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What hampers innovation? Revealed barriers versus deterring barriers

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ABSTRACT

Innovating firms are likely to face several challenges and experience different types of barriers. In this paper we argue that it is necessary to distinguish between two kinds of barriers to innovation. The first corresponds to what we describe as *revealed barriers* and reflects the degree of difficulty of the innovation process and the learning experience consequent on the firm engaging in innovation activity. The second type of impediment, which we label *deterring barriers*, encompasses the obstacles that prevent firms from committing to innovation. We use data from the 4th UK Community Innovation Survey (CIS4) to investigate the relationship between firms' engagement in innovation and their assessment of the barriers to innovation. We show that the relationship is curvilinear in the case of costs and market barriers. These results have important implications for innovation policy and innovation management.

1. Introduction

Successful innovation depends on the firm combining a range of capabilities, including capacity to access finance, understanding market needs, recruiting high-skilled staff, and establishing effective interactions with other actors. Innovating firms necessarily are forced to cope with most, if not all of these challenges. Some firms, however, are deterred from engagement in innovation because of the difficulties involved, and remain locked into established routines. Other firms do try to innovate and invest in formal or informal research and development, but may fail to bring new products or processes to market because they are unable to overcome these barriers. It is important, for two reasons, to distinguish between the different types of innovation barriers.

First, a distinction is crucial from an innovation policy perspective; in order for policy makers to be able to design appropriate measures to tackle systemic failures that prevent firms from engaging in innovation activities, they need to identify why and to what extent firms are excluded from the innovation contest (Woolthuis, 2005; Chaminade and Edquist, 2006). Second, from the perspective of innovation management it is important to identify the barriers commonly faced by firms engaging in innovation activities, and especially those that result in failure to introduce new products/processes in the market; this should provide crucial insights for managers, to inform corporate strategies oriented to overcoming the obstacles to innovation.

This paper aims to examine two arguments. First, we claim that to analyse the relationship between engagement in innovation and the challenges faced by firms, it is necessary to distinguish between two main barriers to innovation: *revealed* barriers and *deterring* barriers. While the former refers to the firm's awareness of the difficulties involved as a result of engagement in innovation activities—pointing to a "disclosing" or "learning" outcome based on direct experience, the latter refers to a barrier that is seen by firms as being insurmountable. Second, drawing on this distinction, we argue that different types of obstacles are likely to have distinct effects as either deterring or revealed barriers. In other words, some types of barriers might deter some firms from any engagement in innovation activities, and some types may be experienced mostly by firms heavily engaged in innovation—irrespective of their success at introducing new products or processes into the market. The objective of this paper is to provide new insights regarding these claims.

The paper is organised as follows. Section 2 reviews the main literature streams focusing on the nature and relevance of barriers that prevent or slow innovation activity. Section 3 discusses how

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the information from 4th UK Community Innovation Survey (CIS4) is used to examine the relationship between firms' engagement in innovation activities and their assessments of the importance of the barriers to innovation. Sections 4 and 5 examine these relationships in detail and report the results of the econometric exercise. Section 6 concludes with a discussion of the main findings and provides some implications of our research.

2. Literature background: *revealed* versus *deterring* barriers to innovation

2.1. Barriers to innovation

The empirical literature based on innovation surveys, such as the European CIS, which explores the nature and impact of innovation across firms and sectors, is large and consolidated. Regarding the role of barriers to innovation, empirical work largely focuses either on (i) the factors affecting perceptions of the importance of barriers (Mohnen and Rosa, 2000; Baldwin and Lin, 2002; Baldwin and Hanel, 2003; Galia and Legros, 2004; Iammarino et al., 2009) or on (ii) the impact of (mainly financial) obstacles on the propensity to innovate and/or the intensity of innovation (Arundel, 1997; Tourigny and Le, 2004; Mohnen and Röller, 2001, 2005; Savignac, 2006, 2008; Tiwari et al., 2007; Mancusi and Vezzulli, 2010). We argue that these two categories of contributions (whose main findings substantially converge), fail to identify the different nature of the barriers to innovation in terms of their revealed versus deterring effects, and the contexts in which they might co-exist. Also, most survey-based contributions tend to focus on the effects of financial obstacles where there is a range of non-financial barriers—market, knowledge and regulation—that are crucial in the context of innovation policy and management.

2.2. Revealed barriers to innovation

Most studies that focus on the factors affecting firms' perceptions of the importance of barriers, show that the greater the firm's involvement in R&D and other innovation activities, the greater will be the importance attached to the impediments to innovation. For instance, Baldwin and Lin (2002), in a representative sample of Canadian manufacturing firms, examine whether the proportions of firms that experience obstacles differ between innovators and non-innovators (and between adopters and non-adopters of advanced technologies). They find that a larger proportion of innovators and adopters of advanced technologies report impediments to technology adoption compared to non-innovators and non-adopters of advanced technologies. Mohnen and Rosa's (2000) results from an empirical analysis of Canadian services over the period 1996–1998, based only on innovators and using R&D intensity as a proxy for innovation intensity, are similar insofar as they find that the most innovation-intensive firms are also those reporting more frequent obstacles to innovation. Along the same lines, Iammarino et al. (2009), using data from the Italian CIS3 and focusing on firm ownership (i.e. foreign multinationals versus nationally owned groups and single domestic firms) and regional location, find support for the hypothesis of a positive association between firms' perception of obstacles and their innovation propensity.

These studies tend to explain this somewhat surprising finding as due to innovators being more likely to have experienced the barriers to innovation and, therefore, being more likely to recognise their importance. 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". This would imply that the perception of obstacles by innovative firms may slow, but not prevent firms' engagement in innovation activity. A more controversial interpretation of the positive link between innovation propensity/intensity and the likelihood of recognising the barriers to innovation as important, is offered by Baldwin and Lin (2002) and Tourigny and Le (2004). They suggest that the obstacles to innovation, at least as measured in innovation surveys such as the CIS, should not be interpreted as preventing innovation or technology adoption, but rather as an indication of how successful the firm is at overcoming them.

This first group of studies thus offers a *revealed barriers* interpretation of the relationship between innovation efforts and obstacles. That is, engagement in innovation activity increases firms' awareness of the associated difficulties (i.e. increases consciousness and knowledge of the factors constraining innovation through the "disclosing" or "learning" outcome of direct experience), although it does not prevent them from engaging in innovation activities or being successful innovators. This interpretation is confirmed by the evidence from another stream of literature in which a number of works examine firms' experiential learning from their own (Miner et al., 1999; Haunschild and Sullivan, 2002; Denrell, 2003) and other organisations' innovation failures (Kim and Miner, 2007; Baum and Dahlin, 2007). The innovation path is invariably punctuated by setbacks and failures (Ferriani et al., 2008), which might be more valuable for learning than accomplishments and successes (Miner et al., 1999; Baum and Dahlin, 2007).

Among the studies in the second group of survey-based contributions, which focus on the impact of obstacles on the propensity to innovate, some account for possible estimation bias due to the endogeneity of the regressors, that is, reverse causality between the perception of obstacles and firms' innovation efforts (Mohnen and Röller, 2001, 2005; Savignac, 2006, 2008; Tiwari et al., 2007; Mancusi and Vezzulli, 2010). These studies show that firms' engagement in innovation activities is significantly reduced or discouraged by the presence of obstacles. For example, Savignac (2006), using data on French manufacturing firms, shows that the likelihood that a firm will implement innovative projects is significantly reduced by the presence of financial constraints. Tiwari et al. (2007), on the basis of the Dutch CIS, estimate the effect of perceived financial obstacles on R&D investment,[1] and find a strong and significant deterrent effect of the former on the latter. The authors test the reverse relationship (i.e. the impact of firms' characteristics on the probability that financial factors are perceived as important) and show that, correcting for endogeneity, innovativeness has a positive—although not significant—effect on the probability that financial obstacles will be seen as important. This result is in line with the findings of the first group of studies considered above.[2] Some of the most recent contributions in this second line of research, which focuses exclusively on financial obstacles, point out that the counter-intuitive, positive correlation between the perception of barriers and engagement in innovation, can be attributed to a combination of several sources of bias (Savignac, 2008; Mancusi and Vezzulli, 2010). First, it can be attributed to the presence of heterogeneous unobserved firm-specific factors (such as entrepreneurial behaviour or identification of market opportunities) that may impact on both aspects of the relationship. Second, it can be attributed to the simultaneous determination of the decision to innovate and the decision to finance R&D projects. In addition to these two sources of endogeneity, there may be selection bias if the firm sample includes firms that, for various reasons, are not interested in innovating. The presence of these firms may well induce a positive spurious correlation

[1] Tiwari et al. (2007) include one dummy for all other obstacles grouped together, and focus on the role of financial barriers.

[2] See also Mohnen et al. (2008).

Table 1
Proportion of firms reporting barriers as important by degree of engagement in innovative activities (number of observations: 12,024).

Type of Barriers	Degree of engagement in innovative activities				
	Zero	1–2	3–4	5–7	Chi-square (χ^2)
Cost factors	30.7	29.0	36.6	42.8	136.69[a]
Knowledge factors	12.1	10.8	13.1	15.2	25.26[a]
Market factors	19.0	15.3	17.4	19.7	23.95[a]
Regulation factors	16.8	14.5	15.4	18.5	18.03[a]

[a] Statistically significant at 1%.

between perception of barriers and firm innovativeness (Savignac, 2008; Mancusi and Vezzulli, 2010), and may over-estimate the role of revealed barriers while underestimating or ignoring deterrents.

2.3. Deterring barriers to innovation

Support for barriers interpreted as a real impediment to the firm's innovation activities—that is, the view of barriers as inducing *deterring* effects—comes from different streams of the literature in the fields of innovation management and industrial organisation, which complement survey-based studies by drawing on in-depth case study evidence or analyses of entry barriers in particular industries. These research strands investigate, for instance, why different types of companies are likely to confront different types of barriers to innovation. Distinctions are made, for example, between large established firms and small new firms and there is a broad consensus that, although the former are suited to developing incremental innovations, small new firms are better at developing radical innovation (Hamilton and Singh, 1992; Henderson, 1993; Christensen and Bower, 1996). The innovation profiles of these two groups of firms differ due, among other factors, to the types of obstacles to innovation that they face.

Large established firms experience barriers to innovation due to path dependence and lock in, which result in a resistance to adjust competencies and previously successful organisational practices (Ferriani et al., 2008). For instance, organisational inertia and structured routines may limit the ability of incumbent firms to identify new opportunities and adapt to environmental changes (Nelson and Winter, 1982; Hannan and Freeman, 1984; Dougherty, 1992), strengthen the resistance to engage in radical innovation to avoid cannibalising existing products or destabilising core competencies (Tushman and Anderson, 1986; Henderson, 1993), or foster a narrow commitment to a few main customers (Christensen, 1997). The obstacles faced by new firms, on the other hand, may be related, principally, to lack of resources and market structure. The former includes knowledge and organisational skills, such as the lack of expertise in the technologies used in manufacturing-intensive sectors (Gort and Klepper, 1982; Katila and Shane, 2005), and lack of finance (Schoonhoven et al., 1990; Katila and Shane, 2005), while market structure, in the traditions of both Schumpeter (1942) and Arrow (1962), may impose severe constraints in the form of competition, firm size and appropriability conditions.[3] New firms are likely to face higher barriers to innovation in larger and less competitive markets where incumbents are better placed to capitalise on the capabilities for coordinating complementary assets which new firms often do not possess (Schoonhoven et al., 1990; Tripsas, 1997; Dean et al., 1998).

[3] Research on technological regimes in the Schumpeter (1942) tradition emphasizes the positive relationship between firm size, market power and innovativeness. However, Arrow (1962) shows that, under conditions of incomplete appropriability of the returns to innovation, this relationship does not necessarily hold. Within this vast literature see Nelson and Winter (1982), Freeman (1982), Winter (1984), Malerba and Orsenigo (1993, 1995).

In short, the innovation survey-based literature pays scant attention to non-innovative firms, either focusing on the barriers faced by innovative firms (e.g. Galia and Legros, 2004; Mohnen and Rosa, 2000) or treating all non-innovators as a single, undifferentiated group (e.g. Baldwin and Lin, 2002; Iammarino et al., 2009). In addition, these studies generally focus only on financial obstacles and largely ignore other constraints (Tiwari et al., 2007; Savignac, 2008; Mancusi and Vezzulli, 2010). Our empirical study tries to overcome some of these limitations by: (a) explicitly considering two types of innovation barriers: revealed and deterring; and (b) examining whether cost, knowledge, market and regulation barriers play distinct roles as deterrents by discouraging engagement in innovation *tout court*, or as revealed obstacles by disclosing the difficulties inherent in the innovation processes of successful innovators.

3. Data and constructs

3.1. Data sources

This paper uses data from the 2005 UK Innovation Survey (part of the fourth iteration of the Community Innovation Survey - CIS4 - covering EU countries), which refer to the period 2002–2004. The survey sampled more than 28,000 UK enterprises with ten or more employees, and had wide sectoral coverage including both manufacturing and service sectors. The data are stratified by Government Office Regions in England, Scotland, Wales and Northern Ireland. The raw data consist of a representative sample of 16,445 firms.

In order to investigate the issues raised in Section 2, we draw on the responses to questions in two sections of CIS4 asking respectively about firms' assessment of the barriers related to their innovation activities, and the range of innovation activities they engage in. Since the responses to these two questions are crucial for the analysis in this study, we discuss their exact framing below.

3.2. Barriers to innovation

The question asks firms to report whether they have experienced barriers, and if so, to assess their importance. It includes 11 items that capture factors that hamper innovation efforts or influence the decision not to innovate (Table A.1 in the Appendix). In Table A.1, the 11 items are grouped into 4 categories: cost factors, knowledge factors, market factors, others. Others include regulation issues and, in what follows, we refer to regulation factors. We use these four categories to present the information from the firms' responses to this section of the questionnaire, and to build our barrier constructs.

3.3. Engagement in innovation activities

The question on engagement in innovation activities asks firms to report whether they have engaged in any of seven types of activities and allows us to identify whether the firm did not innovate or was engaged in one or several (up to 7) innovation activities.

Table 2
List of variables: descriptive statistics (Number of observations: 12,024).[a]

Variables	Mean	St. Dev.	Min	Max
Dependent variables				
Cost barriers	0.34	0.47	0	1
Knowledge barriers	0.12	0.33	0	1
Market barriers	0.17	0.38	0	1
Regulation barriers	0.16	0.37	0	1
Independent variables				
Zero innov. activities	0.23	0.42	0	1
1–2 innov. activities	0.32	0.47	0	1
3–4 innov. activities	0.27	0.45	0	1
5–7 innov. activities	0.17	0.38	0	1
Ln Employees	4.11	1.51	2.20	11.01
Part of a larger company	0.39	0.49	0	1
Start up	0.15	0.36	0	1
International market	2.34	1.15	1	4

[a] Due to missing values, the number of observations is lower than 12,024 for some of these variables.

Table A.2 (in the Appendix) reports how the question was formulated and describes each of the items.

3.4. Identifying "potential innovators"

In line with some of the contributions mentioned in Section 2 (i.e. Savignac, 2008; Mancusi and Vezzulli, 2010), firms that attempt to undertake or have already undertaken innovation activities need to be distinguished from firms with no aspirations or intentions to innovate. Following a similar procedure to that proposed in Savignac (2008), we exclude from the analysis all those firms that reported themselves to be non innovation-active (i.e. that responded positively to Question 20 in the survey, see Table A.3 in the Appendix) and did not experience any barriers to innovation (i.e. had not experienced any of the 11 obstacles included in the question on barriers, see Table A.1). This exclusion is based on the rationale that these firms are unlikely to have any aspirations to innovate (at least, in the period considered in the survey). About 60% of these companies indicated "no need due to market conditions" among the reasons why they considered innovation not necessary or not possible. We classified these 3126 as "not innovation-oriented", and excluded them from the subsequent analysis because their inclusion could lead to selection bias (D'Este et al., 2008; Savignac, 2008; Mancusi and Vezzulli, 2010).

The remaining 12,024 firms are included, and are considered "potential innovators" in the sense that they engaged in innovation activities (regardless of whether they have managed to introduce a new or significantly improved product or process) or did not do so because of the barriers to innovation.[4]

3.5. Engagement in innovation activities and barriers to innovation

We provide a preliminary description of the relationship between the extent to which firms engage in innovation activities and their assessment of the barriers involved. To do this, we consider the four categories of barriers listed above (i.e. costs, market, knowledge, regulation factors), setting four intervals for the extent of engagement in innovation activity: no engagement at all (zero), engagement in 1 or 2 innovation activities (1–2), engagement in 3 or 4 innovation activities (3–4) and engagement in more than four innovation activities (5–7). We use these intervals to identify firms that did not engage in innovation activity, from those firms with various degrees of engagement.

Table 1 considers each of the four barrier types separately and shows the proportion of firms that report at least one item (barrier) as highly important for different levels of engagement in innovation activities. Table 1 provides preliminary support for the proposition that assessment of barriers is not independent of the extent of firm engagement in innovation activity. It shows that, regardless of the type of barrier, assessment of barriers as important increases between low (i.e. 1–2) and high (5–7) levels of innovation activity. However, firms that reported no innovation activities tended to assess the barriers to innovation as comparatively more important than firms with low levels of engagement—and particularly in the case of market barriers.

4. Assessment of barriers and engagement in innovation: empirical analysis

Following the survey-based literature on innovation barriers discussed in Section 2, we analyse how the perception of the different obstacles is affected by the firm's engagement in innovation activity, controlling for various firm and environmental characteristics.

Four dependent variables, one for each set of barriers, are constructed as dichotomous variables: for each set of barriers the variable takes the value 1 if the firm assesses at least one item as highly important, and 0 otherwise. Since perceived obstacles are most likely to be related, possible correlation between the different dependent variables presents an estimation problem. Following Galia and Legros (2004), to take account of non-independence of categories of barriers and the need to control for potential correlation in the error terms, we ran a Multivariate Probit Model (MPM) for the four categories of obstacles.[5]

The firm's degree of engagement in innovation activity is measured by a set of three dummy variables that take the value 1 if the firm has engaged in 1–2, 3–4 or 5–7 innovation activities (the reference category is firms that engaged in zero innovation activities). Firm characteristics include: (a) firm size, measured by number of employees (log values); (b) whether the firm is part of an enterprise group; (c) whether the firm was established after 1 January 2000; and (d) degree of market internationalisation.[6] We

[4] The reason why these figures (12,024 and 3126) do not add up to 16,445 is due to missing values with respect to information on product and process innovation, and to inconsistent response patterns that were removed from the analysis (e.g. firms that responded that "factors constraining innovation" were among the factors making innovation not necessary or possible, but indicated that they did not experience any of the barriers listed).

[5] The MPM allows the error terms to be freely correlated across equations, similar to seemingly unrelated least square regressions (SUR models). The use of MPM allows us to account (and to control) for the fact that the barrier ratings may be correlated (see Greene, 2000, and for Maximum Likelihood Estimation of the MPM mvprobit program in STATA, see Cappellari and Jenkins, 2003).

Table 3
Multivariate probit results. Dependent variables: whether the firm assesses at least 1 barrier-item as highly important, for each set of barrier factors.

Explanatory variables	Cost barriers		Knowledge barriers		Market barriers		Regulation barriers	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
No innovation activity	Reference		Reference		Reference		Reference	
1–2 Innovation Active	−0.077**	0.034	−0.065	0.042	−0.188***	0.038	−0.061	0.039
3–4 Innovation Active	0.140***	0.035	0.089**	0.044	−0.101**	0.040	0.039	0.041
5–7 Innovation Active	0.299***	0.0399	0.219***	0.049	−0.030	0.045	0.241***	0.046
Ln Employees	−0.049***	0.009	−0.070***	0.012	−0.037***	0.010	−0.074***	0.011
Part of a larger company	0.027	0.027	−0.038	0.034	0.011	0.031	−0.079**	0.032
Start up	0.111***	0.033	0.047	0.041	0.072**	0.038	−0.076**	0.040
International market	0.004	0.012	−0.035**	0.015	0.041***	0.014	−0.096***	0.015
Constant	−0.311***	0.072	−0.831***	0.088	−0.722***	0.080	−0.776***	0.086
Regional Dummies	Included		Included		Included		Included	
Sector Dummies	Included		Included		Included		Included	
	Rho1		Rho2		Rho3		Rho4	
Rho1	1.000							
Rho2	0.431***		1.000					
Rho3	0.372***		0.399***		1.000			
Rho4	0.359***		0.337***		0.297***		1.000	
No. total observations	11747							
Log Likelihood	−21049.7							
Wald $\chi^2(96)$	723.0***							

Two tailed *t* test.
* $p < 0.10$
** $p < 0.05$.
*** $p < 0.01$.

also include regional and sectoral dummies.[7] Summary statistics for the variables used in the estimation are reported in Table 2.

5. Results

The results of the MPM are reported in Table 3[8] and show that the relationship between being an innovation-active firm and the importance attached to barriers is rather nuanced. Firms that engage heavily in innovative activities are more likely to assess barriers as important compared to firms that do not engage in innovation activities (the reference category), with the notable exception of "market related" barriers. Table 3 shows that the relationship between engagement in innovation activities and assessment of barriers appears to differ across the four sets of barriers. For instance, in the case of cost and, especially, market barriers, the *deterring* effect emerges as particularly strong, while it is weaker for knowledge and regulation barriers (we observe no statistical significance at standard levels).

Also, the *revealed* or *learning* effect from more intensive innovation activity is more pronounced in the case of cost and knowledge barriers, showing that innovation experience generally helps to reduce uncertainty - especially in relation to cost and knowledge, but also in relation to regulation in the case of very high engagement in innovation activity. The learning effect is weak in the case of market barriers, confirming that entry barriers due to market concentration or the risk of not meeting demand expectations, do prevent firms from engaging in innovation.

Table 3 shows that for cost and market barriers there is evidence of a non-linear relationship, because firms need to progress beyond a certain threshold of engagement in innovation activity before a positive relationship emerges. Below this threshold, the relationship is negative; that is, firms that do not engage at all in innovation activity are more likely to assess barriers as important, compared to firms that engage to a small extent (1–2 activities) in the case of cost barriers, or even to a moderate extent (3–4 activities) in the case of market barriers. The existence of a non-linear relationship between engagement in innovation and assessment of barriers represents some reconciliation between the two apparently conflicting interpretations of innovation barriers discussed in Section 2. The U-shaped relationship shows that costs and market barriers hinder commitment to innovation activity (*deterring* effects) for some firms and reflect learning from direct experience of engagement in innovation (*revealed* effects) for others.

Regarding the other firm-specific variables, as expected, size significantly affects perceptions of the obstacles to innovation (i.e. larger firms perceive them as less relevant than smaller firms), and being a new firm increases the probability of assessing cost and market barriers as important, which is in line with the literature reviewed in Section 2 and with the strong deterrent effect related to market obstacles. Internationalisation of the firm's customer base seems to promote learning effects with regard to overcoming innovation-related barriers, strengthening the findings of the literature on "learning by exporting" (Sofronis et al., 1998, among others), but increases perceptions of market concentration and demand uncertainty—suggesting that the learning effect is limited to knowledge and regulation barriers.

6. Summary and conclusions

This paper has tried to highlight the importance of distinguishing between two different effects of the obstacles that firms face in undertaking innovation activity. The first effect is related to increasing awareness of the difficulties involved in innovating, or the "disclosing" and "learning" content of direct experience, described

[6] This variable takes the values 1–4 depending on whether the most distant market served by the firm is the local market ("1"), the UK ("2"), Europe ("3") or a non-European country ("4").

[7] As highlighted in Section 2, perception of obstacles may depend on whether the firm is trying to introduce an innovation or is engaging in innovation related activities, while innovation-active status may depend on having experienced obstacles. This would require correcting for the presence of potential endogeneity bias in the estimation. However, due to the lack of appropriate instruments (Mohnen and Röller, 2005; Iammarino et al., 2009), we do not try to correct for endogeneity. In our view, the presence of endogeneity is not likely to affect the nature or direction of our findings.

[8] We also ran some robustness checks using different specifications such as ordered probit regressions, taking an ordered categorical dependent variable for the number of barrier items ranked as important: the results were consistent with those in Table 3 and are available from the authors on request.

here as the *revealed* effect of barriers. The second effect is related to the perception of the impediments to innovation by firms that otherwise would be keen to engage in this activity: described here as the *deterring* effect of barriers.

We have shown that, in the cases of cost and market barriers, the relationship between assessment of the barriers and engagement in innovation activities is characterised by a non-linear relationship, indicating the presence of both deterring and revealed effects. That is, the assessment of barriers as important is higher at the extremes: when firms do not engage in innovation activity, and when firms are highly innovative.

Firms that engage in innovation activities generally face *revealed* barriers, assessing barriers as highly important alongside their engagement in innovation. Policy measures to remove or reduce the obstacles to innovation for these firms should be directed to the micro-level, and involve encouragement of better management of innovation activity in order to minimise the impact of these obstacles. It is likely that, for innovators, their relative failures might be as valuable as their successes, producing a positive learning cycle.

Firms that do not engage in innovation, conform to a pattern characterised by *deterring* barriers. For firms trying to enter the innovation contest, obstacles—particularly those related to market structure and demand, and the cost of innovation activity—do represent reasons for withdrawal and "failure without learning".

Revealed and *deterring* effects may both be present, depending on the specific phase in the innovation trajectory: when deciding whether to enter the innovation contest, some obstacles may act as real impediments; after committing to innovation and in the course of the innovation activities, overcoming obstacles may result in a learning process which in turn produces more successful performance.

Our finding that deterring effects are particularly strong in the case of market barriers is important since much of the empirical literature on innovation barriers deals only with financial and cost related hampering factors. As discussed in Section 2, the important deterring role of market factors might be interpreted in light of the presence of markets dominated by established incumbents where it is not feasible for new, smaller firms to engage in innovation-based competition (e.g. Schoonhoven et al., 1990; Tripsas, 1997; Dean et al., 1998). A complementary explanation might be related to the uncertainty in the demand for innovative goods and services. Previous studies find that the market's response to the introduction of a new product/service can be seen as a barrier for firms deciding whether or not to innovate (Iammarino et al., 2009). The risk of not meeting demand and, therefore, of failing to increase market share, may prevent firms from innovating. This result could be interpreted at the macro-level of analysis within a "Schmooklerian" framework, according to which the decision to invest in innovation is mainly "demand-led". It is important that this is accounted for in policy aimed at enlarging the base of innovators. In this case, policy measures should be macro-oriented in order to stimulate consumption, increasing market's response to new products to match demand and supply side of innovation. This would reduce the structural risk of not meeting market's demand or facing high market concentration and therefore encourage initial innovative efforts. A detailed analysis of the issue of demand-side innovation policy in relation to obstacles is beyond the scope of this paper, but is an item on our future research agenda (D'Este et al., 2008).

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Appendix A.

Table A.1
Barriers to innovation: during the three-year period 2002–2004, how important were the following factors as constraints to your innovation activities or influencing a decision not to innovate?

Barrier factors	Barrier items	Factor not experienced	Degree of importance		
			Low	Medium	High
Cost factors	Excessive perceived economic risks	□	□	□	□
	Direct innovation costs too high	□	□	□	□
	Cost of finance	□	□	□	□
	Availability of finance	□	□	□	□
Knowledge factors	Lack of qualified personnel	□	□	□	□
	Lack of information on technology	□	□	□	□
	Lack of information on markets	□	□	□	□
Market factors	Market dominated by established enterprises	□	□	□	□
	Uncertain demand for innovative goods/services	□	□	□	□
Regulation factors	Need to meet UK Government regulations	□	□	□	□
	Need to meet EU regulations	□	□	□	□

Table A.2
Engagement in innovative activities: during the three-year period 2002–2004, did your enterprise engage in the following innovation activities?

	Yes	No
Intramural (in-house) R&D		
Creative work undertaken within your enterprise on an occasional or regular basis to increase the stock of knowledge and its use to devise new and improved goods, services or processes	□	□
Acquisition of R&D (extramural R&D)		
Same activities as above, but purchased by your enterprise and performed by other companies (including other enterprises within your group) or by public or private research organisations	□	□
Acquisition of machinery, equipment or software		
Acquisition of advanced machinery, equipment and computer hardware or software to produce new or significantly improved goods, services, production processes, or delivery methods	□	□

Table A.2 (*Continued*)

	Yes	No
Acquisition of external knowledge		
Purchase or licensing of patents and non-patented inventions, know-how, and other types of knowledge from other enterprises or organisations	□	□
Training		
Internal or external training for your personnel specifically for the development and/or introduction of innovations	□	□
All forms of design		
Expenditure on design functions for the development or implementation of new or improved goods, services and processes. Expenditure on design in the R&D phase of product development should be excluded	□	□
Market introduction of innovations		
Activities for the market preparation and introduction of new or significantly improved goods and services, including market research and launch advertising	□	□

Table A.3
Enterprise with no innovation activity (Question 20).

Q 20. If your enterprise had no innovation activity during the three-year period 2002–2004, please indicate why it has not been necessary or possible to innovate.		
	Yes	No
No need due to prior innovation	□	□
No need due to market conditions	□	□
Factor constraining innovation	□	□

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