysis on each of them might be of crucial importance to draw sensible policy implications.

These contributions also show 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. The empirical literature tends to explain this apparently surprising finding as due to innovators being more likely to have experimented barriers to innovation, and therefore more likely to assess obstacles as important. As Galia and Legros (2004, p. 1189) suggest « it is plausible that certain problems are not effectively encountered until firms face them …innovative firms face problems and more innovative firms have more problems » (5). Such line of reasoning implies that the obstacles perceived by innovative firms do represent actual barriers to innovation which, though not preventing firms from engaging in innovation activities, are very likely to reduce the amount of resources devoted to it and/or the number of innovative activities undertaken. However, not all the authors agree on this interpretation (6) and further research is needed to convey convincing results on this point. Further, a possible endogeneity issue might emerge, due to reverse causality between the perception of obstacles and firm's innovative activities.

Overall, the findings of this first strand of literature – focusing on the effects of firms' characteristics on the perception of obstacles – emphasise some key issues, which have important methodological implications in terms of the choice of the econometric specification to estimate what affects firms' perception of obstacles (7). Firstly, as a firm faces different hampering factors at the same time, when estimating the probability of obstacles to be perceived as important, the various hampering factors should be simultaneously considered. Secondly, as obstacles in the same category may have different roles and each individual obstacle has an informative potential *per se*, individual obstacles should be considered separately rather than regrouped. Thirdly, as perceived obstacles are most likely to be related to one another, the main estimation pro-

(5) Also Mohen and Rosa (2000) p. 6 suggest that « apparently the obstacles do not emerge up to the moment in which the firms have to confront them ».

(6) A more controversial interpretation of the positive link between innovation propensity/intensity and the likelihood of evaluating as crucial the barriers to innovation is offered by Baldwin and Lin (2002) and Tourigny and Le (2004), who maintain that 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.

(7) The choice of the econometric technique used in the paper is justified in Section IV.2. Here we recall the main issues raised in the literature that are crucial for identifying the most appropriate econometric specification.

blem in these models is represented by the possible correlation between the different dependent variables, suggesting the use of a multivariate econometric specification (8).

A second strand of literature focuses on the analysis of the opposite causal relationship, namely the role of perceived obstacles as affecting the probability to innovate and/or the intensity of innovation. Great attention in these studies is devoted to the issue of whether the firm's innovativeness and the perception of obstacles influence one another, thus to the presence of a possible estimation bias due to the endogeneity of the regressors. Mohen and Roller (2005), using CIS1 data for four countries and focusing on four selected obstacles, find that the two phases of the innovation process – probability of introducing innovation and intensity of financial effort devoted to innovation – are subject to different constraints, and offer suggestions to promote complementarities in innovation policy (9). Savignac (2006), matching data from FIT and Banque de France on French manufacturing firms, shows that the likelihood that a firm will implement innovative projects is significantly reduced by the presence of financial constraints, measured by data on perceived obstacles (10). Tiwari *et al*. (2007), on the basis of the Dutch CIS, also estimate the effect of perceived financial obstacles on R&D investment, including a dummy for all other obstacles grouped together. Their results show that financial constraints have a strong and significant effect in discouraging R&D investment (11).

Overall, the analysis of the other way round link between obstacles and innovation – *i.e*. the perception of obstacles as affecting the probability/intensity of innovation – calls (and allows) for a proper treatment of the possible endogeneity bias issue. All the contributions reviewed among this second approach duly account for it, though focusing on just one type of obstacles, and some-

(8) Only Galia and Legros (2004) address and correct for such a problem, by using a multivariate probit model (MPM).

(9) Mohnen and Roller (2005) consider four specific obstacles, one from each category. They correct for endogeneity when estimating the determinants of the intensity of innovation, finding no reverse causality. No correction was made in the case of the propensity equation, due to lack of instruments (p. 1445).

(10) When considering both innovative and non innovative firms, Savignac (2006) finds evidence of the endogeneity problem between the innovation decisions and the existence of financial constraints. Only financial obstacles are included in the estimation.

(11) Tiwari *et al*. (2007) test also the reverse relationship (*i.e*. the impact of firms' characterisctics on the probability that financial factors are perceived as important). They find that, also correcting for endogeneity, innovativeness has a positive -although not significant- effect on the probability that financial obstacles are reported as important. This result is thus in line with the findings obtained by the first stream of literature considered above. See also Mohen *et al*. (2008).

how choosing to overlook the role of non-financial obstacles. Again, this has important implications in terms of the particular econometric strategy chosen.

In this paper, following the first strand of research, we analyse how the perception of different types of obstacles to innovation in the case of Italian firms is affected by both the type of firm (by organisational structure and ownership) and the regional location. We aim in fact to shed light on the role of foreign MNEs and on the regional context. The spatial location of firms is particularly important when considering a country characterized by a considerable regional divide as Italy. Also, while previous studies dealt with data on Canada, France and Netherlands, this paper is the first to analyse the case of a Mediterranean country.

As detailed below in Section IV.2, we follow Galia and Legros (2004) as we believe it crucial to account for the perception of each of the obstacles at the same time, controlling for unobserved correlation between the dependent variables.

IV. — DATA SOURCE AND ECONOMETRIC SPECIFICATION

IV.1. The structure of the Italian CIS3 sample

The Community Innovation Survey (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 (12). 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 (13). All respondent firms are asked to rate the importance of each of the obstacles affecting 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), and refer to the period

(12) 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.

(13) More in particular, 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).

1998-2000. The sample is composed of 15,512 firms stratified by industry and size (14).

Table 1 (page following) 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 – *i.e.* to a foreign MNE – to an Italian group, or single domestic) (15) ;

(ii) location (firm located in the North-West, North-East, Centre or South) (16) ;

(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 does not belong to groups. About 23 % of the respondent firms belong to a group, and less than 6 % of the total belongs to a foreign group, reflecting the relatively marginal foreign presence in Italy. Yet, in line with the literature summarised in Section II, in the Italian case the percentage of innovators among foreign MNEs (57.5 %) is almost the double of that of single domestic firms (31 %) (17), and higher than that of Italian groups (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

(14) 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.

(15) For the definition of statistical unit in the CIS, see the EEC Council Regulation on statistical units (n° 696/93).

(16) 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).

(17) It should be noted that in different rounds of CIS only about one third of firms operating in Italy declared to have 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.

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 a foreign group	905	5.83%	520	57.46%
firm belonging to a domestic group	2,595	16.73%	1301	50.13%
single domestic firm	12,012	77.44%	3683	30.66%
Total sample	**15,512**	**100%**	**5504**	**35.48%**
Location of firm				
firm located in the North-West of Italy	4,852	31.28%	1939	39.96%
firm located in the North-East	4,503	29.03%	1804	40.06%
firm located in the Center	2,979	19.20%	980	32.90%
firm located in the South	3,178	20.49%	781	24.58%
Total sample	**15,512**	**100%**	**5504**	**35.48%**
Sectors				
Extraction	232	1.50%	48	20.69%
Food, beverage and tobacco	627	4.04%	229	36.52%
Textile, clothing and leather	1,186	7.65%	278	23.44%
Wood, paper, printing and publishing	1,502	9.68%	508	33.82%
Coke, oil, nuclear, chemicals	617	3.98%	351	56.89%
Plastic and non metal products	1,071	6.90%	451	42.11%
Metals	1,061	6.84%	440	41.47%
Machinery and equipment	697	4.49%	433	62.12%
Electrical machinery, electronics and optical	1,124	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	1,722	11.10%	408	23.69%
Hotels and restaurants	529	3.41%	89	16.82%
Transport services and communication	1,321	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	**15,512**	**100%**	**5504**	**35.48%**

* KIBS include engineering and technical consultancy

distribution is slightly more balanced (the North hosts around 65 % of the nationally-owned groups). The southern part of the country scores 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

TABLE 2 :
Distribution of innovative firms by type and macro-region – weighted sample

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

macro-regions is significant at the 1 % level, indicating that foreign groups locate in the North-West of Italy significantly more than what 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 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) (18). The evidence confirms both the « innovation divide » in Italy – with central and, 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-west and North-East) is definitely higher than for the Center (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 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

(18) This explains the discrepancy between the percentages of innovative firms by type and region reported in the last column of Table 1 (unweighted sample) and the percentages reported in the last row and column of Table 2 (weighted sample).

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 between manufacturing and 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 III, 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 peculiarities were uncovered for the sample of firms as a whole in the descriptive statistics. Rather surprisingly, the shares of respondents located in the North-east of the country perceiving the obstacles to innovation as important or very important are the highest for some types of obstacles. However, lack of financial resources and regulatory rigidities were perceived as very important by much higher percentages of firms in the South than in the other macro-regions, while, without exception, firms in the North-West and in the central regions show the lowest shares of those attributing 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 firms (foreign multinationals versus domestic firms belonging to a group and single domestic firms), and among macro-regions, and between innovators and non-innovators.

IV.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). 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 (19).

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 (20) does not indicate a direct causal effect between the perception of 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 (21). The matrix of correlation coefficients amongst obstacles shows that this is the case. However, as mentioned earlier in Section III with respect to the existing literature on the perception of obstacles, we are interested in assessing the association of the chosen regressors for each single obstacle, on the basis of the fact that *each* has an informative potential *per se*, controlling for the possible presence of an unobserved structure which correlates obstacles amongst themselves (22).

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 (as in Galia and Legros, 2004) (23). The MPM allows the error terms to be freely

(19) We found that the use as dependent variable of the (discrete) values of the obstacle evaluation (*i.e.* the multinomial ordered probit model) gives similar results to those obtained using the dichotomous variable. See note 23.

(20) Firms were asked to « grade the importance of any hampering factor to technological innovation activity which the enterprise has experienced ».

(21) 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.

(22) 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 produce biased results.

(23) 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.

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)

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 (24).

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

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

(24) 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.

TABLE 3 :
List of variables included in the empirical analysis

Variables	Notes
Dependent Variable	
Excessive financial risk 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 of regulation and normative standards Lack of customer responsiveness to new goods and services	Dummy for firm evaluating the obstacle as important or very important*
Independent variables : firm specific	
Size	Number of employees in 1998 (log value)
Foreign groups	Dummy for firm belonging to a foreign group
ltalian groups	Dummy for firm belonging to an Italian group
Single ltalian 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 = O)
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)
Center	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 Food, beverage and tobacco Textile, 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 (engineering, technical consultancy) Other business services	Dummy for firm belonging to each sector

* 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

innovation over the period 1998-2000 (which assumes the value 1 for firms responding positively, and 0 otherwise) (25).

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 Center (Marche, Umbria, Toscana, Lazio) ; or in the southern regions of Italy (Abruzzo, Molise, Campania, Basilicata, Calabria, Puglia, Sicilia, Sardegna).

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 domestic firms belonging to a group ; and the sub-sample of single domestic firms, to allow a more in-depth exploration of regional differences within each type of firm.

V. — RESULTS

V.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

(25) The perception of obstacles may depend on the firm attempting to introduce innovation, but also the actual status of being innovative may depend on having experienced obstacles. This would require correcting for the presence of a potential endogeneity bias in the estimation carried out. However, several issues led us to choose to maintain the MPM estimation without attempting to correct for endogeneity by instrumenting the « status of being innovative » or the « willingness to innovate ». First of all, to our knowledge there is no such a possibility of employing a IV estimation within an MPM, as there is no solid evidence of the stability of the asymptotic properties of the estimator. Secondly, as in Mohnen and Roller (2005), the attempt to correct for endogeneity is constrained, in our case as in theirs, by the lack of appropriate instruments. To summarise, we chose to maintain the use of an MPM estimation which does not allow correcting for endogeneity bias, in the belief that the presence of endogeneity would not substantially affect the nature and direction of our findings. The identification of an econometric model and an estimation procedure which allow the use of IV within an MPM, though well beyond the scope of the present paper, is part of our research agenda.

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

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

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.

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 (26). Recall that the MPM allows the degree of correlations amongst different obstacle ratings to be controlled for. Therefore, the coefficients reported in Table 4 represent the actual association between the regressors and *each of the obstacles* evaluated by firms.

Overall, it emerges a visible 'innovation divide' pattern in terms of perception of obstacles, in which firms in the North and the Center of Italy tend to perceive the obstacles to innovation as less significant than those located in the South. Firms in the North and the Center 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 for firms located in the North-West of Italy. Although not fully representative of the variety of regional innovation models (given the broad geographical aggregation in macro-regions), this result confirms the traditional North-South distinction in the Italian innovation system.

Our results also reflect the differences in the characteristics of the two Northen areas. We find that the lack of skilled personnel is seen as a more serious impediment for firms in the North-East (significance at 1 %) rather than the North-West (not significant) as compared to the Southern reference category. This may be explained by recalling that the North-East of Italy in the last thirty years has been growing at a very fast rate (higher than the rest of Italy), going through impressive socio-economic changes and experiencing, at the same time, a rapid demographic contraction. The rate of unemployment in this area has been consistently the lowest in Italy, as the labour market in the North-East has reached almost full employment level. The lack of skilled labour (particularly engineers and skilled operatives) has been identified as

(26) For reasons of space, the results at sectoral level are not discussed here. However, as was evident from both the empirical literature in Section III and our descriptive statistics, the relevance of sectoral specificities calls for in-depth analysis, which will be part of our research agenda.

one of the major constraints for the future growth of this area (27). On the other hand the North-West has been the core of the Italian industrialisation process and its economic and institutional evolution has been far more gradual. Indeed, the regions of Lombardia and Piemonte (and to a lesser extent Liguria) represent the technological heart of the Italian innovation system, and enjoy a degree of institutional flexibility and adaptability to change by no means comparable to those in the rest of the country (Iammarino, 2005) (28). This may also help explain why the perception of regulatory rigidities is 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 institutions – interacting with the specificities of regional industrial structures – in shaping technological and innovation environments (29).

The results for types of firm by organisational structure and ownership show that the major difference in the perception of obstacles occurs between firms belonging to a group (foreign and Italian) and single domestic firms, rather than between firms with different nationality of ownership (30). Firms belonging to a group tend to evaluate the obstacles to innovation as important, or very important, significantly less than the reference category (single domestic firms). 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 » for most obstacles. This is the case for obstacles of an economic/financial nature, for those related to the lack of information of technology and also in the case of regulation rigidities, which one might have

(27) At the end of the 1990s the unemployment rate was 4.5 for the North-East against 11.4 for Italy as a whole. See also Gambuzza and Rasera (2000), ISTAT (various years) and, among others, Anastasia and Corò (2001) on the shortage in overhead capital and skilled labour as limits to growth in the area.

(28) On the different development paths of the regions in the North-East of Italy see also Bagnasco (1977), Malerba (1993), Boschma (2003).

(29) For an in-depth historical account of such regional differences see, among others, Zamagni (1990). For consistent results from previous Italian CIS analysed at the regional level see Silvani *et al*. (1993), Iammarino *et al*. (1995, 1998) and Evangelista *et al*. (2001, 2002).

(30) We could also consider Italian firms belonging to a group as a proxy for Italian MNEs. 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 that are multinationals is considerably higher in the case of firms belonging to groups than in the case of single firms. 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.

expected to be more of an obstacle for foreign-owned than for Italian-owned firms (31). Italian groups instead tend to be less sensitive than foreign MNEs to barriers related to the lack of information on markets, which is not surprising as they have stronger ties with the local economy, and to the lack of organisational flexility. 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 V.2 below).

With reference to the role of size, in line with most of the existing empirical evidence (see, for instance, Hyytinen and Toivanen, 2005 ; Tourigny and Le, 2004) we find that while small rather than large firms see the lack of financial resources as significant barriers to innovative efforts, the reverse is true for impediments related to internal organisation. Our data thus confirm that the relative strength of small firms lies in their flexibility. In addition, large firms are also more likely to perceive as important obstacles related to regulatory rigidities and lack of client responsiveness.

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 (32). 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 seen as a barrier by firms when deciding whether to innovate or not. This result, and the existing literature, lead 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.

(31) 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.

(32) See Section III for the conceptual and methodological issues related to this finding.

V.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 comfort the results in section V.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, to an Italian-owned group and for single domestic firms.

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 generally 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 for most obstacles 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 sub-sample of Italian groups. This suggests, therefore, that the most innovative firms 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 (Table 7), which see financial obstacles as more relevant than organisational ones. Finally, size does affect obstacle perception in the case of Italian groups but this is not the case for foreign owned groups.

Table 7 reinforces the results of the full sample estimation (Table 4), in terms of identification of geographical patterns of perception of obstacles. When tes-

See Tables 5, 6 and 7, following pages

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 resources	Lack of org.al flexibility	Lack of skilled personnel	Lack of info tech.	Lack of info markets	Regulat. rigidities	Lack of clients' responsiveness
Independent variables : location of firm									
North-West	-0.061 [0.224]	-0.12 [0.214]	0.086 [0.237]	0.078 [0.226]	0.17 [0.230]	0.131 [0.243]	0.027 [0.243]	-0.219 [0.233]	0.171 [0.246]
North-East	-0.175 [0.240]	0.001 [0.226]	0.248 [0.251]	0.082 [0.241]	0.272 [0.242]	0.153 [0.258]	0.123 [0.257]	-0.131 [0.249]	0.11 [0.263]
Center	0.024 [0.246]	-0.048 [0.233]	0.011 [0.263]	0.15 [0.247]	0.081 [0.256]	0.378 [0.265]	0.22 [0.267]	-0.095 [0.258]	0.254 [0.268]
South	ref	ref	ref	ref	ref	ref	ref	ref	ref
Independent variables : firm specific									
Innovative	0.441 [0.111]***	0.414 [0.099]***	0.346 [0.119]***	0.276 [0.109]**	0.64 [0.111]***	0.493 [0.120]***	0.609 [0.127]***	0.571 [0.125]***	-0.039 [0.114]
Size	0.016 [0.039]	0.015 [0.036]	-0.046 [0.042]	-0.013 [0.038]	-0.048 [0.038]	-0.021 [0.040]	-0.006 [0.041]	0.033 [0.041]	0.049 [0.041]
Independent variables : sectoral affiliation (coefficients not reported)									
Constant	-0.328 [0.622]	-0.27 [0.676]	-5.078 [81.297]	-1.106 [0.819]	-1.552 [0.956]	-1.643 [1.139]	-1.589 [0.810]**	-1.508 [0.966]	-1.51 [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 resources	Lack of org.al flexibility	Lack of skilled personnel	Lack of info tech.	Lack of info markets	Regulat. rigidities	Lack of clients' responsiveness
Independent variables : location of firm									
North-West	0.028 [0.089]	-0.034 [0.080]	-0.182 [0.087]**	0.004 [0.097]	-0.046 [0.088]	-0.059 [0.092]	-0.046 [0.097]	-0.046 [0.090]	-0.061 [0.091]
North-East	0.184 [0.090]**	0.134 [0.081]*	-0.072 [0.088]	0.138 [0.097]	0.115 [0.089]	0.095 [0.092]	0.105 [0.097]	0.054 [0.092]	0.047 [0.092]
Center	0.039 [0.099]	0.01 [0.090]	-0.002 [0.095]	0.045 [0.108]	-0.119 [0.100]	-0.131 [0.105]	0.086 [0.107]	0.026 [0.100]	-0.145 [0.104]
South	ref	ref	ref	ref	ref	ref	ref	ref	ref
Independent variables : firm specific									
Innovative	0.383 [0.062]***	0.37 [0.057]***	0.326 [0.063]***	0.283 [0.067]***	0.42 [0.063]***	0.361 [0.066]***	0.337 [0.069]***	0.205 [0.064]***	-0.013 [0.065]
Size	0.013 [0.021]	-0.005 [0.019]	-0.044 [0.021]**	0.004 [0.022]	-0.036 [0.021]*	-0.041 [0.022]*	-0.042 [0.023]*	0.004 [0.021]	0.015 [0.022]
Independent variables : sectoral affiliation (coefficients not reported)									
Constant	-1.013 [0.372]***	-0.96 [0.377]**	-0.812 [0.382]**	-1.447 [0.433]***	-1.002 [0.403]**	-1.315 [0.433]***	-1.259 [0.432]***	-0.825 [0.369]**	-0.999 [0.392]**
Observations Log Likelihood	2595 -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 resources	Lack of org.al flexibility	Lack of skilled personnel	Lack of info tech.	Lack of info markets	Regulat. rigidities	Lack of clients' responsiveness
Independent variables : location of firm									
North-West	-0.033 [0.036]	-0.01 [0.034]	-0.164 [0.035]***	-0.036 [0.040]	-0.0001 [0.037]	-0.131 [0.039]***	-0.132 [0.039]***	-0.091 [0.038]**	-0.029 [0.037]
North-East	-0.002 [0.036]	0.042 [0.033]	-0.145 [0.035]***	0.052 [0.039]	0.126 [0.036]***	-0.034 [0.037]	-0.027 [0.038]	-0.05 [0.037]	0.033 [0.036]
Center	-0.091 [0.040]**	-0.02 [0.037]	-0.12 [0.038]***	0.018 [0.043]	0.054 [0.040]	-0.08 [0.042]*	-0.116 [0.043]***	-0.049 [0.041]	0.014 [0.040]
South	ref	ref	ref	ref	ref	ref	ref	ref	ref
Independent variables : firm specific									
Innovative	0.346 [0.028]***	0.338 [0.026]***	0.358 [0.027]***	0.176 [0.031]***	0.306 [0.027]***	0.327 [0.029]***	0.286 [0.030]***	0.254 [0.029]***	-0.121 [0.030]***
Size	-0.033 [0.014]**	-0.029 [0.013]**	-0.047 [0.014]***	0.1 [0.015]***	0.037 [0.014]***	0.037 [0.015]**	0.011 [0.015]	0.029 [0.014]**	0.024 [0.014]*
Independent variables : sectoral affiliation (coefficients not reported)									
Constant	-0.933 [0.130]***	-0.723 [0.114]***	-0.601 [0.118]***	-1.487 [0.136]***	-1.34 [0.131]***	-1.512 [0.145]***	-1.373 [0.142]***	-1.143 [0.130]***	-1.049 [0.129]***
Observations	12012								
Log Likelihood	-36786.899								

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

ted 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-Center of the country than in the southern areas for many organisational-related obstacles, lack of financial resources and to regulation rigidity (33).

VI. — CONCLUSIONS

In this paper we analyse to what extent, in the case of firms operating in Italy, the perception of obstacles to innovation is affected by both the type of firm (by organisational structure and ownership) and the regional location, using firm-level data from the Italian third Community Innovation Survey (CIS3). The spatial location of firms is particularly important when considering a country characterised by a considerable regional divide as Italy. In the empirical analysis, we decided to consider at the same time all nine individual hampering factors considered in the Italian CIS3, as each single obstacle has an informative potential *per se*. We thus used a Multivariate Probit Model (MPM) for the nine dependent variables, to control for the potential presence of an unobserved error correlation structure amongst obstacles assessment.

This study has shown that important differences in firms' perception of obstacles to innovation occur both across regional locations and types of firms. Overall, firms located in the North and in the Center of Italy tend significantly less frequently to perceive obstacles to innovation as relevant than firms in the South. In particular, the lack of financial resources is perceived as a stronger impediment to innovation in the South. On the one hand, these results offer support to the typical North-South divide that exists in the Italian innovation system. On the other hand, they also point to important differences between

(33) 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 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.

the two Northern areas (with the lack of skilled personnel seen as a more serious impediment for firms in the North-East, while the perception of regulatory rigidities is found to be significantly lower for firms located in the North-West). We explain how the peculiar structural features of these two areas help interpreting these results. When the estimation is carried out on subsamples 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 major difference in the perception of obstacles occurs between firms belonging to a group (foreign and Italian) and single domestic firms, rather than between firms with different nationality ownership. We find that firms belonging to a group tend to perceive obstacles to innovation as relevant significantly less than single domestic firms, with the exception of lack of organisational flexibility. Thus, firms belonging to a group appear to be less sensitive to their socio-economic and institutional context than single domestic firms. This pattern is however more pronounced in the case of foreign MNEs, which also emerge as the most innovative firms, regardless of their geographical location.

We also find that company size has an important role : while small firms see the lack of financial resources as a more significant barrier to innovative efforts than large firms, the reverse is true for impediments related to internal organisation.

The structural association between firms' perception of obstacles and their innovation propensity is shown to be positive. As in previous studies (*e.g.* Galia and Lagros (2004)), we interpreted this apparently surprising finding as due to innovators being more likely to have experimented barriers to innovation, and therefore more likely to assess obstacles as important. However, a possible endogeneity issue might also emerge, due to reverse causality between the perception of obstacles and firms' innovative activities. Further research is needed to convey convincing results on this point.

Our future research steps will follow three main directions. The issue of the possible endogeneity between obstacle perception and the probability to innovate deserves greater attention. That would require a model allowing the implementation of an instrumental variable procedure within a Multivariate Probit Model framework, which at the current state of the art is not available. The identification of such econometric model and the estimation procedure is a main item of our research agenda. Furthermore, 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. How to attract asset-seeking and knowledge-producing foreign investment, and how

to promote innovation-conducive environments, is still far from being obvious, and further research is needed to provide sounder bases for public intervention.

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