

# **What determines Innovation, Exporting and Productivity in Northern Ireland Services?**

Phase 2 report of the Innovation in Tradable Services Project

Final Report – November 2007

Report prepared by Stephen Roper and Nola Hewitt-Dundas (InnovationLab (Ireland) Ltd) and Professor Jim Love (Aston Business School) for the Department of Enterprise Trade and Investment

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## **Executive Summary**

This report focuses on two questions. What determines service innovation in Northern Ireland? And, what impact does innovation have on service firms' exporting and productivity?

The analysis outlined here adopts an econometric approach and builds on the earlier Phase 1 report on Tradable Services Innovation and Exporting in Northern Ireland. The report is based on information from the Innovation Survey 2005 and matched data from the 2004 and 2005 Annual Business Inquiry databases.

### **What drives service innovation?**

Our analysis is based on data provided by over 700 services firms in Northern Ireland. It highlights a number of factors which are important in driving innovation in Northern Ireland:

- Firms with customers outside Northern Ireland are around 50-55 per cent more likely to be innovating than firms with only local customers.
- Firms undertaking R&D are 26.4 per cent more likely to be undertaking service innovation, and 11.1 per cent more likely to be undertaking marketing innovation than other firms.
- Innovation is more common among larger services firms, newer firms and those which are part of larger groups. Independent firms are significantly less likely to be innovators.
- Factor shortages or access to finance are not significant barriers to service innovation in Northern Ireland. Instead demand-side, market related factors that dominate firms' innovation decisions reducing the probability to innovation by 6-7 per cent.
- We find clear evidence of a positive association between firms' absorptive capacity and government support and innovation although these effects are not always statistically robust. Specific support for innovation by government remains uncommon across the service sector and has little significant effect overall. There is clear evidence, however, that specific interventions intended to either develop skills or the capital basis for innovation have consistent positive effects on the probability of undertaking all forms of innovation.

Finally, it is worth noting that our analysis suggests that in terms of the probability of service innovation – and standardizing for firm characteristics - the models suggest sectors divide into two broad groups:

- *Sectors with low service innovation probabilities*: motor trades, wholesale and retail trades, hotels and hospitality, real estate and renting and financial services.
- Sectors with *high service innovation probability*: transport and communications, other business services and computer services and R&D.

## **How does innovation impact on exporting and productivity?**

Links between innovation, exporting and productivity prove complex. The key results are:

- Undertaking innovation is not sufficient to turn a non-exporting firm into an exporter, however, innovating does have a positive impact on the extent and growth of exporting.
- Innovation has no direct impact on productivity but does have a strong indirect effect on productivity through its impacts on the extent and growth of exports. On average, an exporter in 2004 will have 10.9 pp faster productivity growth in the next year than a non-exporter.

The implication is that, by itself, innovation is not enough. To derive the greatest productivity benefits from innovating, service firms need to look beyond sales in Northern Ireland. Innovation PLUS exporting is required for sustained productivity growth in services.

# 1. Introduction

This report focuses on the determinants of service innovation in Northern Ireland and the impact of innovation – and other firm characteristics – on exporting and productivity. The analysis outlined here builds on the earlier Phase 1 report on Tradable Services Innovation and Exporting in Northern Ireland and adopts an econometric approach to try and identify the scale and significance of the different influences on innovation, exports and productivity. Reviews of previous studies in this area are included in the Phase 1 report and are not therefore reproduced here.

Data for this analysis like that from the earlier Phase 1 report is based largely on information from the Innovation Survey 2005 and matched data from the 2004 and 2005 Annual Business Inquiry databases. The Innovation Survey 2005 includes a number of measures of firms' innovation activity and here we focus on six specific measures relating to: binary indicators of whether firms engaged in service innovation, marketing innovation, strategy innovation, adoption of advanced management techniques (AMTs), organisational innovation and finally an indicator of the percentage of firms' sales derived from innovative products. This latter measure we refer to as firms' 'innovation success'.

The report is divided into two main sections. The first deals with the determinants of service innovation in Northern Ireland and the second with the impact of innovation on exporting and productivity. In the text we present a series of tables which give a symbolic summary of the estimation results and indicate whether individual effects are positive and significant, i.e. "+"; positive but statistically insignificant, i.e. "(+)", with similar symbols for negative effects.

## 2. What determines Service Innovation?

In the Phase 1 report we review the research literature on the determinants of innovation in both services and manufacturing. Increasingly, this literature focuses on the so called knowledge production function or innovation production function. This relates innovation outputs to knowledge inputs, with the translation of knowledge into innovation reflecting the effectiveness of firms' internal processes. In services, organisational change is generally thought to be more important than in manufacturing, with technological innovation of marginally less importance.

In the annex we outline a series of probit models which reflect the probability that service firms in Northern Ireland were engaged in five types of innovative activity over the 2002 to 2004 period. In each case the models include the following sets of explanatory variables:

- Local and external connectivity with other organisations which provide knowledge inputs for innovation. Local variables here reflect contacts within

Northern Ireland and therefore the strength of the local innovation system. External contacts reflect contacts outside the region and indicate the importance of firms' contacts with more widespread innovation networks.

- A range of background characteristics on the firm including R&D, employment, plant vintage and whether or not the firm was part of a larger group of companies. R&D here is seen as having two key roles: as a potential source of new knowledge for innovation but also as an indicator of firms' absorptive capacity, i.e. their ability to absorb external knowledge.
- Absorptive capacity indicators – in addition to the role of R&D as an element of absorptive capacity we also include in the model a series of variables designed to reflect absorptive capacity more directly. These include the level of graduate employment in the firm, investments in training specifically associated with firms' innovation activity as well as the level of investment for innovation.
- Information on perceived barriers to innovation in Northern Ireland. Our expectation would be that where firms identify barriers to innovation these have a negative effect on the probability of innovating.
- Measures designed to capture government assistance to firms from local or regional sources, from national UK sources and any support received from international (EU) sources. In each case we anticipate positive effects where such support has an additional effect.

In addition we include in each model a series of sectoral indicators designed to pick up the marked sectoral differences in innovation activity identified in the Phase 1 study.

## **2.1 Connectivity**

Table 1 summarises the impact of firms connectivity on their engagement with each type of innovation activity. Two groups of contacts are distinguished: local partners (i.e. those within Northern Ireland) and external partners. Overall, the results are somewhat more patchy than might have been expected with the following key points emerging:

- Links to other group companies either local or external have mixed impacts on most types of innovation but a positive impact on service innovation.
- Links to local and external suppliers have little significant effect.
- Local customers play little role in stimulating innovation while external customers play a significant role in stimulating service, marketing, strategic, AMT and organisational innovation. This reflects later findings that exporting and contacts with external markets may help to stimulate competitive behaviours in firms and improve productivity.

- Links to local and external competitors have relatively little effect on innovation.
- Labs, consultants and universities, whether local or external have little consistent effect on innovation.

Perhaps the most important of these results is the clear role of external customers (or exporting) in stimulating innovation activity. In fact, marginal values derived from the models suggest that a firm with links to external customers is 55.2 per cent more likely to undertake service innovation, 50.3 per cent more likely to undertake marketing innovation and 17.9 per cent more likely to undertake strategic innovation than firms without such links (Table A3).

**Table 1: Connectivity and Service Innovation: Symbolic Summary**

	Services	Marketing	Strategy	AMT	Organisation
Local group members	+	(-)	(-)	(-)	-
Local suppliers	(-)	(-)	(+)	(+)	(-)
Local customers	(+)	(-)	-	(-)	(+)
Local competitors	(+)	(+)	(+)	(-)	(+)
Local laboratories, consultants	(-)	(+)	(+)	+	+
Local universities	(+)	(+)	(-)	(+)	(+)
External group members	(+)	(+)	(+)	(-)	(+)
External suppliers	(+)	(+)	(+)	(+)	(-)
External customers	+	+	+	+	+
External competitors	(-)	(+)	(+)	+	(+)
External labs, consultants	(-)	-	(-)	-	(+)
External universities	-	(+)	(+)	(+)	(-)

**Source:** Table A2

## **2.2 Firm Characteristics, Sector**

Other factors linked to the basic characteristics of the firm also prove important in determining the probability that service firms in Northern Ireland will engage in innovation. R&D is often said to be of less importance for service sector firms than for manufacturing businesses but our results here emphasise its importance even in services with positive and significant effects on service and marketing innovation (Table 2). On average firms undertaking R&D have a 26.4 per cent increase in the probability of undertaking service innovation, and 11.1 per cent increase in the chance of undertaking

marketing innovation (Table A3). Notably, however, these effects are smaller than those associated with connectivity to external customers.

We also note positive effects between the probability of innovating and firm size, and a tendency for newer firms to be more likely to engage in both AMT and strategic innovation (Table 2). Ownership also has a strong and consistently positive effect on innovation of all sorts with firms which are part of a larger group more likely to innovate than independent firms. In general, however, these ownership effects are smaller than those for R&D and links to external customers.

**Table 2: Firm Characteristics and Service Innovation: Symbolic Summary**

	Services	Marketing	Strategy	AMT	Organisation
<b>Firm characteristics</b>					
Research and Development	+	+	(+)	(+)	(-)
Employment (2002, nos)	(+)	(+)	+	+	(+)
Employment squared	(+)	(-)	-	(-)	(-)
Firm established post 2000	(+)	(-)	+	(-)	(+)
Part of larger group	+	+	+	+	+

**Source:** Table A2

In Phase 1 of the services sector study we also noted marked sectoral differences in the pattern of innovation in Northern Ireland, and these are reflected in Table 3. In the econometric modeling these effects are measured relative to the sector omitted from the models. Here we use choose to use ‘motor trades’ as the reference or ‘base’ sector as this sector had some of the lowest overall low levels of innovation relative to that in other service sectors. Positive coefficients therefore mean that the sector was more innovative than the average for the motor trades sector. Insignificant coefficients (positive or negative) suggest that a sector was equally as innovative as the motor trades sector.

The most consistent effects here are for service innovation itself with few significant differences in terms of marketing, strategy or organisational change. In terms of the probability of service innovation – and standardizing for firm characteristics - the models suggest sectors divide into two broad groups (Table 3):

- **Sectors with low service innovation probabilities:** motor trades, wholesale and retail trades, hotels and hospitality, financial services and real estate and renting;
- Sectors with **high service innovation probability:** transport and communications, other business services, computer services and R&D.

**Table 3: Sector and Service Innovation: Symbolic Summary**

	Services	Marketing	Strategy	AMT	Organisation
Wholesale	(+)	(+)	+	+	(+)
Retail	(+)	(-)	+	+	(+)
Hotels and hospitality	(+)	(-)	+	+	(-)
Transport and Communications	+	(-)	+	+	(+)
Financial services	(+)	(+)	+	(+)	(+)
Real estate, renting	(+)	(-)	+	(-)	(-)
Computer services, R&D	+	(-)	+	(+)	(+)
Other Business Services	+	(+)	+	+	(+)

**Source:** Table A2

### **2.3 Barriers to Service Innovation**

The estimation of our innovation equations provides an opportunity to evaluate the impact of perceived barriers to innovation activity in Northern Ireland. These results have to be seen in the context of the points made in the Phase 1 report, however, which suggested that in general firms in Northern Ireland perceived less commonly perceived barriers to innovation than firms in other UK regions.

In the models the effect of perceived barriers to innovation are generally weak – suggesting little systematic impact – although there are some notable exceptions related to lack of qualified personnel and the nature of the markets in which firms are operating (Table 4). In particular firms perceiving a lack of qualified personnel were 20.2 per cent *more* likely to be undertaking organisational innovation (Table A3). These effects are most likely to reflect the stronger perception of skills barriers among innovating firms rather than among non-innovators.

**Table 4: Perceived Barriers to Innovation and Service Innovation: Symbolic Summary**

	Services	Marketing	Strategy	AMT	Organisation
Riskiness of innovation	+	(+)	+	+	(+)
Costs of innovation	(-)	(-)	(-)	(+)	(+)
Costs of finance	(-)	(-)	(-)	(-)	(+)
Availability of finance	(+)	(+)	(+)	(+)	(+)
Lack of qualified personnel	(+)	(+)	(+)	(+)	+
Lack of info on markets	(+)	(+)	(+)	(+)	(+)
Market dominated by established firms	-	(+)	(-)	(-)	(-)
Uncertain demand for innovation	-	(+)	(-)	+	(+)
Need to meet UK regulations	(-)	(-)	(-)	(-)	(+)
Need to meet EU regulations	(+)	(+)	(+)	(+)	(-)

Market conditions were more important in reducing the probability of service innovation with a perception that the market was dominated by established firms reducing the probability of undertaking service innovation by 8.7 per cent and a perception of an uncertain demand for innovation reducing service innovation by 6.8 per cent (Table A3)

In summary we can conclude that factor shortages or access to finance is not a significant barrier to service innovation in Northern Ireland, instead it is demand-side, market related factors that dominate firms' innovation decisions.

## **2.4 Absorptive Capacity and Government Assistance**

Absorptive capacity relates to firms' ability to absorb external knowledge and information and incorporate it into their innovation process. In the Phase 1 report – particularly in the sectoral studies – it became clear that a number of aspects of government assistance in Northern Ireland, particularly support for skills development and investment were key to developing firms' absorptive capacity (Table 5). We therefore consider these measures here along with more focussed support from government for R&D and innovation.

As we would expect given the analysis of Phase 1 of the project we find general evidence of a positive association between our indicators of absorptive capacity and innovation – i.e. we see a preponderance of positive effects. The evidence is more mixed, however, in terms of those effects which are statistically robust or significant. In fact in these terms we find little support for the assertion that firms' general capabilities in terms of graduate level skills positively influence innovation although there are clearer positive organisational effects (Table 5). More specific interventions however intended to either develop skills or the capital basis for innovation have more consistent and statistically

significant positive effects on the probability of undertaking all forms of innovation (Table 5). Our econometric evidence therefore reinforces the role of absorptive capacity in enabling service innovation and in particular the potentially positive role of measures designed to stimulate training and investment for innovation.

**Table 5: Absorptive Capacity and Service Innovation: Symbolic Summary**

	Services	Marketing	Strategy	AMT	Organisation
Science and Eng graduates	-	(+)	(+)	(-)	(+)
Other graduates	(+)	(+)	(+)	+	+
Training for innovation	+	+	+	+	+
Investment for innovation	(+)	+	(+)	+	+

As with the absorptive capacity effects, we anticipate positive innovation effects from government assistance from either local, national or EU governments and this is largely what we observe (Table 6). Again, however, these effects are not uniformly statistically robust or significant. Here, too some care is also necessary in the interpretation of the coefficients relating to government assistance as these will reflect both the effect of government assistance on firms' innovation probability as well as the possibility of selection effects, i.e. that better firms may well be selected to receive assistance as well as benefiting from that assistance<sup>1</sup>. These policy effects cannot therefore be interpreted as pure policy effects as they will reflect both the selection and assistance effects (Table 6).

**Table 6: Government Assistance and Service Innovation: Symbolic Summary**

	Services	Marketing	Strategy	AMT	Organisation
Local or regional	(+)	+	(+)	(-)	(+)
UK national	(-)	(-)	(-)	(+)	(+)
EU assistance	+	(+)	+	+	(+)

## 2.5 Summary of Key Effects

A number of factors emerge as the key drivers of service sector innovation in Northern Ireland:

- Local linkages play little consistent role in stimulating innovation while external customers play a significant role in stimulating all types of service innovation activity.

<sup>1</sup> A range of specific econometric techniques have developed over recent years to address this issue and identify clearly the pure 'assistance' effects of policy intervention. See Roper and Hewitt-Dundas (2005) for an example using Northern Ireland and Irish data. Roper, S and Hewitt-Dundas, N (2005) 'Measuring the Impact of Grant Support for Innovation: Panel Data Evidence for Irish Firms', European Regional Science Association, Amsterdam, August 2005.

- A firm with links to external customers is 55.2 per cent more likely to undertake service innovation, 50.3 per cent more likely to undertake marketing innovation and 17.9 per cent more likely to undertake strategic innovation than firms without such links.
- Firms undertaking R&D have a 26.4 per cent increase in the probability of undertaking service innovation, and 11.1 per cent increase in the chance of undertaking marketing innovation.
- The probability of innovating is also positively related to firm size and newness
- Ownership also has a strong and consistently positive effect on innovation of all sorts with firms which are part of a larger group more likely to innovate than independent firms.
- Factor shortages or access to finance are not significant barriers to service innovation in Northern Ireland, instead it is demand-side, market related factors that dominate firms' innovation decisions reducing the probability to innovation by 6-7 per cent.
- We find general evidence of positive effects on innovation related to firms' absorptive capacity and government assistance although in many cases these effects are not statistically robust. We find little support for the positive impact of focussed support for innovation but there is clear evidence that specific interventions intended to either develop skills or the capital basis for innovation have consistent positive effects on the probability of undertaking all forms of innovation. This is likely to reflect the more widespread availability of such support for services firms in Northern Ireland than more focussed innovation support. This issue is discussed in more detail in the Phase 1 report.

Finally, it is worth noting that our analysis suggests that in terms of the probability of service innovation and once we allow for differences in firm characteristics between sectors the models suggest sectors divide into two broad groups:

- ***Sectors with low service innovation probabilities:*** motor trades, wholesale and retail trades, hotels and hospitality, real estate and renting and financial services;
- ***Sectors with high service innovation probability:*** transport and communications, other business services and computer services and R&D.

## 3. Innovation and Firm Performance

### 3.1 Exporting

The literature review undertaken for Phase 1 of the Innovation in Tradable Services project indicated that there is very little existing evidence in the academic literature on the relationship between innovation and exports in services.

In this section we look in detail at the impact of the different forms of innovation examined earlier on three aspects of firms' exporting performance in Northern Ireland:

- **Exporter** – i.e. whether the firm was or was not exporting outside Northern Ireland as reported in the 2005 ABI;
- **Export share** - i.e. the proportion of exports in total sales in 2005 as reported in the 2005 ABI;
- **Export growth from 2004 to 2005** – the percentage growth in the real value of export sales indicated by firms' returns to the 2004 and 2005 ABI.

In each case we allow for all five types of innovation identified earlier, and also allow for the effect of firm characteristics (e.g. size etc.), issues of absorptive capacity, and for sectoral differences in exporting performance. It should also be noted at the outset that the number of observations available for the export growth estimations is relatively small (c. 131 compared with 709 and 690 for exporter and export share respectively.). As before detailed estimation results are included in the Annex with only a symbolic summary of results included in the text.

The first notable result from our estimation is that we find no positive relationship whatsoever between any aspect of innovation behaviour and whether or not a firm is an exporter (Table 9). In other words all of the coefficients in the models relating different types of innovation to firms' status as an exporter are insignificant or marginally negative (see Tables A4 and A5). Thus neither the act of innovating nor having a high proportion of new products in sales will make a firm *become* an exporter. More positively, however, firms undertaking organisational innovation do export a significantly larger proportion of their sales from Northern Ireland, i.e. their export share increases (Table 9, and Tables A4 and A5). We also see a small but significant positive effect from service innovation on export growth. Thus introducing new services will not turn non-exporters into exporters, but it will improve the export growth performance of those that are already exporters.

**Table 9: Innovation, Exporting and Productivity: Symbolic Summary of Effects**

	Exporter	Exp. Share	Exp Grth
<b>Innovation</b>			
Service Innovation	(-)	(+)	(+)
Marketing Innovation	(-)	(-)	(-)
Strategic Innovation	(-)	(-)	(+)
AMT Innovation	(+)	(+)	-
Organisational Innovation	(+)	+	+
Service Innovation ‘success’	-	(+)	+

Other factors aside from innovation can, of course, also impact on service firms’ exporting behaviour (Table 10). Although being an innovator has no effect on being an exporter, for example, having in-plant R&D does make it more likely that firms will export although this effect is not statistically significant.

Other firm characteristics and absorptive capacity measures have little systematic impact on exporting (Table 10). There is no evidence that firm size has any impact on exporting once other factors are allowed for (Table 10). Finally, as one would expect, several of the sectoral indicators are highly significant with e.g. wholesale, retail and hotel enterprises showing very low levels of exporting relative to the reference sector ( Motor Trades).

**Table 10: Determinants of Exporting and Productivity: Symbolic Summary of Effects**

	Exporter	Exp. Share	Exp Grth
<b>Firm characteristics</b>			
Research and Development	+	(+)	(+)
Employment (2002, nos)	(-)	(-)	(+)
Employment squared	(+)	(+)	(-)
Firm established post 2000	(-)	(+)	(+)
Part of larger group	(-)	(-)	(-)
<b>Absorptive Capacity</b>			
Science and Eng graduates	(+)	+	-
Other graduates	(+)	(-)	(+)
Training for innovation	-	(-)	(+)
Investment for innovation	(+)	(+)	(+)
<b>Sectoral Indicators</b>			
Wholesale	(+)	(+)	(+)
Retail	-	(-)	(+)
Hotels and hospitality	-	-	(-)
Transport and Communications	+	+	(-)
Financial services		(+)	
Real estate, renting	(+)	(+)	(-)
Computer services, R&D	+	+	(-)
Other Business Services	+	+	(-)

### **3.2 Innovation and Productivity**

The benchmark and performance analysis in Phase 1 of the Innovation in Tradable Services project indicated that, on average, labour productivity was around a quarter higher in innovating service sector firms compared with non-innovators. This apparent effect could, however, be the result of other factors which act simultaneously on both innovating and productivity, such as firm size, absorptive capacity, sectoral differences etc.

In this section we allow for all these other factors in establishing the relationship between innovation and productivity. We consider two measures of productivity:

- **Labour productivity** (i.e. value added per employee) in 2005 as reported in the ABI;

- **Labour productivity growth** (real %) between 2004 and 2005, again as reported by firms in the 2004 and 2005 ABIs.

The variables in the estimation are those used in the export estimation above, with the addition of a measure of capital intensity (capital investment per employee) and whether or not the firm was an exporter in 2004. As with exports, the Annex contains results both for a service innovation dichotomous variable (Table A6), and for ‘innovation success’ i.e. the proportion of sales accounted for by services which were new or significantly improved during 2002-04 (Table A7). Tables 11 and 12 provide a symbolic summary of effects.

The results for innovation could not be clearer: once other factors are taken into account, there is no apparent impact of innovation on firm productivity or productivity growth in the following year. At first sight this may appear to be something of a puzzle; while the introduction of new services might not have a positive productivity effect, and could even reduce productivity in the short term due to ‘disruption effects’, one might expect organisational or AMT innovations to have some effect on subsequent productivity.

**Table 11: Innovation and Productivity: Symbolic Summary of Effects**

	Productivity	Prod. Grth
<b>Innovation</b>		
Service Innovation	(-)	(-)
Marketing Innovation	(-)	(-)
Strategic Innovation	(+)	(+)
AMT Innovation	(-)	(-)
Organisational Innovation	(+)	(+)
Service Innovation ‘success’	(-)	(+)

However, two points are relevant here. First, similar results have been found for the effect of innovation on business services in the United States (Mansury and Love 2006)<sup>2</sup>, suggesting either that the lack of direct impact of service innovation on productivity is widespread, or that the impact of service innovation on productivity takes longer to manifest itself than the relatively short period under consideration in the present study. Second, the analysis (Table 12 and Tables A6 and A7) indicate that there is a positive effect of R&D on productivity and productivity growth. Firms with an R&D presence have rates of productivity growth 9.6 pp higher than those with no R&D. Given the strong association between R&D and virtually all forms of service innovation outlined earlier, this reinforces the role that in-house R&D can play even in a service context:

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<sup>2</sup> Mansury M A and Love J H (2006) ‘Innovation, Productivity and Growth in US Business Services: a Firm-level Analysis’ , Research Paper 0638, Aston Business School, Birmingham.

R&D underpins innovation, and thus ultimately encourages higher levels of productivity and productivity growth. Therefore rather than suggest that there is no link between service innovation and productivity, it might be more accurate to suggest that any such link is moderated at least partly through the positive impact of R&D, either directly as a spur to innovation or indirectly as an element of the firm's absorptive capacity.

Other influences on productivity are much as might be expected (Table 12) although smaller firms have higher productivity *ceteris paribus* than larger services firms. New firms (established since 2000) are markedly less productive than older establishments, but have the same average rate of productivity growth. More capital intensive firms tend to have higher labour productivity, an almost universal finding in other studies. The sectoral indicators are in line with the findings of Phase 1 of the study: the retail and hotels sectors have very low labour productivity, while the productivity (and productivity growth) of the real estate sector is significantly above that of other service sectors.

**Table 12: Determinants of Productivity: Symbolic Summary of Effects**

	Productivity	Prod. Grth
<b>Firm characteristics</b>		
Research and Development	+	+
Employment (2002, nos)	-	(-)
Employment squared	(+)	(+)
Firm established post 2000	-	(+)
Part of larger group	(+)	(-)
Capital intensity	+	(-)
Exporter	+	+
<b>Absorptive Capacity</b>		
Science and Eng graduates	(+)	(+)
Other graduates	(+)	(-)
Training for innovation	(-)	(-)
Investment for innovation	(+)	(+)
<b>Sectoral Indicators</b>		
Wholesale	(+)	(-)
Retail	-	(-)
Hotels and hospitality	-	(-)
Transport and Communications	(+)	(-)
Financial services	n/a	n/a
Real estate, renting	+	+
Computer services, R&D	+	(-)
Other Business Services	(+)	(-)

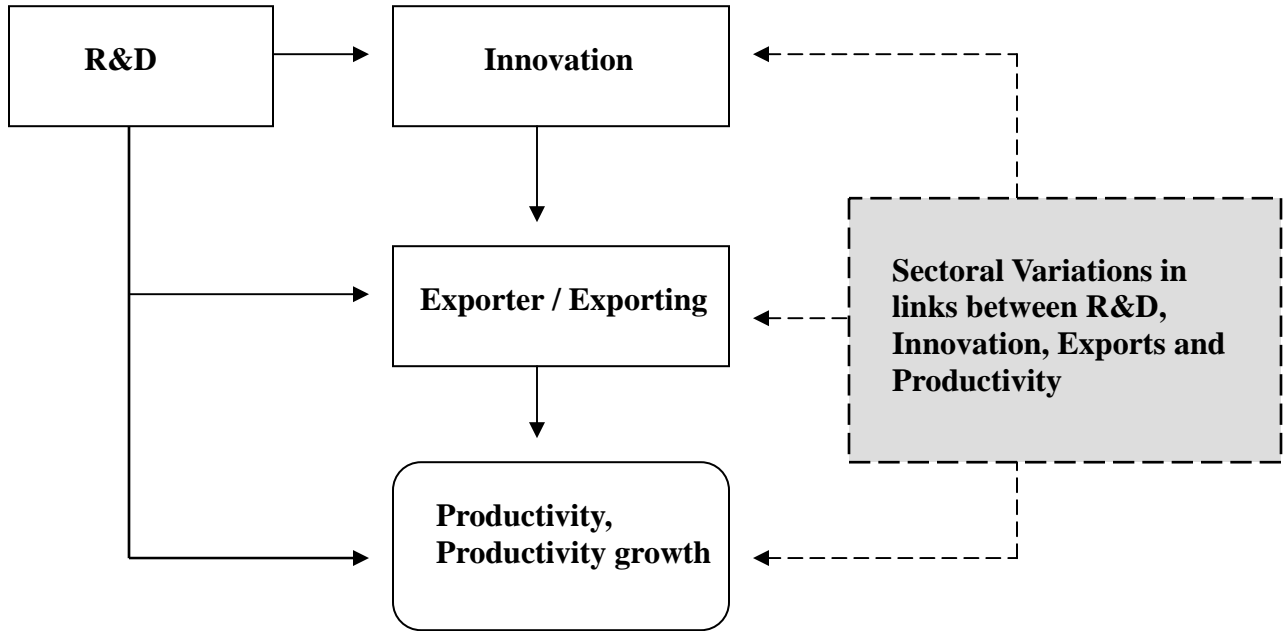
### ***3.3 Innovation, R&D, Exporting and Productivity***

The analysis above has looked separately at innovation and exporting and at innovation and productivity. However, we must acknowledge that these three issues are intertwined in potentially complex ways that even the multivariate analysis above cannot fully unravel.

For example, the relationship between productivity and exporting is potentially two-way: does exporting make firms more productive (because of learning effects and exposure to foreign competition), or do better performing firms simply choose to become exporters? There are sound reasons to expect exporting to enhance productivity, both through the exposure to foreign competition which exporting brings, and through 'learning by exporting', principally involving being exposed to superior foreign knowledge and technology. However, the broad thrust of previous research is that more productive firms

self-select into export markets: there is mixed evidence on whether exporting leads to higher productivity thereafter, and almost no research on services.

**Figure 1: Innovation, R&D, Exporting and Productivity in NI Services**



In Table 12 (and Tables A6 and A7) it is clear that being an exporter is associated with markedly greater productivity and productivity growth in the subsequent period. On average, an exporter in 2004 will have 10.9 pp faster productivity growth in the next year than a non-exporter. This does not rule out the possibility of a ‘self-selection’ effect which persists over time. However, in some of our analysis (not reported) we included productivity as a variable in the exporting equations and found no effect, suggesting that the beneficial impact of exporting on productivity is real.

We can therefore make some tentative conclusions about the link between innovation, exporting and productivity in the Northern Ireland services sector. Although innovation appears to have no direct impact on productivity, and innovating will not turn a non-exporter into an exporter, it does have a positive impact on the extent and growth of exporting. At the same time, exporting is strongly associated with productivity, suggesting an indirect link between innovation and productivity via exporting. Earlier we also suggested that not only does R&D have a direct effect on productivity, it also has an indirect effect through R&D’s impact on innovation.

A diagrammatic representation of these relationships between innovation, R&D, exporting and productivity in services is shown in Figure 1. This figure does not purport to be a complete description of every part the process. For example, there will be

significant sectoral variations in the nature and strength of these relationships, as indicated by the shaded box and dotted lines. Figure 1 should therefore be interpreted as providing a high-level overview of how R&D, innovation and exporting interact to affect firm-level productivity in services in Northern Ireland, based on the econometric analysis outlined above.

The crucial point of the figure is the indirect nature of the link between innovation and productivity (growth). Being an innovator assists exporting, and this in turn assists productivity. Both these effects are underpinned by R&D, or at least a formal commitment to the innovation process. By itself, innovating is not enough: to derive productivity benefits from innovating, service firms need to look beyond sales in Northern Ireland. Innovation PLUS exporting is required for sustained productivity growth in services.

## **Annex Tables**

**Table A1: Descriptive Statistics**

	n	Mean	Std. Dev
<b>Innovation Measures</b>			
Service Innovation	768	0.147	0.355
Marketing Innovation	767	0.163	0.369
Strategic Innovation	767	0.125	0.331
AMT Innovation	766	0.127	0.333
Organisational Innovation	767	0.138	0.345
Innovation Success	773	7.004	20.355
<b>Performance Measures</b>			
Exporter	773	0.342	0.474
Exports as share of sales (2005, %)	700	1.730	6.068
Export growth 2004-05 (%)	166	-0.235	1.608
GVA per employee (2005	698	28.570	39.667
GVA growth per employee (2005)	683	0.066	0.519
<b>Connectivity</b>			
Local group members	773	0.025	0.157
External group members	773	0.007	0.086
Local suppliers	773	0.023	0.151
External suppliers	773	0.027	0.161
Local customers	773	0.034	0.181
External customers	773	0.021	0.145
Local competitors	773	0.023	0.150
External competitors	773	0.019	0.136
Local laboratories, consultants	773	0.014	0.117
External labs, consultants	773	0.012	0.108
Local universities	773	0.018	0.133
External universities	773	0.009	0.096
<b>Firm characteristics</b>			
Research and Development	773	0.203	0.402
Employment (2002, nos)	773	84.585	933.713
Firm established post 2000	772	0.149	0.356
Part of larger group	768	0.214	0.410
<b>Perceived barriers to innovation</b>			
Riskiness of innovation	773	0.121	0.326
Costs of innovation	773	0.129	0.335
Costs of finance	773	0.109	0.312
Availability of finance	773	0.087	0.281
Lack of qualified personnel	773	0.047	0.212

Lack of info on markets	773	0.030	0.169
Market dominated by established firms	773	0.052	0.221
Uncertain demand for innovation	773	0.046	0.210
Need to meet UK regulations	773	0.079	0.269
Need to meet EU regulations	773	0.067	0.250
<b>Absorptive Capacity</b>			
Science and Eng graduates	773	5.464	16.656
Other graduates	773	5.979	13.351
Training for innovation	769	0.333	0.471
Investment for innovation	769	0.397	0.489
<b>Government Assistance</b>			
Local or regional	766	0.063	0.242
UK national	766	0.056	0.229
EU assistance	762	0.006	0.078
<b>Sectoral Indicators</b>			
Motor Trades	773	0.089	0.284
Wholesale	773	0.122	0.327
Retail	773	0.243	0.429
Hotels and hospitality	773	0.223	0.417
Transport and Communications	773	0.074	0.261
Financial services	773	0.032	0.176
Real estate, renting	773	0.041	0.198
Computer services, R&D	773	0.037	0.189
Other Business Services	773	0.139	0.346

**Notes:** Observations relate to private services sector and are weighted to give regionally representative results.

**Sources:** Innovation Survey 2005, Annual Business Inquiry, 2004 and 2005.

**Table A2: Determinants of Service Innovation in Northern Ireland: Equation Coefficients from Probit Models**

	Service Innovation		Marketing Innovation		Strategic Innovation		AMT Innovation		Organisational Innovation	
	Coef.	t stat	Coef.	t stat	Coef.	t stat	Coef.	t stat	Coef.	t stat
<b>Connectivity</b>										
Local group members	0.931	1.870	-0.013	-0.020	-0.322	-0.620	-0.466	-0.760	-1.605	-2.960
External group members	0.259	0.420	0.230	0.280	0.139	0.180	-0.445	-0.450	0.746	1.000
Local suppliers	-0.195	-0.320	-0.112	-0.220	0.800	1.560	0.051	0.090	-0.685	-1.210
External suppliers	0.513	1.090	0.083	0.140	0.204	0.400	0.492	0.820	-1.002	-1.860
Local customers	0.032	0.070	-0.307	-0.630	-1.569	-3.350	-0.858	-1.630	0.384	0.840
External customers	1.786	3.190	1.568	3.140	0.955	1.910	0.871	1.870	2.213	4.000
Local competitors	0.384	0.690	0.167	0.360	0.600	1.170	-0.452	-0.840	-0.074	-0.140
External competitors	-0.537	-1.020	0.892	1.240	0.738	1.580	2.097	2.750	0.478	0.770
Local laboratories, consultants	-0.624	-1.010	0.661	0.970	0.611	0.900	1.529	1.950	1.204	1.980
External labs, consultants	-0.094	-0.140	-1.467	-1.640	-1.041	-1.490	-1.825	-1.930	0.149	0.210
Local universities	0.272	0.540	0.256	0.480	-0.067	-0.120	0.879	1.390	0.217	0.400
External universities	-1.409	-1.800	0.205	0.250	0.089	0.120	0.226	0.270	-0.409	-0.520
<b>Firm characteristics</b>										
Research and Development	1.186	5.320	0.529	2.680	0.188	0.920	0.282	1.480	-0.228	-1.040
Employment (2002, nos)	0.000	0.060	0.000	1.590	0.001	2.150	0.000	2.060	0.000	1.340
Employment squared	0.000	0.220	0.000	-1.010	0.000	-1.900	0.000	-0.620	0.000	-0.430
Firm established post 2000	0.318	1.430	-0.199	-0.880	0.652	3.520	-0.181	-0.720	0.003	0.010
Part of larger group	0.473	2.510	0.449	2.670	0.939	5.380	0.535	3.170	0.970	5.440
<b>Perceived barriers to innovation</b>										
Riskiness of innovation	0.649	2.030	0.411	1.490	0.473	1.650	0.461	1.610	0.397	1.400
Costs of innovation	-0.430	-1.290	-0.076	-0.280	-0.032	-0.120	0.115	0.380	0.065	0.220
Costs of finance	-0.307	-0.890	-0.353	-1.010	-0.259	-0.790	-0.138	-0.410	0.101	0.300
Availability of finance	0.404	1.230	0.384	1.190	0.197	0.640	0.044	0.140	0.142	0.440
Lack of qualified personnel	0.407	1.140	0.674	2.050	0.411	1.210	0.310	0.950	0.865	2.780
Lack of info on markets	0.000	0.000	0.567	1.160	0.604	1.270	0.502	1.060	0.610	1.420
Market dominated by established firms	-1.613	-2.870	0.003	0.010	-0.292	-0.680	-0.517	-1.190	-0.137	-0.380

Uncertain demand for innovation	-0.814	-1.570	0.133	0.360	-0.334	-0.860	0.566	1.720	0.169	0.570
Need to meet UK regulations	-0.621	-1.170	-0.027	-0.060	-0.586	-1.040	-0.044	-0.100	0.158	0.360
Need to meet EU regulations	0.602	1.110	0.145	0.300	0.517	0.880	0.321	0.710	-0.687	-1.460
<b>Absorptive Capacity</b>										
Science and Eng graduates	-0.011	-2.260	0.005	1.130	0.001	0.150	-0.004	-0.740	0.001	0.290
Other graduates	0.003	0.650	0.006	1.110	0.003	0.460	0.018	3.280	0.009	1.750
Training for innovation	0.383	1.850	0.326	1.700	0.485	2.260	0.447	2.290	0.421	1.890
Investment for innovation	0.243	1.150	0.563	2.810	0.230	1.110	0.561	2.680	0.528	2.510
<b>Government Assistance</b>										
Local or regional	0.039	0.140	0.498	1.830	0.054	0.170	-0.009	-0.030	0.255	0.860
UK national	-0.323	-1.020	-0.328	-0.920	-0.159	-0.490	0.489	1.400	0.554	1.610
EU assistance	1.011	2.020	0.308	0.370	1.493	2.110	1.339	2.080	0.278	0.360
<b>Sectoral Indicators</b>										
Wholesale	0.726	1.180	0.110	0.240	1.255	2.770	1.238	2.750	0.272	0.460
Retail	0.334	0.650	-0.474	-1.080	1.072	2.620	0.898	2.140	0.006	0.010
Hotels and hospitality	0.057	0.100	-0.132	-0.280	0.778	1.690	1.170	2.570	-0.020	-0.030
Transport and Communications	1.036	2.010	-0.062	-0.140	1.388	3.300	1.249	2.870	0.141	0.240
Financial services	0.898	1.590	0.055	0.110	1.229	2.660	0.378	0.660	0.123	0.210
Real estate, renting	0.852	1.380	-0.222	-0.370	1.195	2.270	-0.133	-0.220	-0.398	-0.570
Computer services, R&D	1.618	2.420	-0.587	-0.960	1.289	2.120	0.944	1.540	0.087	0.130
Other Business Services	0.923	1.740	-0.222	-0.480	1.574	3.700	1.192	2.680	0.117	0.200
Constant	-2.484	-4.990	-1.838	-4.410	-3.304	-8.010	-3.344	-7.630	-2.236	-3.890
Number of observations		756		757		757		757		757
Wald Chi2(42)		237.74		157.34		177.93		199.16		198.99
Prob >chi2		0		0		0		0		0
Pseudo R2		0.361		0.314		0.306		0.382		0.324

**Notes:** Observations are weighted to give regionally representative results.

**Sources:** Innovation Survey 2005, Annual Business Inquiry, 2004 and 2005.

**Table A3: Determinants of Service Innovation in Northern Ireland: Marginal Effects from Probit Models**

	Service Innovation		Marketing Innovation		Strategic Innovation		AMT Innovation		Organisational Innovation	
	dy/dx	t stat	dy/dx	t stat	dy/dx	t stat	dy/dx	t stat	dy/dx	t stat
<b>Connectivity</b>										
Local group members	0.227	1.330	-0.002	-0.020	-0.023	-0.800	-0.036	-1.180	-0.081	-5.770
External group members	0.044	0.360	0.046	0.250	0.015	0.160	-0.035	-0.690	0.170	0.730
Local suppliers	-0.024	-0.380	-0.018	-0.230	0.137	1.010	0.006	0.090	-0.061	-2.140
External suppliers	0.101	0.840	0.015	0.140	0.023	0.340	0.078	0.610	-0.073	-4.060
Local customers	0.005	0.070	-0.044	-0.790	-0.049	-3.950	-0.051	-3.140	0.071	0.680
External customers	0.552	2.630	0.503	2.610	0.179	1.200	0.175	1.240	0.700	4.200
Local competitors	0.070	0.560	0.032	0.330	0.090	0.820	-0.035	-1.170	-0.010	-0.140
External competitors	-0.052	-1.570	0.243	0.930	0.122	1.050	0.626	2.280	0.094	0.600
Local laboratories, consultants	-0.057	-1.830	0.164	0.750	0.093	0.620	0.411	1.330	0.331	1.420
External labs, consultants	-0.013	-0.150	-0.098	-5.140	-0.043	-3.320	-0.057	-4.330	0.024	0.190
Local universities	0.046	0.460	0.052	0.410	-0.006	-0.130	0.178	0.910	0.036	0.350
External universities	-0.075	-5.030	0.040	0.220	0.009	0.110	0.030	0.230	-0.044	-0.740
<b>Firm characteristics</b>										
Research and Development	0.264	3.560	0.111	2.280	0.019	0.860	0.036	1.300	-0.030	-1.120
Employment (2002, nos)	0.000	0.060	0.000	1.600	0.000	2.760	0.000	1.950	0.000	1.340
Employment squared	0.000	0.220	0.000	-1.030	0.000	-2.440	0.000	-0.620	0.000	-0.430
Firm established post 2000	0.053	1.240	-0.032	-0.950	0.090	2.560	-0.018	-0.780	0.000	0.010
Part of larger group	0.082	2.330	0.091	2.320	0.140	3.280	0.076	2.640	0.202	4.230
<b>Perceived barriers to innovation</b>										
Riskiness of innovation	0.128	1.570	0.086	1.260	0.060	1.240	0.067	1.260	0.071	1.170
Costs of innovation	-0.049	-1.580	-0.013	-0.290	-0.003	-0.120	0.014	0.350	0.010	0.210
Costs of finance	-0.037	-1.070	-0.051	-1.240	-0.021	-0.920	-0.014	-0.450	0.015	0.290
Availability of finance	0.072	1.000	0.081	1.010	0.021	0.560	0.005	0.130	0.022	0.400
Lack of qualified personnel	0.075	0.920	0.165	1.580	0.053	0.930	0.043	0.790	0.202	1.980
Lack of info on markets	0.000	0.000	0.134	0.910	0.090	0.880	0.080	0.780	0.128	1.060
Market dominated by established firms	-0.087	-5.160	0.001	0.010	-0.022	-0.860	-0.040	-1.850	-0.018	-0.420

Uncertain demand for innovation	-0.068	-3.090	0.025	0.340	-0.024	-1.140	0.093	1.300	0.027	0.520
Need to meet UK regulations	-0.061	-1.770	-0.005	-0.060	-0.037	-1.580	-0.005	-0.100	0.025	0.330
Need to meet EU regulations	0.121	0.850	0.027	0.280	0.070	0.650	0.044	0.590	-0.065	-2.340
<b>Absorptive Capacity</b>										
Science and Eng graduates	-0.002	-2.230	0.001	1.100	0.000	0.150	0.000	-0.750	0.000	0.290
Other graduates	0.000	0.650	0.001	1.070	0.000	0.450	0.002	2.520	0.001	1.700
Training for innovation	0.060	1.660	0.061	1.640	0.053	1.780	0.056	2.070	0.067	1.740
Investment for innovation	0.036	1.130	0.106	2.560	0.023	1.050	0.069	2.590	0.083	2.150
<b>Government Assistance</b>										
Local or regional	0.006	0.140	0.112	1.500	0.005	0.160	-0.001	-0.030	0.043	0.750
UK national	-0.037	-1.260	-0.047	-1.120	-0.013	-0.550	0.076	1.060	0.111	1.240
EU assistance	0.259	1.430	0.064	0.310	0.371	1.330	0.340	1.380	0.049	0.300
<b>Sectoral Indicators</b>										
Wholesale	0.149	0.890	0.020	0.230	0.244	1.790	0.265	1.920	0.045	0.410
Retail	0.054	0.590	-0.070	-1.220	0.162	1.850	0.144	1.660	0.001	0.010
Hotels and hospitality	0.008	0.100	-0.022	-0.290	0.106	1.220	0.213	1.760	-0.003	-0.030
Transport and Communications	0.252	1.480	-0.010	-0.140	0.304	2.150	0.283	1.990	0.022	0.220
Financial services	0.214	1.150	0.010	0.110	0.265	1.710	0.055	0.530	0.019	0.200
Real estate, renting	0.198	1.000	-0.034	-0.420	0.250	1.460	-0.013	-0.240	-0.044	-0.740
Computer services, R&D	0.482	1.900	-0.070	-1.440	0.284	1.350	0.194	1.050	0.013	0.130
Other Business Services	0.201	1.320	-0.035	-0.530	0.336	2.400	0.243	1.890	0.018	0.190

**Notes:** Observations are weighted to give regionally representative results.

**Sources:** Innovation Survey 2005, Annual Business Inquiry, 2004 and 2005.

**Table A4: Estimations of Export Performance: Service innovation  
(marginal effects)**

	<b>Exporter</b>		<b>Export Share</b>		<b>Export Growth</b>	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
<b>Innovation</b>						
Service Innovation	-0.001	-0.010	2.430	1.320	0.154	0.980
Marketing Innovation	-0.055	-0.820	-3.238	-1.530	-0.514	-2.570
Strategic Innovation	-0.007	-0.090	-2.019	-0.920	0.167	0.830
AMT Innovation	0.047	0.570	1.222	0.580	-0.246	-1.240
Organisational Innovation	0.119	1.300	4.603	2.090	0.460	2.100
<b>Firm characteristics</b>						
Research and Development	0.073	1.100	1.238	0.660	0.368	1.590
Employment (2002, nos)	0.000	-0.450	-0.002	-1.050	0.003	1.470
Employment squared	0.000	1.070	0.000	1.220	0.000	-1.480
Firm established post 2000	-0.046	-0.760	0.673	0.370	0.110	0.520
Part of larger group	-0.081	-1.530	-2.356	-1.580	-0.227	-1.330
<b>Absorptive Capacity</b>						
Science and Eng graduates	0.003	1.680	0.073	1.710	-0.010	-3.040
Other graduates	0.000	0.150	-0.015	-0.310	0.003	0.660
Training for innovation	-0.150	-2.830	-1.841	-1.120	0.033	0.150
Investment for innovation	0.009	0.160	1.862	1.210	0.142	0.750
<b>Sectoral Indicators</b>						
Wholesale	0.078	0.610	2.486	0.820	0.223	0.200
Retail	-0.182	-2.420	-4.284	-1.560	0.023	0.020
Hotels and hospitality	-0.350	-6.380	-21.022	-3.900	-0.144	-0.140
Transport and Communications	0.357	3.110	7.361	2.580	-0.167	-0.150
Financial services			10.847	0.880		
Real estate, renting	0.173	1.150	1.744	0.440	-0.128	-0.110
Computer services, R&D	0.571	3.870	16.354	3.790	-0.055	-0.050
Other Business Services	0.214	1.770	6.306	2.150	-0.302	-0.270
Estimation	Probit		Tobit		OLS	
Wald Chi-squared (12)	248.20					
LR Chi-squared (22)			203.86			
(Pseudo) R <sup>2</sup>	0.286		0.091		0.187	
Observations	709		690		131	

**Notes:** Observations are weighted to give regionally representative results.

**Sources:** Innovation Survey 2005, Annual Business Inquiry, 2004 and 2005.

**Table A5: Estimations of Export Performance: Innovation success  
(marginal effects)**

	<b>Exporter</b>		<b>Export Share</b>		<b>Export Growth</b>	
	Coeff.	t-stat.	Coeff.	t-stat.	Coeff.	t-stat.
<b>Innovation</b>						
Innovation Success	-0.002	-1.740	0.018	0.530	0.006	1.980
Marketing Innovation	-0.042	-0.600	-3.072	-1.450	-0.555	-2.760
Strategic Innovation	0.007	0.080	-1.932	-0.870	0.117	0.580
AMT Innovation	0.054	0.650	1.333	0.630	-0.234	-1.140
Organisational Innovation	0.122	1.350	4.585	2.070	0.404	1.810
<b>Firm characteristics</b>						
Research and Development	0.082	1.260	1.751	0.950	0.331	1.390
Employment (2002, nos)	0.000	-0.480	-0.002	-1.010	0.003	1.430
Employment squared	0.000	1.090	0.000	1.180	0.000	-1.430
Firm established post 2000	-0.043	-0.700	0.529	0.290	0.034	0.170
Part of larger group	-0.082	-1.570	-2.171	-1.450	-0.165	-1.000
<b>Absorptive Capacity</b>						
Science and Eng graduates	0.002	1.560	0.067	1.580	-0.010	-3.250
Other graduates	0.000	0.210	-0.015	-0.320	0.004	0.910
Training for innovation	-0.136	-2.580	-1.710	-1.040	0.125	0.570
Investment for innovation	0.010	0.170	1.941	1.260	0.084	0.450
<b>Sectoral Indicators</b>						
Wholesale	0.071	0.560	2.440	0.800	0.259	0.230
Retail	-0.187	-2.500	-4.251	-1.540	0.060	0.050
Hotels and hospitality	-0.351	-6.470	-20.817	-3.910	-0.321	-0.310
Transport and Communications	0.357	3.110	7.713	2.710	-0.160	-0.140
Financial services			10.982	0.890		
Real estate, renting	0.168	1.120	1.957	0.490	-0.055	-0.050
Computer services, R&D	0.595	4.240	16.734	3.860	-0.163	-0.150
Other Business Services	0.211	1.750	6.650	2.270	-0.248	-0.220
Estimation	Probit		Tobit		OLS	
Wald Chi-squared (12)	172.89					
LR Chi-squared (22)			202.77			
(Pseudo) R <sup>2</sup>	0.289		0.090		0.20	
Observations	710		691		131	

**Notes:** Observations are weighted to give regionally representative results.

**Sources:** Innovation Survey 2005, Annual Business Inquiry, 2004 and 2005.

**Table A6: Estimations of Productivity: Service innovation (marginal effects)**

	<b>Productivity (2005)</b>		<b>Productivity Growth</b>	
	Coeff.	t-stat	Coeff.	t-stat
<b>Innovation</b>				
Service Innovation	-0.002	0.000	-0.023	-0.540
Marketing Innovation	-2.749	-1.570	-0.023	-0.500
Strategic Innovation	0.361	0.190	0.017	0.370
AMT Innovation	-0.682	-0.340	-0.019	-0.400
Organisational Innovation	2.957	1.510	0.014	0.290
<b>Firm characteristics</b>				
Research and Development	2.341	1.610	0.095	2.510
Employment (2002, nos)	-0.007	-1.750	0.000	-0.790
Employment squared	0.001	1.490	0.000	1.200
Firm established post 2000	-3.355	-3.060	0.002	0.040
Part of larger group	0.734	0.530	-0.042	-1.160
Capital intensity	0.151	2.190	-0.002	-1.110
Exporter (2004)	10.246	6.330	0.109	3.100
<b>Absorptive Capacity</b>				
Science and Eng graduates	0.012	0.260	0.001	0.730
Other graduates	0.052	1.290	-0.001	-0.910
Training for innovation	-2.078	-1.620	-0.051	-1.470
Investment for innovation	1.134	0.890	0.043	1.120
<b>Sectoral Indicators</b>				
Wholesale	1.068	0.340	-0.016	-0.190
Retail	-5.157	-2.390	-0.029	-0.410
Hotels and hospitality	-10.462	-4.740	-0.028	-0.380
Transport and Communications	2.860	1.130	-0.072	-1.100
Real estate, renting	14.253	3.170	0.161	1.860
Computer services, R&D	9.621	1.970	0.002	0.020
Other Business Services	4.657	1.590	-0.022	-0.320
Constant	21.708	9.870	0.034	0.490
Estimation	OLS		OLS	
F (,,)	30.16		2.67	
R <sup>2</sup>	0.542		0.094	
Observations	650		542	

**Notes:** Observations are weighted to give regionally representative results.

**Sources:** Innovation Survey 2005, Annual Business Inquiry, 2004 and 2005.

**Table A7: Estimations of Productivity: Innovation success (marginal effects)**

	Productivity (2005)		Productivity Growth	
	Coeff.	t-stat	Coeff.	t-stat
<b>Innovation</b>				
Innovation Success	-0.015	-0.480	0.000	-0.200
Marketing Innovation	-2.634	-1.490	-0.024	-0.530
Strategic Innovation	0.411	0.220	0.015	0.330
AMT Innovation	-0.609	-0.310	-0.020	-0.430
Organisational Innovation	2.993	1.540	0.015	0.310
<b>Firm characteristics</b>				
Research and Development	2.443	1.680	0.092	2.450
Employment (2002, nos)	-0.007	-1.760	0.000	-0.780
Employment squared	0.001	1.490	0.000	1.190
Firm established post 2000	-3.304	-3.080	0.002	0.050
Part of larger group	0.697	0.510	-0.043	-1.200
Capital (Investment?)	0.152	2.200	-0.002	-1.090
Exporter (2004)	10.270	6.360	0.108	3.090
<b>Absorptive Capacity</b>				
Science and Eng graduates	0.011	0.240	0.001	0.810
Other graduates	0.051	1.250	-0.001	-0.890
Training for innovation	-2.017	-1.580	-0.052	-1.500
Investment for innovation	1.164	0.920	0.042	1.100
<b>Sectoral Indicators</b>				
Wholesale	1.020	0.320	-0.018	-0.210
Retail	-5.187	-2.420	-0.030	-0.430
Hotels and hospitality	-10.496	-4.780	-0.028	-0.380
Transport and Communications	2.835	1.140	-0.076	-1.150
Financial services				
Real estate, renting	14.192	3.150	0.158	1.830
Computer services, R&D	9.889	2.030	-0.005	-0.050
Other Business Services	4.603	1.590	-0.025	-0.370
Constant	21.741	9.930	0.035	0.500
		OLS		OLS
F (.,.)		29.99		2.61
R <sup>2</sup>		0.54		0.094
Observations		651		542

**Notes:** Observations are weighted to give regionally representative results.

**Sources:** Innovation Survey 2005, Annual Business Inquiry, 2004 and 2005.