Department for **Innovation, Universities** & **Skills**

Revealed versus Deterring Barriers to Innovation

Evidence from the 4th Community Innovation Survey (CIS4)

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DIUS Research Report 09 09

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Pablo D'Este [°*]
Simona Iammarino [*]
Maria Savona [•*]
Nick von Tunzelmann [*]

[*] *Science and Technology Policy Research (SPRU)*
The Freeman Centre
University of Sussex
Brighton BN1 9QE

[°] *School of Management*
Cranfield University
Bedford MK43 0AL

[•] *CMI / CBR*
University of Cambridge
Cambridge CB2 1AG

E-mails: p.d-este-cukierman@sussex.ac.uk, s.iammarino@sussex.ac.uk, savona@cournot.u-strasbg.fr, g.n.von-tunzelmann@sussex.ac.uk

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1. Introduction

1.1. Setting the scene and the main focus of the research

A large proportion of firms do not manage to introduce new products to the market or are simply indifferent to innovative activities altogether. For instance, the UK CIS4 shows that while about 37% of firms do not engage in any type of innovative activities, of those that do engage 55% do not introduce new (or significantly improved) products (i.e. goods or services). Despite that, little is known about firms that do not innovate, and in particular, about the role of barriers to innovation, the extent to which barriers actually hamper or slow down innovation, or the factors affecting firms' perception on how important barriers to innovation are.

The existing literature on barriers to innovation has either focused on how differences among innovative firms' characteristics affect the perception of barriers (e.g. Galia and Legros, 2004; Mohnen and Rosa, 1999), or it has treated all non-innovative firms as an undifferentiated group (e.g. Baldwin and Lin, 2002; Iammarino et al., 2006). These approaches have led to conclusions that emphasise the positive relationship between firms' engagement in innovation activities and the importance that firms attached to barriers. This report argues that, by looking more in detail into the group of non-innovative firms, we are likely to gain a richer picture that helps to uncover the heterogeneous nature of non-innovative firms, and the distinct factors that affect their assessment of how important barriers are.

In particular, this study addresses two main questions. On the one hand, it aims to bring the characteristics of non-innovating companies to the fore. In this sense, the report intends to shed light on a greatly neglected issue: whether differences among non-innovating companies exist in relation to their assessment of how important barriers are, and what are the characteristics that distinguish different groups of non-innovating firms.
On the other hand, by conducting a detailed analysis of non-innovators, this report examines whether the relationship between the importance attached to barriers and the degree of engagement in innovative activities varies between different types of non-innovating companies.

This report investigates these issues using data from the UK Innovation Survey 2005 (which is part of the fourth iteration of the wider Community Innovation Survey (CIS 4) covering European countries). This survey sampled over 28 thousand UK enterprises, covering enterprises with 10 or more employees, with a wide sectoral coverage including both the manufacturing and the service sectors. The final data consist of a representative sample of 16,445 firms in the UK, covering the period 2002 to 2004.

The analysis conducted in this report highlights two issues. First, it is crucial to distinguish those non-innovating firms that do not engage in innovation activities as a consequence of barriers, from those that do not find it necessary to innovate as a result of the characteristics of the environment in which they operate.

Second, among the firms that report barriers to innovation as important, the report shows that it is also critical to disentangle a situation in which barriers act as factors preventing firms from engaging in innovative activities - *perceived* barriers - from a situation in which obstacles act as factors that constrain the success of the firm's engagement in innovative activities - *revealed* barriers. The few contributions on barriers have addressed the latter type, in which firms confront obstacles to innovation alongside their engagement in innovative activities, but it has largely failed to capture the former situation.

The structure of the report is as follows. Section 2 explains how the information from the CIS 4 has been used in order to examine whether different groups of non-innovators can be identified. This section also provides a description of the three groups of non-innovators identified, for better characterising the differences between them. Section 3 examines in detail the differences between non-innovators in terms of their degree of experience of barriers to innovation, and their assessment of how important barriers are. Section 4 takes a close look at the relationship between the degree of engagement in innovative activities and the assessment of the importance of barriers, comparing non-innovators and innovative firms. Finally, Section 5 concludes with a discussion of the results.

2. Types of non-innovators

2.1. Definition of strict innovators and strict non-innovators

In this report we use a strict definition of what innovators and non-innovators are, based on the characterisation of innovation as the commercialisation of a new product or the implementation of a new process. More precisely, taking the expressions used in the CIS4, an enterprise is defined as an *innovator* if, during the period 2002-04, the enterprise introduced a new or significantly improved product (either a good or service) or any new or significantly improved processes for producing or supplying products new to the enterprise.

Consistently, if the enterprise did not introduce a new or significantly improved product or process over the period 2002-04, we classify the enterprise as a strict non-innovator. There are several reasons why the use of this strict definition is convenient. First, it helps to separate invention from innovation by requiring new products and processes to be of economic value, as shown by their commercialisation (i.e. introduction to market). Second, it is consistent with the standard definition of innovation as recommended by the Oslo Manual (OECD, 2005). Third, it helps to separate the firm's efforts in innovative activities (as measured by the firm's investment in R&D-related activities) from the outputs of those activities (as reflected by the market introduction of new products).

This third point is of particular importance in the context of our study of barriers to innovation, for two reasons. On the one hand, the strict definition of non-innovators helps to avoid inconsistent responses in the questionnaire. More specifically, the survey defines innovation in a very broad way, by including in the definition of 'innovation' any spending on innovation activities. Thus, if an enterprise spends on machinery, equipment, R&D or training related to the development of new products, this enterprise is classified as an innovative active one. However, we find that 30% of the firms that answered question 20 (which concerns barriers to innovation) have been engaged in some innovation activity, while this is a question believed to be answered only by enterprises with no innovation activity. By contrast, only 19 firms that responded to question 20 were strictly defined innovators. Therefore, using a strict definition provides a more consistent pattern of responses to the survey.

On the other hand, it is crucial in the context of our study to distinguish clearly between measures of input and output regarding innovation activities. In order to address the main questions laid out in this report, we need to discriminate between firms that have engaged in innovative activities but have not introduced new products from those that have done both. Therefore, a strict definition of what innovators and non-innovators are is particularly important within the context of this study.

2.2. Different groups of non-innovators

In order to identify different groups of non-innovators, we have examined the patterns of responses to the two sections in the questionnaire that ask respondents about barriers to innovation. These two questions are question 19 and question 20. In question 19, respondents are asked to report on whether they have experienced any of 11 barrier items, and also they are asked to assess how important those barrier items are in terms of constraining the enterprise innovation activities (i.e. ticking whether the barrier item is of 'low', 'medium' or 'high' importance). Question 19 is addressed to all respondents.

In question 20, which is only addressed to those enterprises that had no innovation activity, firms are asked to indicate why it has not been necessary or possible to innovate, by ticking any of three, not mutually exclusive, options: a) no need due to prior innovations; b) no need due to market conditions; and c) factors constraining innovation.

Using the responses to these two questions (in particular, whether firms have experienced any barrier item listed in question 19 and the responses to question 20), we classified strictly non-innovator firms in three groups: a) consistently barrier-related; b) consistently non-barrier related; and c) other non-innovators. Below we describe these three groups in detail.

a) Consistently barrier related:

This group of non-innovators is composed of 1,365 firms that ticked positively 'factors constraining innovation' in question 20 (that is, 'factors constraining innovation made innovation not necessary or not possible') and have experienced at least one of the 11 barrier items listed in question 19. Thus, we can read this group as consistently responding that innovation barriers have been factors constraining their innovation activities, since barriers to innovation are deemed by these firms to be among the reasons that made innovation not possible, and also report that they have experienced at least one of the barrier items.

b) Consistently non-barrier related:

This group of non-innovators is composed of 3,595 firms that have systematically not experienced any of the barrier items in question 19. While this group of firms reports having not experienced any of the barrier items in question 19, they differ in terms of how they responded to question 20. On this respect, this group could be divided in two. First are the firms that specifically reported in question 20 that 'factors constraining innovation' were not among the reasons why the company did not innovate (in other words, they indicate that the reasons were either 'no need due to prior innovations', or 'no need due to market conditions', or both). On the other hand are those firms that provide little information on the basis of their responses to question 20, either because they respond negatively to all three items in question 20, or they left the question 20 unanswered.

c) Other non-innovators:

This is a residual or 'grey area' group composed of 5,142 firms that were not classifiable in any of the two groups defined above. The firms in this group conform to one of three patterns. On the one hand, some firms report that 'factors constraining innovation' were not among the factors making innovation not necessary or not possible (in question 20), though they did experience some of the 11 barrier items in question 19. Other firms left question 20 unanswered and report having experienced some of the barrier items in question 19. And finally, and to a large extent showing a rather inconsistent profile of response, are those that responded that 'factors constraining innovation' were among the factors making innovation not necessary or not possible (in question 20), but indicating that they did not experience any of the barrier items in question 19.[1]

2.3. Characteristics of firms in the 3 groups of non-innovators

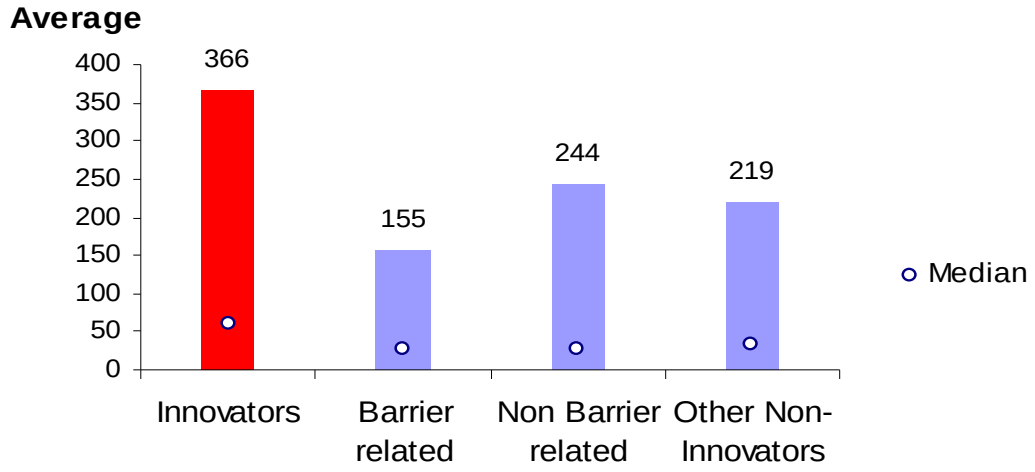
In this sub-section we describe the main characteristics of the three groups of non-innovators, paying particular attention to: a) average firm size; b) sectoral composition; and c) degree of engagement in innovative activities. Moreover, in comparing the three groups according to these facets, we also depict the profile shown by the group of firms classified as strict innovators as a benchmark for comparisons. The group of strictly defined innovators is composed of 5,820 firms.

[1] There were 772 companies following this profile of responses. One possible explanation may be that the list of barrier items in question 19 was not sufficiently comprehensive to include the barriers to innovation these firms may have encountered. However, it is nevertheless intriguing that these firms did not experience any of the 11 barrier items, while reporting that factors constraining innovation have been important.

2.3.1. Average firm size

Using the number of firm employees as a measure of firm size, Figure 1 compares the average firm size (and median firm size) for the three groups of non-innovators and the group of innovators. As Figure 1 shows, the group of innovators is composed of firms that are significantly larger than non-innovators. It is also important to note that non-innovators significantly differ in term of firm average number of employees. In particular, 'barrier related' shows the lowest values - an average firm size of 155 employees - while 'non-barrier related' have the largest - an average firm size of 244 employees. However, the three groups of non-innovators display very little differences in terms of size when looking at the medians: the median number of employees is 26 for 'barrier related', 28 for 'non-barrier related' and 32 for 'other non-innovators'.[2]

Figure 1 - Characteristics of firm groups in terms of average firm size (number of employees)



2.3.2. Sectoral composition

In order to better characterise the three groups of non-innovators, it is important to examine the extent to which groups differ with respect to the sectoral profile of the companies. In order to address this issue, we have used two different levels of aggregation to classify firms in sectors. Firstly, we explore whether groups differ in terms of the proportion of firms in manufacturing and services (Figure 2.1). Secondly, we have used a more disaggregated sectoral classification, using the 7 sectors of activity in accordance to the clustering criteria used by DTI (2006): primary sector; engineering-based manufacturing; other manufacturing; construction; retail and distribution; knowledge-intensive services; other services (Figure 2.2).

[2] While the median number of employees for innovators is 59, almost twice the value compared to non-innovators.

Figure 2.1 - Manufacturing versus services: sectoral composition

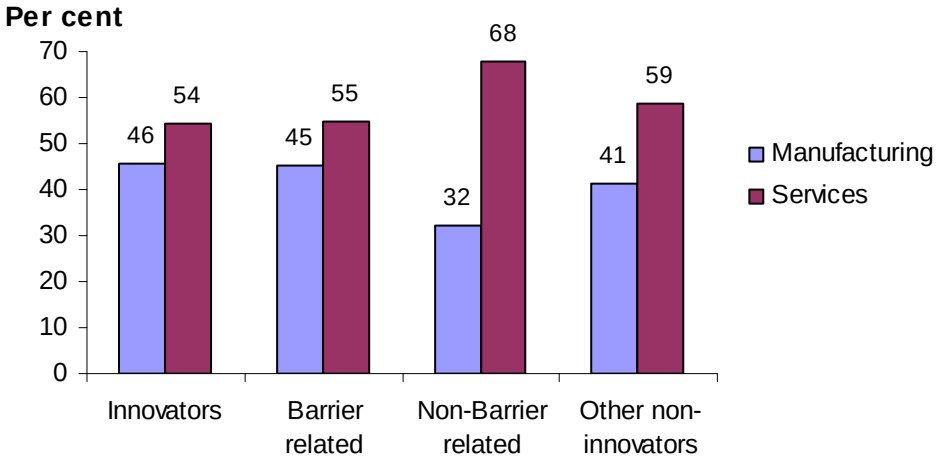
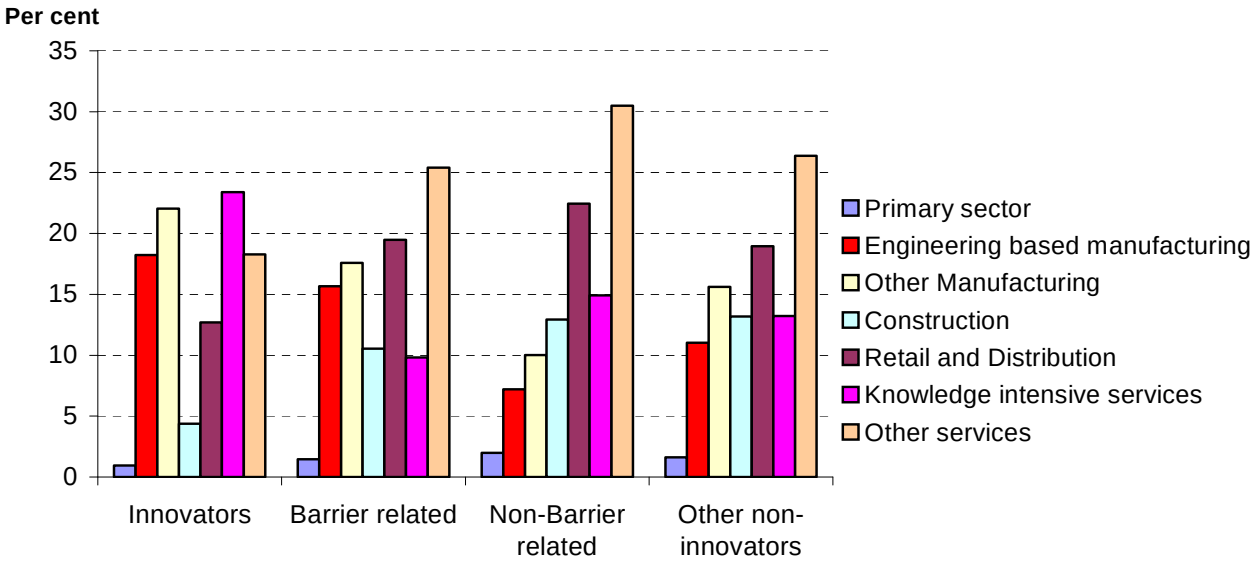


Figure 2.2 - Disaggregated sectoral composition by groups of firms



As Figure 2.1 shows, the group of 'non-barrier related' non-innovators is the one with a much larger proportion of firms in the service sector (i.e. 68%), while the group of 'barrier-related' non-innovators shows a balanced distribution of companies between manufacturing and services (i.e. 45% in manufacturing and 55% in services), and in this respect is similar to the group of innovators. However, when the more disaggregated sectoral profile is considered, it is clear that substantial differences emerge between the 'barrier related' non-innovators and innovators. As Figure 2.2 shows, the former group has a much larger share of companies in the construction sector as compared to innovators (11% versus 4%), as well as in the distribution and retail sector (20% versus 13%); conversely, it has a much lower proportion of companies in the knowledge-intensive service sector as compared to innovators (10% versus 23%).

2.3.3. Degree of engagement in innovative activities by group of firms

The responses from the survey allow us to measure the extent to which firms have engaged in a wide range of activities related to innovation. In particular, question 13 asks respondents to report on whether, over the period 2002-04, firms engaged in any of seven innovation activities listed. These activities include: intramural R&D; acquisition of R&D; acquisition of machinery, equipment and software to produce new or significantly improved products; acquisition of external knowledge (e.g. licensing of patents); training of personnel for the development or introduction of innovations; expenditure on design functions for the development of new or improved products or processes; and expenditures on activities for the market preparation and introduction of new or significantly improved products (including market research and launch advertising).

The fact that our focus is on non-innovators does not mean that these firms are not engaging in innovating activities. As we made clear in our definition of strict non-innovators, our targeted firms are those that have neither introduced a new or significantly improved product nor a process. However, as we show in this section, this does not mean that strict non-innovators do not engage in innovative activities - as measured by the seven items listed in question 13. Rather the opposite: non-innovators do engage in innovative activities, showing that while our targeted firms may not have been successful in introducing a new product or process, they have invested a significant amount of resources in innovation-related activities. Figure 3.1 shows that a substantial proportion of 'barrier-related' and 'other non-innovators' engage in at least one of the seven innovative activities considered in the questionnaire. More precisely, 48% of firms in the former group and 59% of the latter engage in at least one innovative activity. These percentages are significantly below those of 'innovators', where the large majority of companies engage in innovative activities, but well above the percentage of the 'non-barrier related' non-innovators (only 20% of firms in this group engage in innovative activities).

Figure 3.1 - Proportion of firms that engage in at least 1 innovative activity

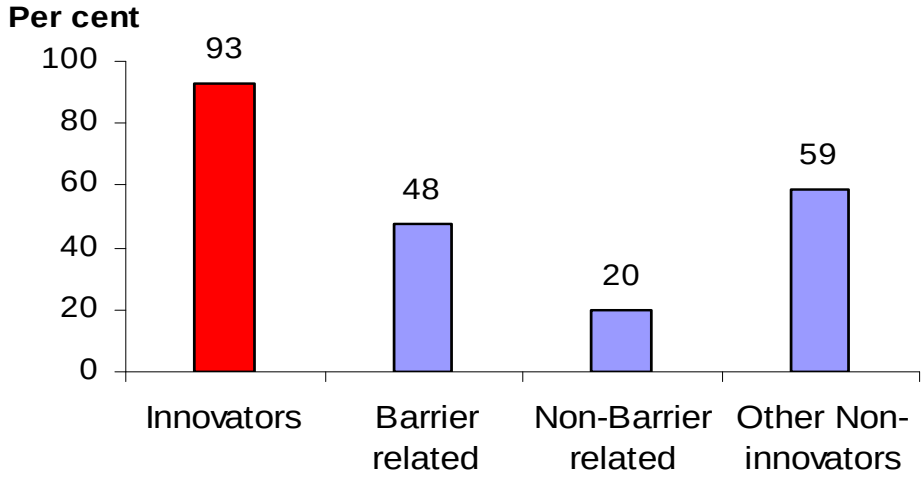


Figure 3.2 - Proportion of firms by number of innovative activities they engage in

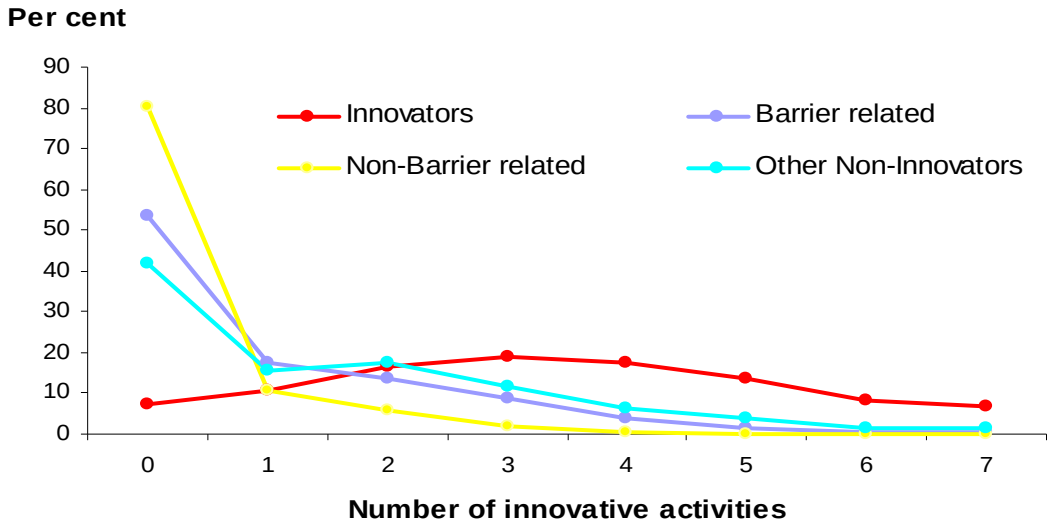


Figure 3.2 provides further information on the profile of each group with respect to engagement in innovative activities. Not only do a large proportion of 'innovators' engage in innovative activities (as shown in Figure 3.1), but they also engage in a larger number of innovative activities as compared to non-innovators (i.e. in 3 innovative activities on average), displaying a bell-shaped distribution around the average. On the contrary, all non-innovators display a highly skewed distribution, with tiny shares of firms engaging in four or more innovative activities. However, it is relevant to point out that 'barrier related' and 'other non-innovators' have non-negligible proportions of firms engaging in one, two or three innovative activities (for instance, in the case of 'barrier related' such proportions are: 17%, 14% and 9%, respectively).

To summarise, on the basis of the responses to the two questionnaire sections on barriers, we have identified 3 groups of strict non-innovators. First is the 'barrier related' group, which is composed of those firms that explicitly report that constraints to innovation have been a relevant factor to explain why they did not consider it necessary or possible to innovate. Second is the 'non-barrier related' group, which is composed of those firms that did not experience barriers to innovation, reporting that they did not have any need to innovate (largely as a consequence of prior innovations or market conditions). And there is a third group - 'other non-innovators' - largely composed of firms that did not consider constraints to innovation to be among the relevant factors to explain why they did not consider it necessary or possible to innovate, though (in contrast to the second group) firms in this group did experience barriers to innovation to some degree.

In addition to their responses on the relevance of barriers to innovation, the profiles of these three groups are quite different in other facets too. For instance, by examining the sectoral composition and the degree of engagement in innovative activities (other than the introduction of new products/processes), it is possible to characterise the 'non-barrier related' group as formed of firms largely in 'retail and distribution' or other services (such as 'hotels and restaurants' and 'real estate' activities), as well as firms that engage very little in innovative activities. This profile is consistent with the pattern displayed by this group regarding barriers to innovation, reporting having not experienced barriers to innovation at all, and having assessed that the lack of engagement in innovative activities is largely 'due to market conditions'.[3]

[3] About 60% of the firms in this group that tick positively any of the items in question 20 responded that 'No need due to market conditions' was one of the factors explaining why the firm did not consider it necessary or possible to innovate.

The other two groups of non-innovators differ substantially from the pattern shown by the ‘non-barrier related’ group. Besides the fact that ‘barrier related’ and ‘other non-innovators’ are less concentrated in the service sector, these two groups show a much larger degree of engagement in innovative activities than the ‘non-barrier related’ group.

3. Experience and assessment of barriers to innovation

In this section we compare the three groups of strict non-innovator firms with respect to: a) the extent to which firm experience barriers; and b) the extent to which firms assess barriers as important. Once again, the group of strict innovators acts as a point of reference in order to evaluate the figures displayed by non-innovator firms.

This section examines the responses on the different types of barriers to innovation; however, we chose not to report results for the eleven barrier items individually, but for four blocks of barriers. In so doing, we have followed the grouping suggested by the questionnaire itself, where four higher-level groups of barriers are highlighted.[4] These four groups of barriers are: 'cost factors', 'knowledge factors', 'market factors' and 'regulation factors'. Table 1 below indicates the items included within each of these four blocks.

Table 1 - Four groups of barriers to innovation

Groups of barriers to innovation	Barrier items included
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 or services
Regulation Factors	• Need to meet UK Government regulation • Need to meet EU regulations

Therefore, the results reported on barriers are presented at the level of the four groups. For instance, evidence on the extent to which a firm experiences 'cost factors' barriers is based on whether that firm has experienced at least one of the factors included within the group 'cost factors'. Regarding the importance attached to barriers, we have used the information on whether the firm assessed the importance of barrier items as 'low', 'medium' or 'high'. We have identified the assessment of a barrier group as highly important when a firm has assessed at least one of the items in a barrier group as highly important.

3.1. Experience and assessment of barriers: innovators vs. non-innovators

When we compare the group of innovators with the overall group of non-innovators, we find results that are in accordance with the existing literature. The evidence from the CIS4 shows that innovators have a much higher share of firms reporting to have experienced barriers to innovation, compared to non-innovators, regardless of the type of barrier considered (see Figure 4.1). A similar pattern emerges when examining the proportion of firms assessing barriers as highly important: a larger proportion of innovative firms assess barriers as highly important, compared to non-innovators (Figure 4.2).

[4] For a different methodological choice, focused on individual barriers, see Iammarino et al. (2006).

Figure 4.1 - Proportion of firms that experience barriers

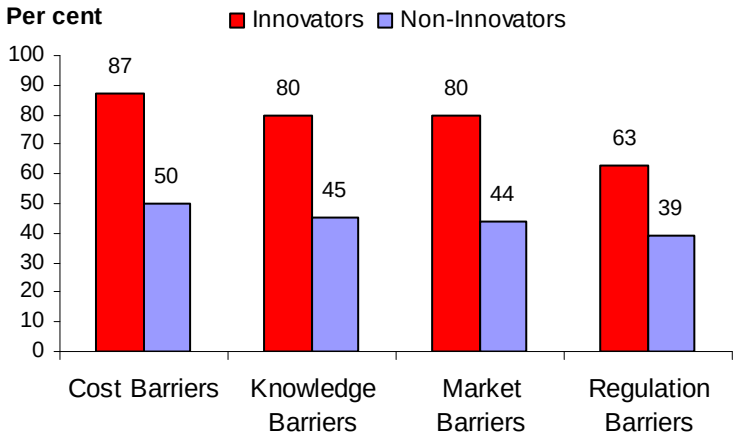
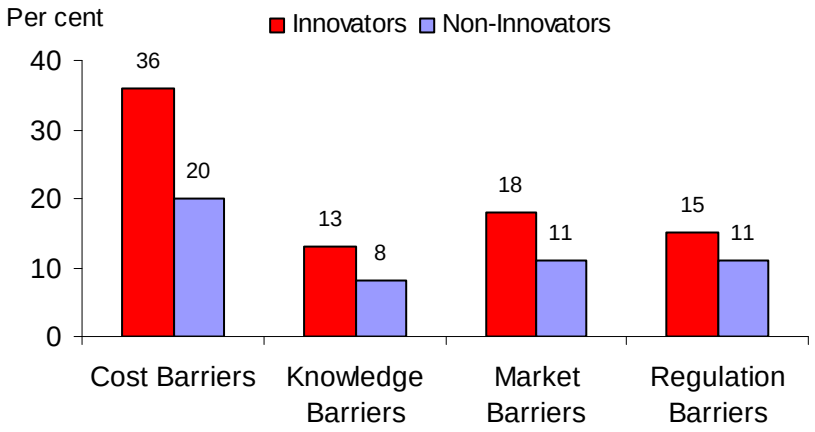


Figure 4.2 - Proportion of firms that assess barriers as highly important

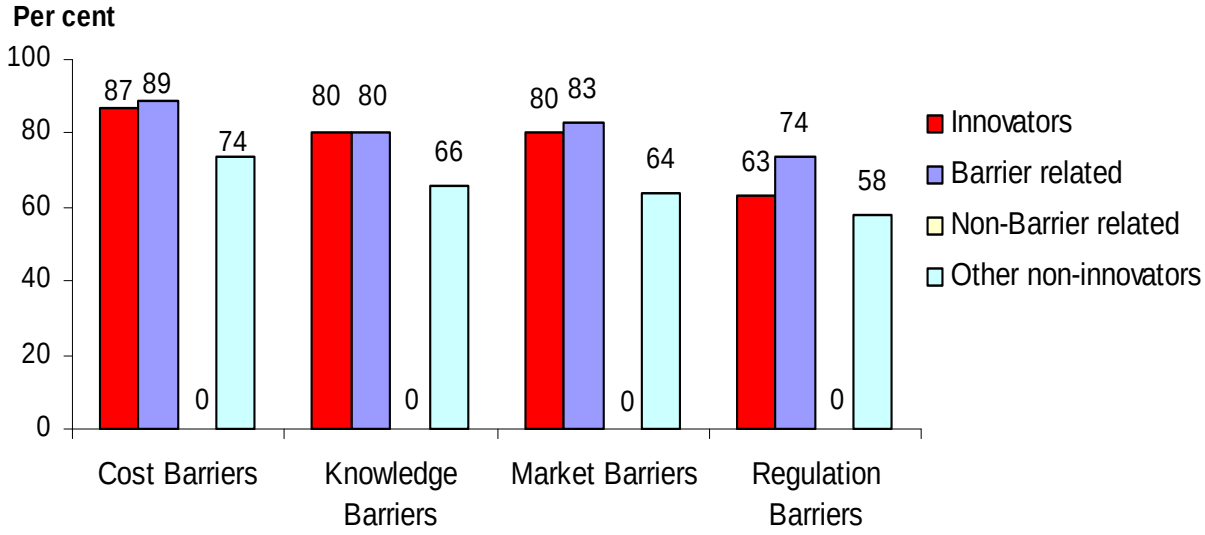


These two results are consistent, as mentioned in Section 1, with the argument that those firms that are more heavily engaged in innovation activities are more likely to experience barriers to innovation, and also to assess such obstacles as important (e.g. Arundel, 1997; Baldwin and Lin, 2002; and Iammarino et al., 2006).

3.2. Experience and assessment of barriers: innovators vs. 3 groups of non-innovators

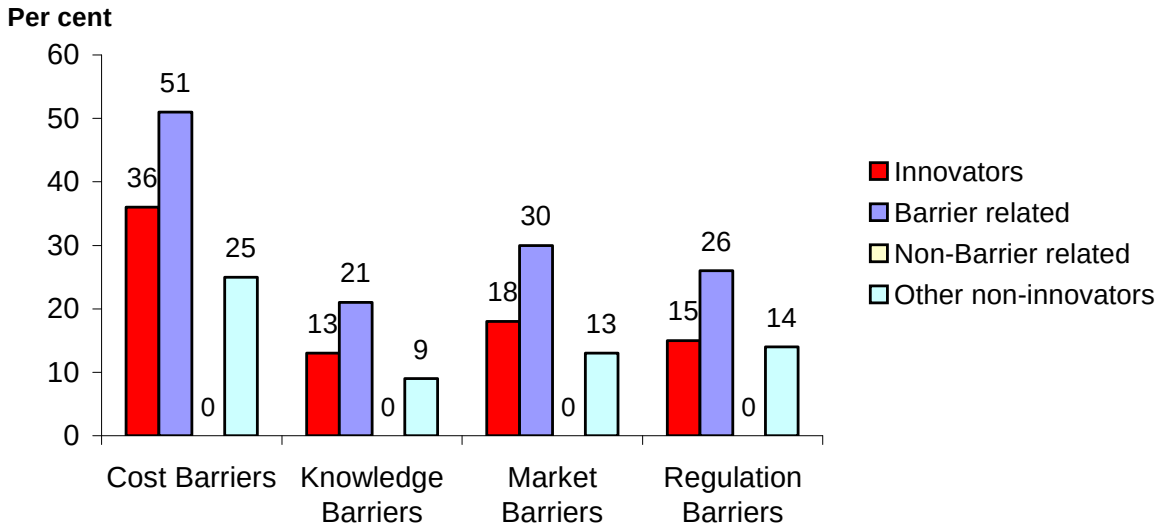
However, the picture is rather different when we consider the 3 groups of strict non-innovators separately. In this case it becomes evident that differences between innovators and non-innovators are much less clear-cut than when we consider all non-innovative firms as a homogenous group. On the one hand, it emerges that the 'barrier related' group displays a proportion of firms experiencing barriers that is almost identical to that of innovators, with the exception of regulation barriers, for which the proportion of 'barrier related' firms is considerably higher (see Figure 5.1). Moreover, the proportion of 'other non-innovators' that experience barriers, while below the percentages of innovators and 'barrier related', display substantial shares.

Figure 5.1 - Proportion of firms that experience barriers: innovators vs. 3 groups of non-innovators



On the other hand, as Figure 5.2 shows, the 'barrier related' group displays a proportion of firms assessing barriers as highly important that is systematically higher than that for innovators, regardless of the type of barrier considered. Moreover, the 'other non-innovators' display percentages of firms assessing barriers as important that closely resemble those of innovators.

Figure 5.2 - Proportion of firms that assess barriers as highly important: innovators vs. 3 groups of non-innovators



This evidence highlights the fact that some non-innovators not only experience barriers to a similar extent as innovators, but even more critically, they also assess barriers as more important. A couple of issues must be discussed at this point, in regard to the way the non-innovator groups were defined, and how such a definition may influence the results shown in Tables 5.1 and 5.2.

On the one hand, the fact that the proportion of companies experiencing barriers increases dramatically for two groups of non-innovators can be seen as a natural consequence of the fact that one of the groups (i.e. the 'non-barrier related' group) is capturing a large number of those companies that did not experience barriers. In other words, if those firms that did not experience barriers are removed and placed in a separate group, it should not come as a surprise that the proportion of firms experiencing barriers in the two remaining groups of non-innovators rises. While this is true, it is relevant to note that: a) there is no a priori reason why the proportion of firms in the 'barrier related' and 'other non-innovators' should be so in line with the innovators in terms of the experience of barriers; and more importantly, b) these results highlight the fact that, when analysing barriers to innovation, it may not be correct to consider all non-innovators as a single group. The reason for this is that a large proportion of non-innovators are simply not interested in innovation activities, largely as a consequence of not needing to innovate in order to survive in the markets where they operate, and therefore these companies are not appropriate terms of comparison with those that do engage in innovative activities. As we have seen in Section 2, this is largely the case of the group labelled 'non-barrier related': it is clear that this group is biasing downwards the figures on experiencing and assessment of barriers, when considering all non-innovators as a homogeneous group.

On the other hand, in regard to the assessment of barriers as important: while the 'barrier related' and the 'other non-innovators' are defined on the basis of having experienced at least one barrier item, this does not make comparisons with the innovators inappropriate. On the contrary, in connection with the argument above, it is only after experiencing barriers that companies can assess whether barriers are important. What the evidence from Figures 5.1 and 5.2 shows is that two groups of non-innovators and the group of innovators do experience barriers to a similar extent, and therefore are comparable to each other. In other words, the fact that they assess barriers differently becomes particularly telling in the light of the fact that they experience barriers to a similar extent. Also, the differences in the assessment of barriers are extremely meaningful since we have not imposed any condition regarding the assessment of barriers in our definitions of the three groups of non-innovators.

3.3. Assessment of barriers across regions

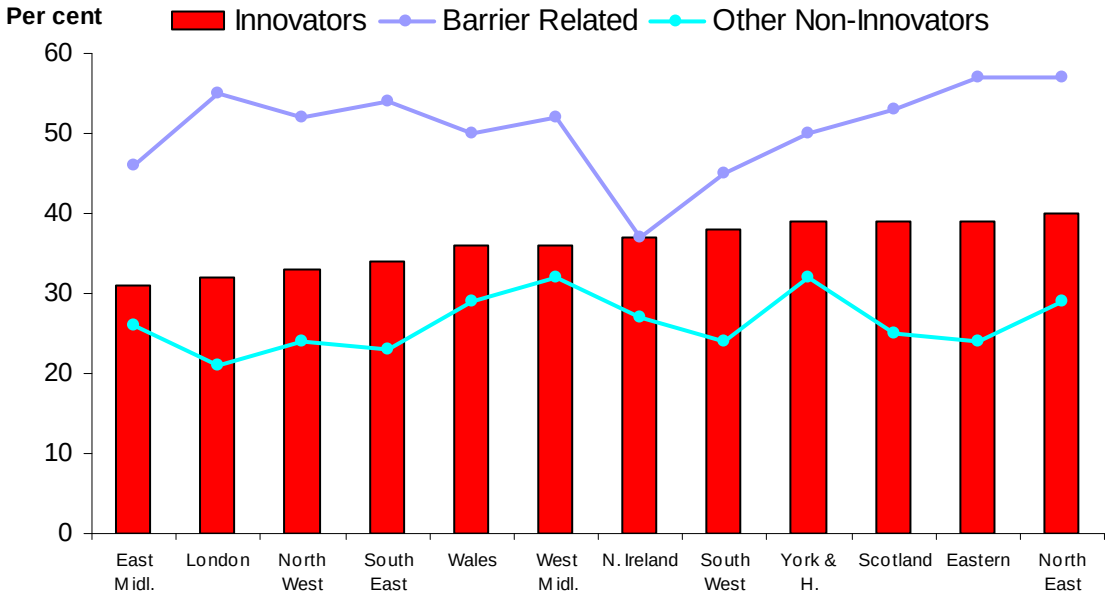
This sub-section investigates the extent to which the differences between groups of firms in terms of the assessment of barriers are consistent across UK regions, or whether such differences are particularly driven by the special features of some regions. Figure 6 illustrates the proportion of firms in each group that rank 'cost barriers' as highly important. Regions are ordered in terms of the responses from 'innovators' regarding the proportion of companies assessing barriers as important.

Overall, what Figure 6 shows can be summarised as follows. On the one hand, the 'barrier related' group shows a higher proportion of firms assessing barriers as important across all regions (with the only exception of Northern Ireland where the percentage is indistinct from that of 'innovators'). Therefore, 'barrier related' firms most frequently assess cost barriers as important compared to the other groups, regardless of the region considered.

On the other hand, the range of variation across regions in the proportion of firms assessing barriers as important is larger in the 'barrier related' group compared to the group of innovators. Furthermore, the rank of regions in terms of the proportion of firms assessing barriers as important differs between the three groups. These results point out that the three groups of firms differ with respect to the profile of regions that display higher shares of firms assessing cost barriers as highly important.

The results for the other types of barriers follow a very similar pattern to that described in Figure 6 for 'cost barriers'. Figures for the other three types of barriers are shown in the Appendix.

Figure 6 - Proportion of firms assessing barriers as highly important: Cost Barriers



4. Factors influencing the assessment of barriers to innovation

This section examines two issues. First, it investigates whether the differences between groups of firms in terms of the assessment of barriers are consistent once we control for both firm and environment characteristics. Second, it examines the extent to which firms show a similar pattern with regard to the factors that shape the assessment of barriers.

4.1. Assessment of barriers: do non-innovators differ from innovators?

The previous section (Section 3) has shown that 'barrier related' firms are more likely to assess barriers as highly important as compared to innovators (and compared to 'other non-innovators'). While that has been shown so far at a descriptive level, we would like to examine in this section whether such differences are significant, once we explicitly consider a number of factors that may influence that assessment.

To do so, we consider firm and environment characteristics. Among firm characteristics, we include: a) the firm size, as measured by the number of employees (in logarithms); b) the firm's degree of engagement in innovative activities, as measured by whether the firm has been engaged in 1 to 2, 3 to 4, or 5 to 7 innovative activities over the period 2002-04 (based on question 13);[5] c) whether the firm is part of a large group (based on question 1); d) whether the firm was established after 1st January 2000 (based on question 4); and e) degree of internationalisation of the market served (based on question 2).[6] Additionally, the analysis includes also control variables at the regional level (i.e. 11 regional dummies) and sectoral level (8 dummies for sectors).

We use four dependent variables, one for each group of barriers. The dependent variables are dichotomous, indicating whether the firm assesses as important at least one barrier item (within each group of barriers). Our sample is composed of all innovators plus the two groups of non-innovators that have at least experienced one barrier item ('barrier related' and 'other non-innovators'): 12,327 observations in total. A logistic regression model was applied. The results for the logistic regressions are displayed in Table 2.

The results from Table 2 confirm that there are significant differences between the innovators and the two types of non-innovators in terms of their assessment of barriers. Other things equal, being a 'barrier related' firm increases the probability of assessing barriers as highly important compared to innovators. Instead, a firm in the group of 'other non-innovators' has a lower probability of assessing barriers as important compared to innovators (with the exception of regulation barriers, for which there are no significant differences compared to innovators).

The other result from Table 2 is that the more firms engage in innovative activities, the more importance they attach to barriers, as shown by the fact that being engaged in a larger number of innovative activities increases the probability of assessing barriers as highly important, irrespective of the type of barrier considered.

[5] The reference category here is that of firms that have not engaged in any type of innovative activity.
[6] This is a variable that takes the values 1 to 4 depending on whether the most distant market served by the company is the local market ('1'), the UK ('2'), Europe ('3') or any non-Europe country ('4').

Table 2 - Logistic Regression results for reporting to have assessed at least one item within each type of barriers as highly important

Explanatory variables	Cost related barriers		Knowledge related barriers		Market related barriers		Regulation related barriers	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
1-2 Innovation Activities	0.277 ***	0.058	0.192 **	0.083	0.012	0.071	0.258 ***	0.073
3-4 Innovation Activities	0.626 ***	0.063	0.458 ***	0.089	0.151 **	0.076	0.453 ***	0.080
5-7 Innovation Activities	0.891 ***	0.072	0.715 ***	0.101	0.302 ***	0.088	0.851 ***	0.091
LN Employees	-0.064***	0.015	-0.122 ***	0.023	-0.056 ***	0.019	-0.124 ***	0.020
Part of a larger company	0.027	0.046	-0.086	0.066	0.009	0.056	-0.160 ***	0.060
Start up	0.169 ***	0.055	0.067	0.077	0.124 *	0.068	-0.149 **	0.072
International market	0.019	0.021	-0.054 *	0.029	0.083 **	0.025	-0.162 ***	0.027
Barrier related	0.986 ***	0.070	0.786 ***	0.091	0.876 ***	0.080	0.901 ***	0.084
Other non-innovators	-0.196 ***	0.049	-0.186 **	0.072	-0.156 **	0.062	0.030	0.064
Cte	-1.022 ***	0.126	-1.755 ***	0.180	-1.595 ***	0.155	-1.785 ***	0.170
Regional Dummies	Included		Included		Included		Included	
Sector Dummies	Included		Included		Included		Included	
N total observations	12044		12042		12041		12040	
N (dependent var. =1)	3999		1462		2049		1873	
Log Likelihood	-7345.0		-4321.0		-5351.2		-5003.4	
Chi-square	620.5 ***		262.3 ***		282.6 ***		401.5 ***	
Pseudo R^2	0.07		0.04		0.04		0.06	

Two tailed T test: * p < 0.10; ** p < 0.05; *** p < 0.01

In brief, while the results from Table 2 indicate that, consistently with the existing literature, the logic of revealed barriers is present - that is, firms that engage more heavily in innovative activities attach more importance to barriers - it does also emerge that certain types of non-innovators are more likely than innovators to assess barriers as highly important. In order to investigate these two findings in more detail, it is necessary to examine the relationship between assessment of barriers and engagement in innovation activities for each group of firms separately. This is done in the following sub-section.

4.2. Assessment of barriers and engagement in innovative activities

This sub-section investigates the extent to which innovators and non-innovators differ in terms of the relationship between the degree of engagement in innovative activities and the assessment of barriers. We examine this relationship for each group of firms separately. In order to capture the extent to which firms assess a certain barrier group as important, we define our dependent variable as a categorical ordered one, considering the number of barrier items (within each barrier block) that are assessed as highly important. Thus, for instance, in the case of 'cost factors' the dependent variable ranges from 0 to 4, since firms may assess either none, one, two, three or all four cost-related items as highly important. The explanatory and control variables are the same as those used in the preceding analysis in Section 4.1. In accordance with the nature of the dependent variables, Ordered Logistic regressions were run. The size of our samples varies across groups of firms: 5,820 observations for 'innovators'; 5,140 for 'other non-innovators'; and 1,365 for 'barrier-related' non-innovators. Tables 3, 4 and 5 display the results of the regressions for each of the three groups of firms in turn.

Table 3 - Ordered Logistic Regression: Sample of '*innovators*'
Dependent variable: number of barrier items assessed as highly important

Explanatory variables	Cost Related barriers		Knowledge related barriers		Market related barriers		Regulation related barriers	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
1-2 Innovation Activ.	0.026	0.122	-0.078	0.182	0.107	0.162	-0.071	0.173
3-4 Innovation Activ.	0.358 ***	0.119	0.186	0.175	0.221	0.158	0.341 **	0.166
5-7 Innovation Activ.	0.634 ***	0.121	0.408 **	0.178	0.327 **	0.161	0.675 ***	0.168
LN Employees	-0.067 ***	0.020	-0.109 ***	0.030	-0.046 *	0.026	-0.091 ***	0.028
Part of a larger company	0.046	0.060	-0.031	0.089	0.034	0.078	-0.081	0.085
Start up	0.267 ***	0.075	0.181 *	0.107	0.243 **	0.096	-0.080	0.106
International market	-0.026	0.027	-0.078 *	0.040	0.062 *	0.035	-0.235 ***	0.038
Cte (first threshold)	0.619 ***	0.188	1.398 ***	0.275	1.567 ***	0.244	1.614 ***	0.271
Regional Dummies	Included		Included		Included		Included	
Sector Dummies	Included		Included		Included		Included	
N total observations	5793		5793		5792		5792	
Log Likelihood	-6226.6		-2655.9		-3178.9		-2805.4	
Chi-squared	133.4 ***		79.7 ***		69.4 ***		155.6 ***	
Pseudo R^2	0.03		0.03		0.02		0.04	

Two tailed T test: * p < 0.10; ** p < 0.05; *** p < 0.01

Table 4 - Ordered Logistic regression: Sample of '*other non-innovators*'
Dependent variable: number of barrier items assessed as highly important

Explanatory variables	Cost Related barriers		Knowledge related barriers		Market related barriers		Regulation related barriers	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
1-2 Innovation Activities	0.485 ***	0.080	0.445 ***	0.123	0.152	0.102	0.538 ***	0.101
3-4 Innovation Activities	0.848 ***	0.091	0.686 ***	0.140	0.276 **	0.119	0.600 ***	0.119
5-7 Innovation Activities	1.162 ***	0.124	1.133 ***	0.176	0.556 ***	0.159	1.013 ***	0.156
LN Employees	-0.077 ***	0.026	-0.151 ***	0.042	-0.063 *	0.034	-0.157 ***	0.035
Part of a larger company	-0.132 *	0.078	-0.139	0.120	0.041	0.099	-0.214 **	0.101
Start up	0.143	0.091	0.162	0.135	0.105	0.117	0.059	0.114
International market	0.099 ***	0.035	0.006	0.054	0.112 **	0.044	-0.043	0.046
Cte (first threshold)	1.585 ***	0.194	2.024 ***	0.287	2.060 ***	0.248	1.853 ***	0.253
Regional Dummies	Included		Included		Included		Included	
Sector Dummies	Included		Included		Included		Included	
N total observations	4958		4956		4956		4955	
Log Likelihood	-4253.5		-1801.5		-2234.0		-2320.7	
Chi-square	196.7 ***		97.5 ***		58.1 ***		124.1 ***	
Pseudo R^2	0.5		0.04		0.02		0.04	

Two tailed T test: * p < 0.10; ** p < 0.05; *** p < 0.01

Table 5 - Ordered Logistic regression: sample of '*barrier-related non-innovators*'
Dependent variable: number of barrier items assessed as highly important

Explanatory variables	**Cost Related barriers**		**Knowledge related barriers**		**Market related barriers**		**Regulation related barriers**	
	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.	Coefficient	S.E.
1-2 Innovation Activ.	-0.233 *	0.119	-0.169	0.160	-0.348 **	0.140	0.001	0.147
3-4 Innovation Activ.	0.015	0.159	0.109	0.207	-0.199	0.188	-0.124	0.207
5-7 Innovation Activ.	0.512	0.337	0.572	0.424	-0.053	0.397	0.353	0.449
LN Employees	-0.097 **	0.045	-0.113 *	0.061	-0.088 *	0.053	-0.220 ***	0.061
Part of a larger company	0.041	0.124	-0.221	0.169	-0.208	0.147	-0.392 **	0.163
Start up	0.164	0.138	-0.342 *	0.197	-0.115	0.167	-0.839 ***	0.197
International market	-0.102 *	0.156	-0.033	0.075	0.049	0.065	-0.173 **	0.072
Cte (first threshold)	-0.919 ***	0.296	1.365 ***	0.413	0.235	0.341	0.281	0.390
Regional Dummies	Included		Included		Included		Included	
Sector Dummies	Included		Included		Included		Included	
N total observations	1293		1293		1293		1293	
Log Likelihood	-1756.5		-864.6		-1015.4		-878.6	
Chi-Square	45.1 ***		33.1 *		47.3 ***		96.4 ***	
Pseudo R^2	0.04		0.03		0.05		0.09	

Two tailed T test: * p < 0.10; ** p < 0.05; *** p < 0.01

Table 3 shows that 'innovators' are more likely to assess a higher number of barrier items as important, the more they engage in innovative activities. Even though the intensity of the relationship varies from one barrier type to another, there is always a common pattern characterised by a positive and significant relationship for all types of barriers to innovation. Once again, this result is consistent with the existing literature, which emphasises the argument that those companies that are more active in innovative activities are more likely to be exposed to barriers to innovation, and therefore, more likely to assess barriers as important.

Such a pattern is even more acutely present when looking at Table 4, where the results for the sample of 'other non-innovators' are reported. For this group of firms, the relationship between the degree of engagement in innovative activities and the likelihood of assessing barriers as important is stronger than in the case of innovators, as shown by much higher and statistically significant estimated coefficients.

The fact that 'other non-innovators' seem to be more sensitive in assessing barriers to innovation as important the more they engage in innovative activities, as compared to 'innovators', is an extremely interesting result. It highlights the fact that, while both groups of firms - 'innovators' and 'other non-innovators' - display a positive relationship between assessment of barriers and engagement in innovation activities, 'other non-innovators' consider barriers as bearing heavier obstacles for the progress of their innovative activities. Finally, regarding 'barrier-related' non-innovators, Table 5 shows that for this group of firms we can clearly reject the hypothesis of a positive relationship between assessment of barriers as important and degree of engagement in innovative activities. For instance, in the cases of 'knowledge' and 'regulation' barriers, the probability of assessing barriers as highly important does not increase with the degree of engagement in innovative activities (even though the estimated coefficient associated with a level of engagement in 5 or more innovative activities is positive, it is not statistically different from that associated with our reference category - being engaged in zero innovative activities).

But even more importantly, in the case of ‘cost’ and ‘market’ barriers, there is evidence of a negative relationship between assessment of barriers as important and a low degree of engagement (compared to our reference category of no engagement at all). In other words, for barrier related non-innovators, firms that do not engage at all in innovative activities show a significantly higher assessment of barriers than those that engage little (in 1 or 2 activities), indicating the presence of a curvilinear relationship (U-shaped relationship). These results seem to indicate that for this group of firms, barriers to innovation act as a deterrent to innovative activities. In other words, it is not the engagement of innovative activities that explains firms attaching greater importance to barriers; instead, this group of firms seem to be inhibited from engaging in innovative activities as a consequence of how important barriers are perceived to be.

5. Discussion

This report has aimed at taking a closer look at the population of firms that do not innovate - i.e. those that have not introduced a new (or significantly improved) products or processes - with the purpose of assessing what are the factors that influence firms' assessment of barriers to innovation as important. Based on data from the UK CIS 4, three groups of non-innovators have been identified. Given that the ultimate purpose of this study is to examine the factors influencing the *assessment* of barriers, this study has identified different groups of firms on the basis of whether firms have experienced barriers to innovation (coupled with firms' answers to the question on what factors made innovation either not necessary or possible), on the understanding that firms cannot assess barriers unless they have experienced them. Three groups of non-innovators were identified, which can be briefly labelled as follows:[7]

a. '*Non-barrier related*': those firms that did not experience any type of barrier to innovation and who largely reported that innovation was not necessary due to the market conditions in which they operate.

b. '*Barrier related*': those firms that report that factors constraining innovation were among the reasons that made innovation not necessary or possible, and who did experience at least one barrier item.

c. '*Other non-innovators*': those firms that have experienced at least one barrier to innovation, but who report that factors constraining innovation were not among the reasons that made innovation not necessary or possible.

The findings from this report show that distinguishing among non-innovating firms, as described above, is relevant for a number of reasons.

First, in order to compare like with like. We know that a large proportion of companies are rather indifferent about innovative activities (DTZ, 2004). Such an attitude towards innovation is likely to be dominant for companies within group (a) - the 'non-barrier related' one. About 80% of the companies in this group have not engaged in any innovative activity, consistently with their responses reporting that innovation is not seen as necessary largely due to the market conditions in which they operate. If these companies are not in the 'innovation contest', it is essential to single them out when comparing innovators with non-innovators, otherwise we are in danger of getting misleading results.

As this report has shown, conflicting results are obtained when examining how firms respond in relation to whether they have experienced barriers to innovation, and how much importance they attach to barriers to innovation. When we compared innovators and the whole set of non-innovators (as if they were a homogeneous group), we found that innovators are much more likely to have experienced barriers and assessed barriers as important. However, once we distinguish between different types of non-innovators, we observe that the picture that emerges is dramatically different. In this case, we observe that two groups of non-innovators do experience barriers to a similar degree compared to the group of innovators, and even more importantly, firms in the 'barrier related' group assess barriers to innovation as being more important as compared to 'innovators'.

[7] A more detailed description of how these groups were defined is provided in section 2 of this report.

From these results, it is clear that considering all non-innovators together (as an undifferentiated group) provides a picture that is largely affected by the responses from the group of non-innovators that are rather uninterested in innovative activities. In other words, the 'non-barrier' related group is biasing downwards the overall proportion of non-innovators who experience barriers, and who assess barriers as important. To avoid this type of bias, and have more reliable figures on the proportion of non-innovators that experience barriers and assess barriers as important, it is advisable to separate the first group of non-innovators from the rest.

Second, in order to investigate the relationship between assessment of barriers and engagement in innovative activities. Much of the literature on innovation barriers highlights the existence of a positive relationship between assessment of barriers and implementation of innovative activities. However, this report shows that a closer inspection of different types of non-innovators provides a more informed picture on that relationship. On the one hand, the report shows that the group of 'other non-innovators' presents a very strong positive relationship between degree of engagement in innovative activities and the level of importance attached to barriers. While this result is consistent with the 'reverse causation' argument highlighted in the literature, it is crucial to point out that the positive relationship found is stronger than the one at work for the group of innovators. This indicates that this group of non-innovators is particularly sensitive to barriers that emerge alongside their innovative activities, compared to innovators.

On the other hand, the report shows that the 'barrier related' group departs from the above pattern. For this group of firms there is no evidence of a significant positive relationship between degree of engagement in innovative activities and the importance attached to innovation-related barriers. Instead, the report finds that, within the 'barrier related' group, firms with no engagement in innovative activities are more likely to attach greater importance to 'cost' and 'market' barriers as compared to firms who engage in 1 or 2 innovative activities. These results, therefore, help to restore the original meaning of barriers to innovation as reflecting mechanisms that deter firms from engaging in innovation activities, as opposed to mechanisms that are revealed alongside involvement in innovative activities. In short, 'barrier related' and 'other non-innovators' are substantially different in regard to the factors that influence their assessment of barriers. While the former group of firms seem likely to be deterred from engaging in innovative activities as a consequence of obstacles to innovation, the latter group conforms to a situation in which the performance of the innovative activities in which these firms are engaged is likely to be negatively affected by the obstacles faced in conducting such activities. These results point to differences between the types of barriers faced by the two groups of non-innovators: 'deterring' versus 'revealed' barriers.

In accordance with the above conclusions, these two groups of non-innovators would also differ in terms of the measures requested to attenuate the obstacles to innovation. In the case of 'other non-innovators' such measures are likely to be related to a better management of innovation activities, in order to minimize the obstacles realized in the course of such activities, while 'barrier related' firms may request measures that facilitate the adoption of innovative activities in the first place. A detailed analysis of this issue is beyond the scope of this report, though this is certainly an area that would deserve further research. Furthermore, there are some methodological suggestions related to the survey itself. As mentioned through the report, there were some inconsistencies in the pattern of responses regarding the two questions addressing barriers to innovation. First, about 30% of the companies that answered question 20 were actually 'innovative active' - i.e. firms that have engaged in at least one innovative activity - while this is a question that requests answers only from non-innovative active firms. This high proportion of inconsistent answers is likely to be caused by confusing the concept of (strict) innovator with the concept of 'innovative active'. One straightforward way to solve this would be to remove the filter (that is, to avoid

requesting that the question should be answered only in those cases in which firms are innovative active). The reason for this is that there seems to be a very effective self-selection process in answering this question, since there were only 19 strict innovator companies who answered this question. Therefore, avoiding the filter and just asking ‘please, indicate why it has not been necessary or possible to innovate’ is likely to work better.

The second pattern of inconsistent responses was characterised by those companies answering positively that ‘factors constraining innovation’ were among the reasons why the firm did not consider it necessary or possible to innovate (question 20), but then have reported that no barrier item has been experienced (question 19). One mechanism to alleviate this problem could be to change the order of the questions, placing question 20 before question 19. In addition, it may be helpful to make an explicit reference in item 3, within question 20, to the factors constraining innovation as listed in question 19 (in order to make the connection between the two questions more explicit).

Finally, there may be a concern for an overlap in meaning as regards item 2 in question 20 (i.e. ‘No need due to market conditions’) and the ‘market factors’ of question 19. A respondent may think that ‘No need to innovate due to market conditions’ may embrace, for instance, a situation in which the market is dominated by established firms (item 8 in question 19). One possible way to sort this could be to make more explicit what is meant by ‘No need due to market conditions’ (for instance, a clarification between brackets following the item).

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Appendix

Figure A1 - Proportion of firms assessing barriers as highly important: Knowledge Barriers

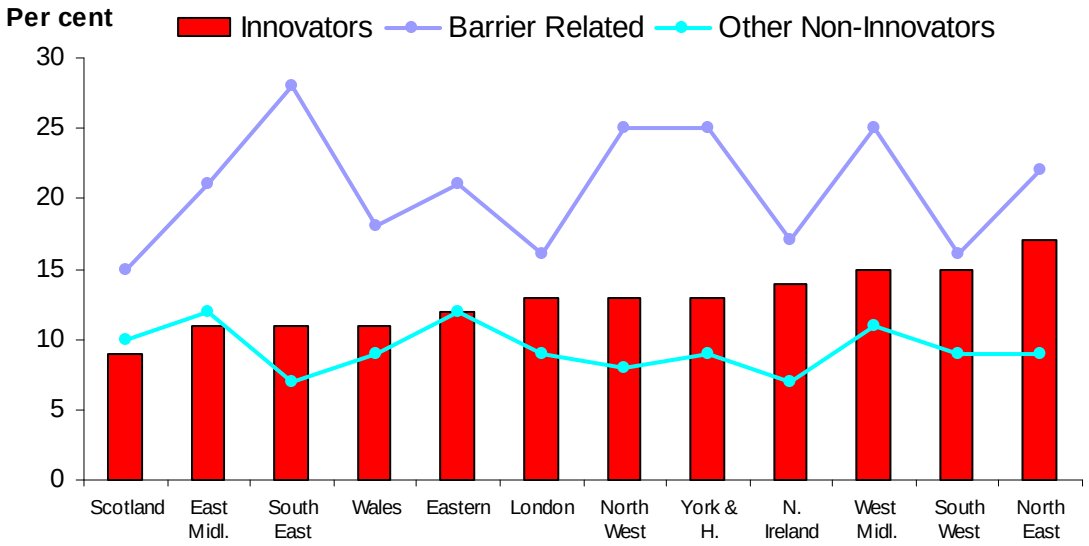


Figure A2 - Proportion of firms assessing barriers as highly important: Market Barriers

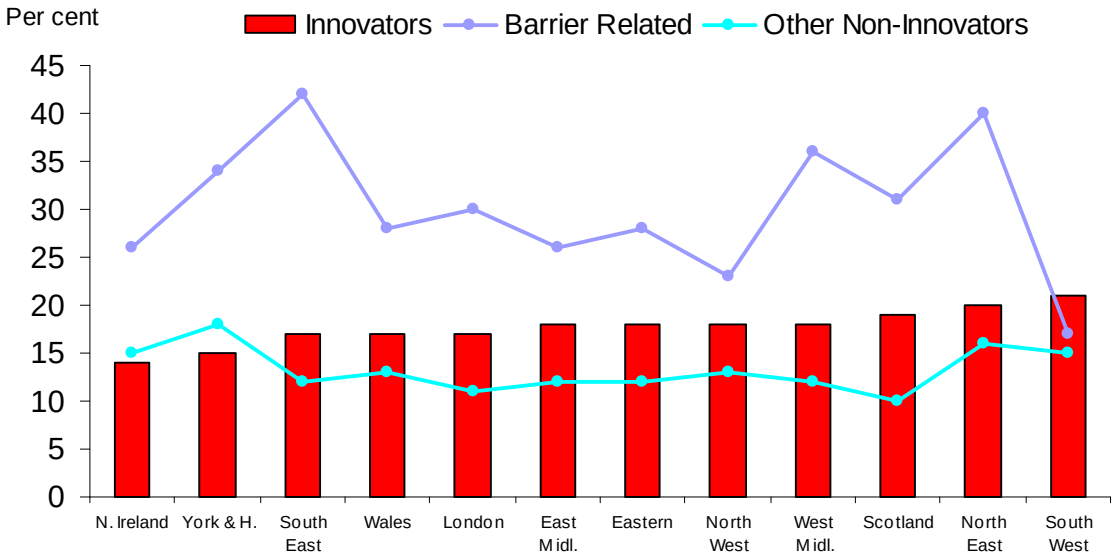
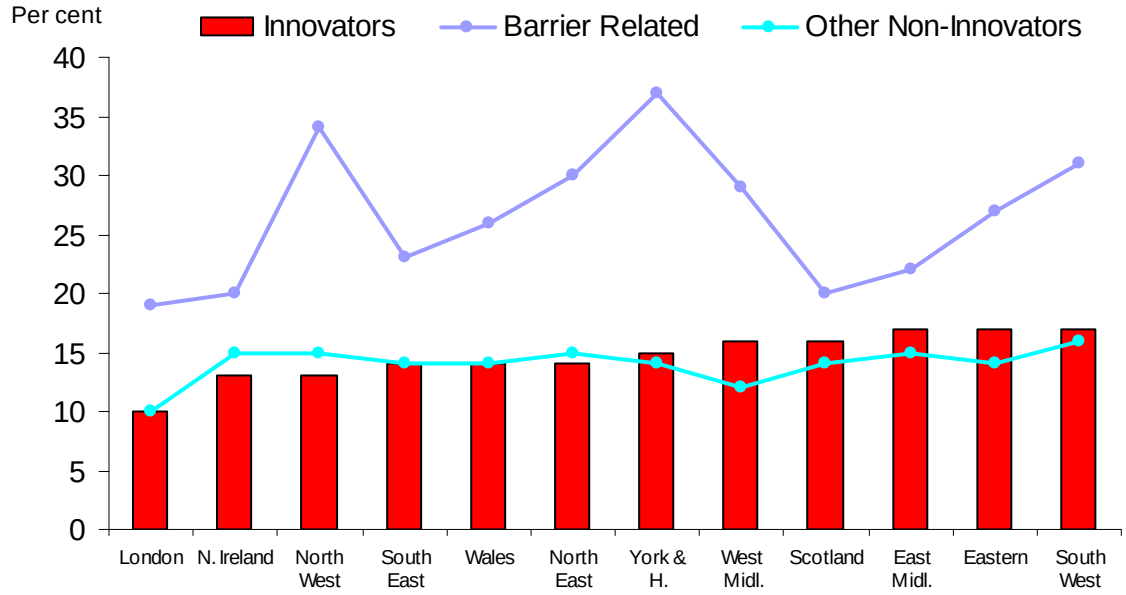


Figure A3 - Proportion of firms assessing barriers as highly important: Regulation Barriers



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