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Innovation in Scotland: Analysis of the community innovation survey 2009

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Introduction

Strengthening levels of innovation is one of the cornerstones of the Scottish Government's Economic Strategy¹. Innovation is a key catalyst for productivity growth as new ideas drive enterprise, create new products and markets and improve efficiency, delivering benefits to firms, customers and society. It is a crucial factor in determining competitiveness and national progress².

Until recently, the most common and well known measure of innovation has been the ratio of national expenditure on R&D to GDP³. Data shows that there has been a significant gap in business research and development (R&D) expenditure between Scotland and the UK, EU and OECD averages in recent years. Scottish Business Enterprise R&D (BERD) expenditure was 0.56% of Scottish GDP in 2009, lower than the rate for the UK as a whole (1.11%) and the EU (1.17%)⁴. Compared to other UK Government regions, Scotland ranked in 10th place out of the 12 regions.

However, while R&D is useful for measuring technology-based activities, it is increasingly recognised that this is only one element of the broader concept of innovation and is frequently more relevant for manufacturing than for services⁵. Evidence shows that firms introduce new products and services onto the market without necessarily performing R&D. A lot of innovation activity is based on (or embodied in) advanced machinery and computer systems purchased to implement new or improved processes and deliver new products and services. Innovation can also be purchased through rights to use patents, licences, trademarks and software. Innovation can also encompass training and new design and marketing processes⁶. Evidence also shows that many firms adopt multiple, complementary innovation strategies, with the most innovative firms introducing both product and process innovations as well as marketing or organisational innovations. Therefore, productivity growth can be achieved through advances in technology combined with new approaches to creating and delivering of goods and services.

There is now a solid body of evidence describing the relationship between research, innovation and economic development⁷. The evidence suggests that investment in 'intangible assets' that give rise to innovation (R&D, software, human capital and new organisational structures) now accounts for up to 12% of GDP in some countries and contributes as much to labour productivity growth as investment in tangible assets such as machinery and equipment. According to OECD estimates, investment in intangible assets accounted for around a quarter of labour productivity growth in the UK and other countries between 1995 and 2006⁸.

The Community Innovation Survey (CIS) allows an assessment of business innovation performance, wider than just R&D expenditure, across European Union countries. CIS collects a range of information from businesses on the types of innovation they are involved in, motivation for innovation, spending on a range of innovation activities beyond R&D, collaboration and linkages between businesses or with public research organisations, as well as data on sales from product innovations⁹. In light of the growing recognition that innovation encompasses a wider range of activities, and that broader metrics are required to reflect this, the Innovation Survey provides a key data set to measure innovation within businesses¹⁰.

UK innovation survey, Scottish sample and analysis

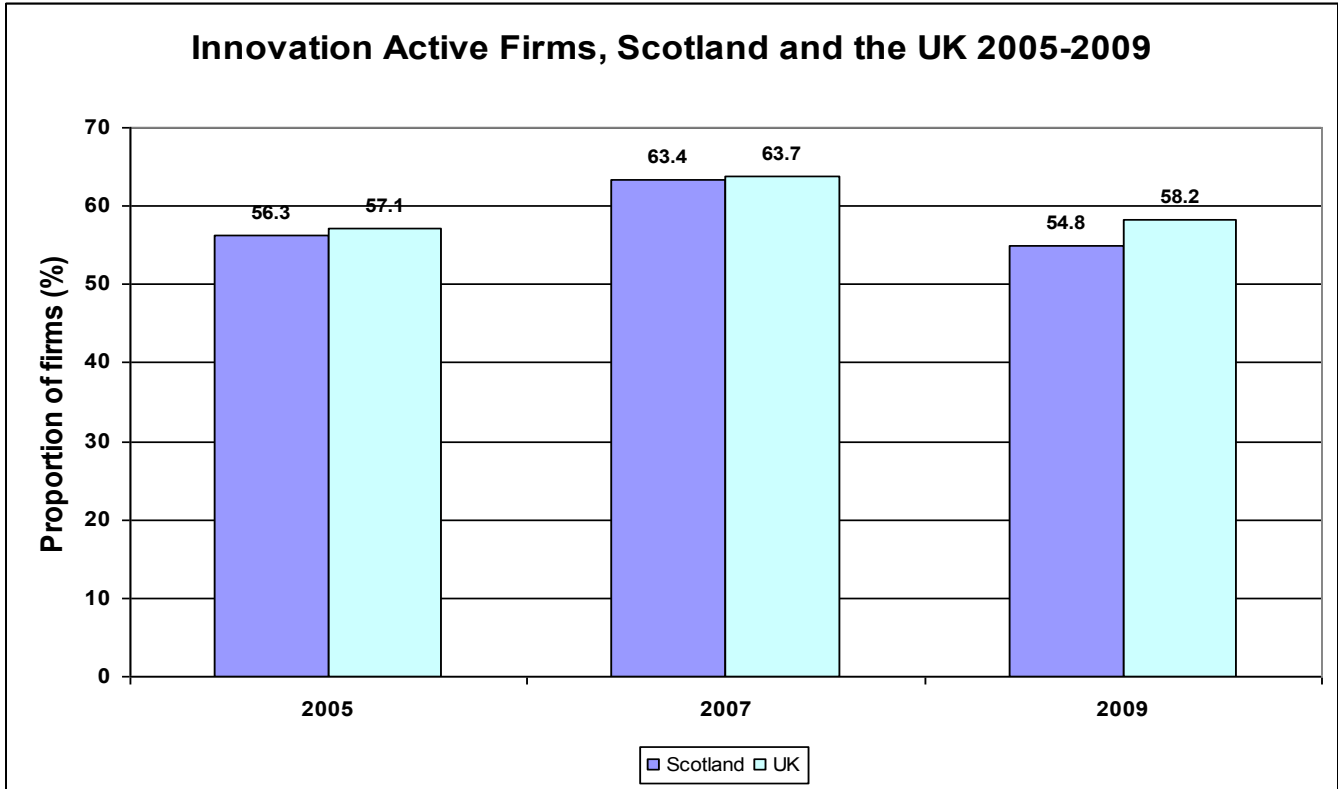
This paper presents an initial analysis of the Scottish results of the 2009 UK Innovation Survey. The 2009 survey is the third bi-annual survey, and this analysis focuses on Scottish trends over time and provides comparisons with the UK as a whole.

The UK Innovation Survey is a voluntary survey of a sample of firms with 10 or more employees. It has been conducted every two years by the Office for National Statistics (ONS) on behalf of the Department for Business, Innovation & Skills (BIS) and its predecessors since 2005. Earlier surveys were undertaken every four years¹¹. The results feed into the Community Innovation Survey (CIS), which allows Europe's progress in the area of innovation to be monitored.

Both across the UK as a whole, and specifically in Scotland, the 2009 survey achieved a response rate of 49%. In Scotland, 2,393 enterprises were surveyed and 1,184 questionnaires were returned. To compensate for the firms that did not respond to the survey and those not selected for the sample, BIS developed weightings so that the results are representative of the population of firms as a whole. On average each respondent represents 13 enterprises in the population¹².

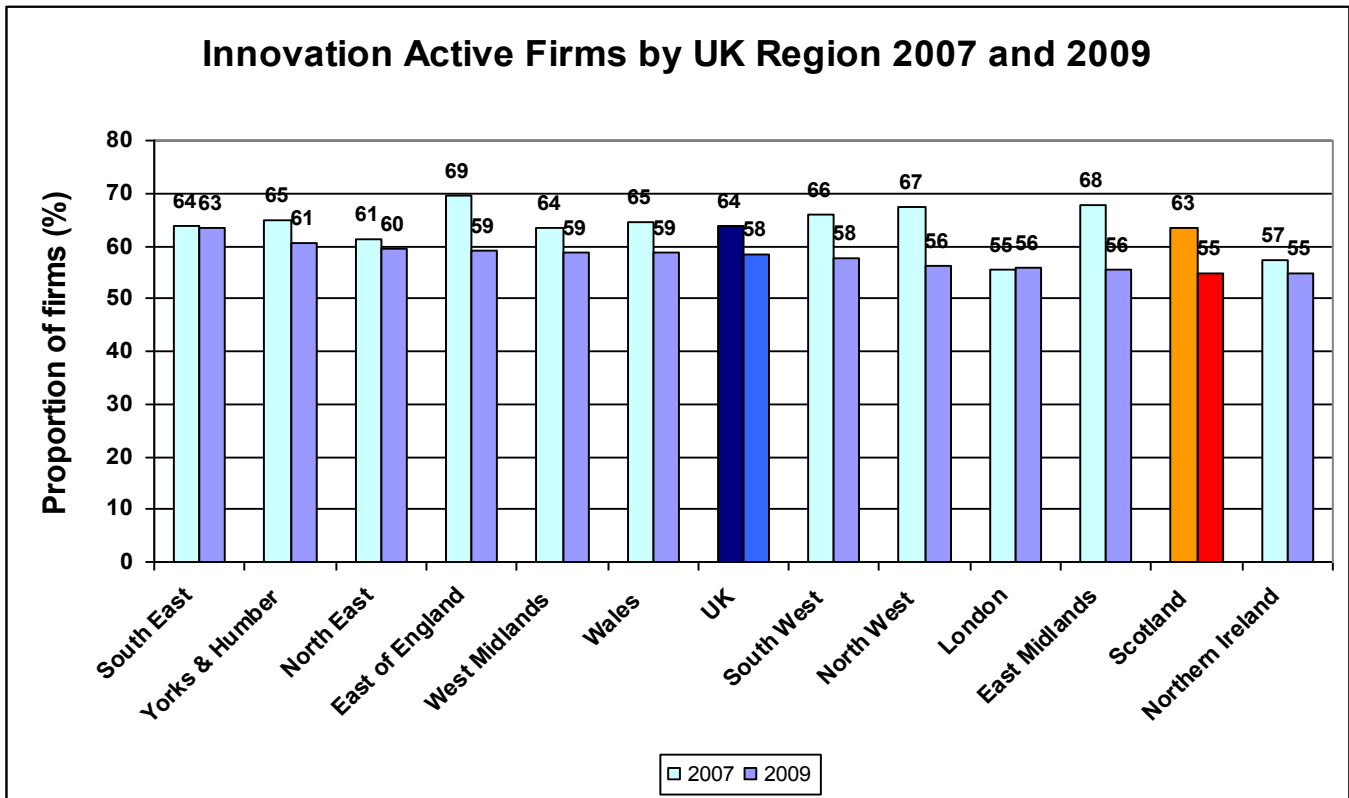
The analysis in this paper is based on microdata sourced from ONS¹³. Scotland's performance is compared over time and to the UK by business size band and focuses on

Figure 1: Proportion of innovation active firms in Scotland and the UK, 2005-2009



Source: ONS

Figure 2: Innovation active firms by government office region 2007 and 2009



Source: ONS

innovation activity indicators and innovation 'inputs' and 'outputs'.

• Innovation activity indicators

'Innovation active' firms are defined as enterprises engaged in any of the following¹⁴:

- Introduction of a new or significantly improved product (goods or service) or process;
- Engagement in innovation projects not yet complete or abandoned;
- Expenditure in areas such as internal research and development, training, acquisition of external knowledge or machinery and equipment linked to innovation activities.
- Broader areas of innovation include the introduction of innovative business practices and organisational structures:
- 'Wider innovators' are firms that have introduced new and significantly improved forms of organisation business structures or practices aimed at improving internal efficiency or effectiveness of approaching markets and customers;
- 'Broader innovators' are firms that are either innovation active or wider innovators, or both.

• Innovation inputs and outputs

There are several types of innovation expenditure that firms may undertake, such as bought-in machinery, equipment, software, knowledge and expertise. Impact on turnover is a measure of the effects, or outputs, of innovation. This is important since, for businesses, the value of innovation is the financial return. This paper reviews:

- Forms of innovation expenditure (inputs);
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- Turnover from innovation (outputs)

Analysis of the main innovation and broader indicators in this paper are based on weighted data. In line with the Scottish CIS3, CIS4 and CIS5 analyses, however, the analysis of input and output indicators is based on un-weighted data. The rationale for using un-weighted data was outlined in the 2005 report published by the Scottish Government in 2007¹⁵

Innovation active businesses in Scotland

In the 2009 survey, in Scotland and the UK, the proportion of innovation active firms was 54.8 per cent and 58.2 per cent respectively, lower than in the 2005 and 2007 surveys. The 2009 survey covered the period 2006 to 2008, and by

the end of 2008 the Scottish and UK economies were in recession. This is likely to have had an impact on the number of businesses starting innovation activities in 2008 and affect the overall number of innovation active firms in the survey period¹⁶. The fall in innovation activity levels between the 2007 and 2009 surveys was slightly greater in Scotland than the UK and, since 2005, Scotland has tended to lag the UK as a whole (figure 1).

Scotland ranked in 11th place out of the 12 UK Government Office Regions in the 2009 survey, although since 2007 the gap in performance between the lowest and highest regions has narrowed. It is also worth highlighting that smaller sample sizes for the regions leads a bigger standard error in the results than for the larger UK sample¹⁷. Therefore, the differences between regions may not be significant.

Figure 2 shows the proportion of innovative active firms ranged from 63 per cent in South East England to 55 per cent in Northern Ireland and Scotland in 2009. The regional patterns and rankings can generally be explained by differences in industrial composition and business size, and variations in sectoral business cycles and product life cycles¹⁸. This suggests levels of innovation activity differ depending on firm size and sector. Table 1 summarises the results for Scotland by size band and table 2 indexes these results relative to the UK = 100.

The above results show that innovation activity levels tend to increase as the size of the business increases, reflecting the pattern shown in previous surveys. In 2009, the UK had a higher proportion of innovation active firms in the small and medium size-bands than in Scotland. However, Scotland had a greater proportion of large firms that were innovation active. Compared to 2007, the proportion of innovation active small and medium sized firms fell more in Scotland than the UK (falls of -4.7 and -13.8 percentage points compared to -1.4 and -10.3), but less in large firms (-8.7 compared to -14.8).

Table 2 highlights the effect of this on all firms with 10 or more employees in 2009. Compared to the UK, large firms in Scotland outperformed the rest of the UK against most of the indicators, while the UK outperformed Scotland in product innovation in each size band.

New or significantly improved products

The ONS report, "First findings of the UK 2009 Survey", notes that the increased investment in innovation activity reported in the 2007 survey in many cases may have resulted in product and process innovations during the period 2006-2008. Although still lagging the UK average of 23.9 per cent, the proportion of firms introducing new or significantly improved products in Scotland increased by almost two percentage points to 21.3 per cent, with product innovation activity almost returning to 2005 survey levels¹⁹. Nevertheless, despite an overall improvement, Scotland

Table 1: Innovation indicators by firm size band, proportion of firms (%), Scotland 2009

Activity	10 to 49 employees	50-249 employees	250+ employees	All 10+ employees
Innovation Active	53.8	58.2	67.1	54.8
Product Innovator	20.4	25.2	28.7	21.3
Process Innovator	11.8	14.2	22.9	12.5
Ongoing/abandoned activities	7.0	9.9	20.2	7.8
Innovation Expenditure	40.7	46.4	53.6	41.9
Wider Innovation:	23.5	34.8	45.6	25.9
Corporate Strategy	14.0	16.9	24.4	17.1
Management Techniques	9.4	15.4	26.0	14.6
Organisational Structure	17.4	23.8	31.5	22.2
Marketing Concept	13.5	15.1	21.3	15.6
Broader Innovation	54.9	66.9	71.8	57.3

Table 2: Main innovation indicators by firm size band, Scotland relative to UK = 100 2009

Activity	10 to 49 employees	50-249 employees	250+ employees	All 10+ employees
Innovation Active	94	93	110	94
Product Innovator	89	89	91	89
Process Innovator	99	92	121	99
Ongoing/abandoned activities	84	79	128	86
Innovation Expenditure	97	94	118	97
Wider Innovation	96	95	117	97
Corporate Strategy	109	97	130	110
Management Techniques	103	96	142	111
Organisational Structure	109	101	120	109
Marketing Concept	89	78	120	92
Broader Innovation	93	100	110	95

Note: If the figure for Scotland relative to the UK is less than 100, then the proportion of firms engaged in that innovation activity in Scotland was less than the proportion in the UK. Conversely, if the figure is greater than 100, then the proportion of firms engaged in that activity in Scotland was higher than in the UK.

ranked in 10th place out of 12 UK regions, only the North East and Northern Ireland had lower product innovation levels.

Scotland has had a smaller proportion of product innovators than the UK average in every business size band over the last three surveys, the only exception being in the 2005 survey, when there was a tendency for large firms in Scotland to have slightly higher product innovation activity. This could be due to differences in the sector breakdowns between Scotland and the UK or influenced by weightings. For example, the UK Innovation Survey Report 2009 showed that the highest proportions of product innovators were in engineering-based manufacturing, other manufacturing and knowledge-intensive services such as financial services. As Scotland has a smaller proportion of firms in these sectors in its business base than the UK as a whole (around 34 per cent compared to 42 per cent²⁰), then this is likely to reduce the overall proportion of firms that are product innovators when weightings are applied to the sample distribution. Similarly, the UK Innovation Survey 2009 analysis²¹ that a higher proportion large firms were product innovators than small or medium sized firms. If Scotland has a smaller proportion of large firms than the UK

as a whole this would be likely to reduce the proportion of firms that are product innovators. However, there is little difference in the distribution of firms by size band between Scotland and the UK, with small businesses having the largest share of the business base and large firms have the smallest share in each. This suggests that industry structure is the main influence on differences between the UK and Scotland in overall product innovation performance.

New or significantly improved processes

In terms of process innovation, Scotland's performance relative to the UK is slightly better, with the proportion of firms around the UK average over the last three surveys. The proportion of process innovators increased between 2007 and 2009 in both Scotland and the UK, however, activity levels were still lower than those reported in the 2005 survey. In 2005, both Scotland and the UK had 16 per cent of firms that were process innovators compared to 12.5 per cent and 12.6 per cent respectively in 2009. The proportion of process innovators ranged from 14.2 per cent in the South East of England to 10.6 per cent in Northern Ireland in 2009. At 12.5 per cent, Scotland was close to the UK average, and ranked in 7th place out of 12 regions. Both product and process innovators are more likely to be

larger firms. In the last three surveys a higher proportion of large Scottish firms were process innovators than across the UK as a whole.

Expenditure on innovation

Most innovation active firms have expenditure associated with innovation activities. In 2009, 55 per cent of firms were innovation active in Scotland, 76 per cent of which had innovation expenditure. Firms reported a range of investments, including, R&D, training and the acquisition of equipment and software. Although the proportion of firms reporting expenditure fell in 2009 compared to the previous two surveys, this may partly have been due to the economic

Wider innovation

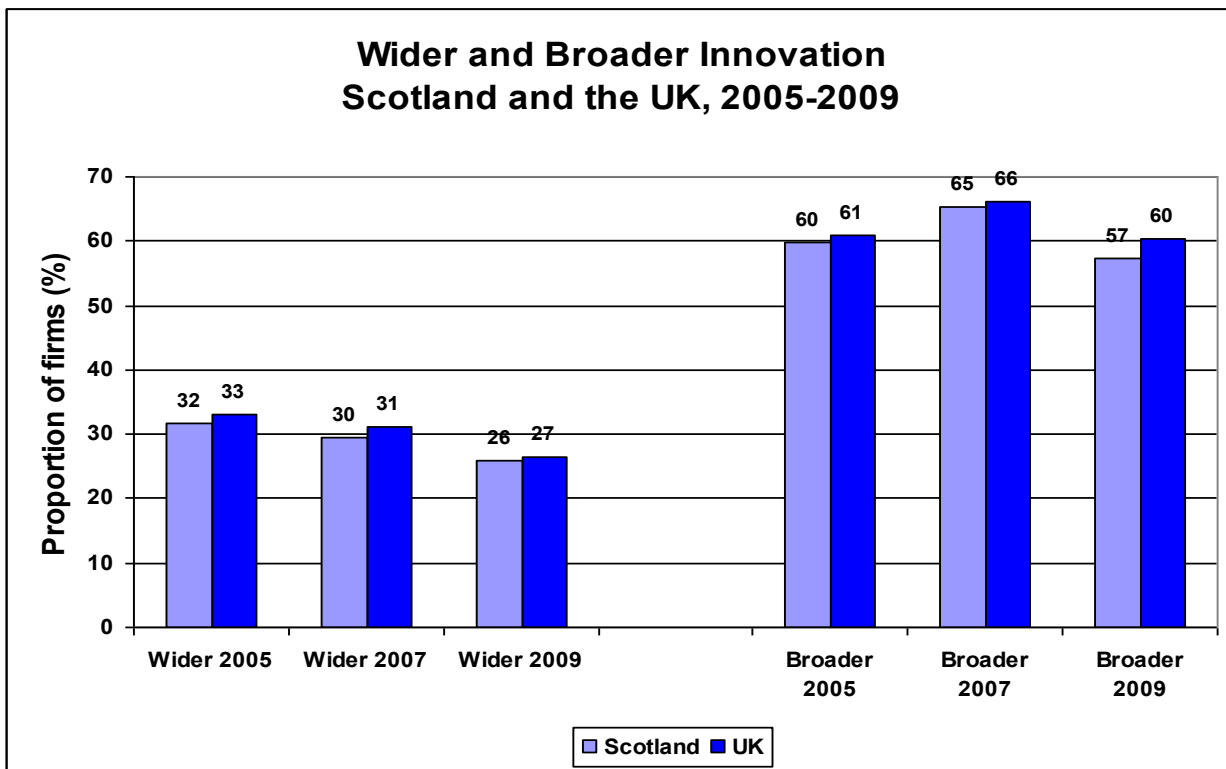
In addition to technological development and investment in innovation-related activities, strategic innovations are also important in terms of improving firms' competitiveness and

downturn. Once again, Scotland's overall performance was broadly similar to the UK (42 per cent compared to 43 per cent across the UK). For the third consecutive survey, Scotland remained in 8th place out of the 12 regions.

Over the last three surveys, a higher proportion of firms in the largest size band have had innovation-related expenditure in Scotland than in the UK. The effect of this, combined with the proportion of large firms with ongoing activities, could lead to an increase in large firms' innovation activity levels in the next survey.

growth opportunities. Wider innovation indicators are used to measure this. Wider innovators are those firms that have undergone strategic, organisational, managerial techniques and marketing changes to achieve efficiencies or

Figure 3: Wider and broader innovation in Scotland and the UK, 2005-2009



Source: ONS

improvements to service. The proportion of firms reporting wider and broader innovation activity fell between 2007 and 2009 in Scotland and the UK (figure 3).

Firms were asked if they had made any major changes to their business structure or practices over the survey period. As in the rest of the UK, there was less engagement by Scottish firms in non-technological innovation than in the previous survey, continuing the decline from 2005. Scotland ranked in 6th place out of the 12 UK regions. The

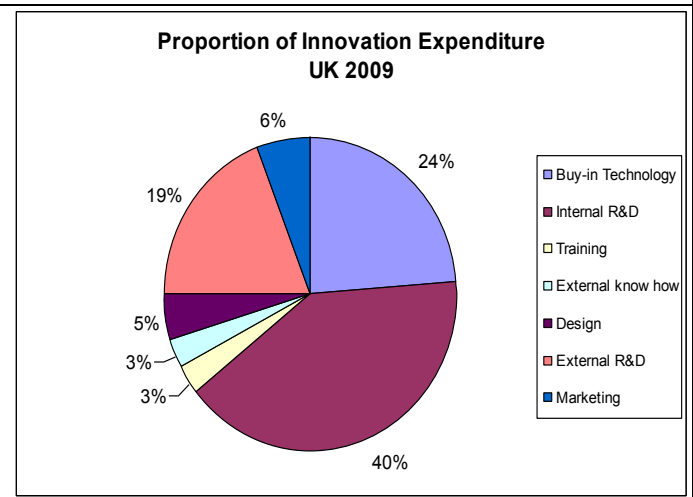
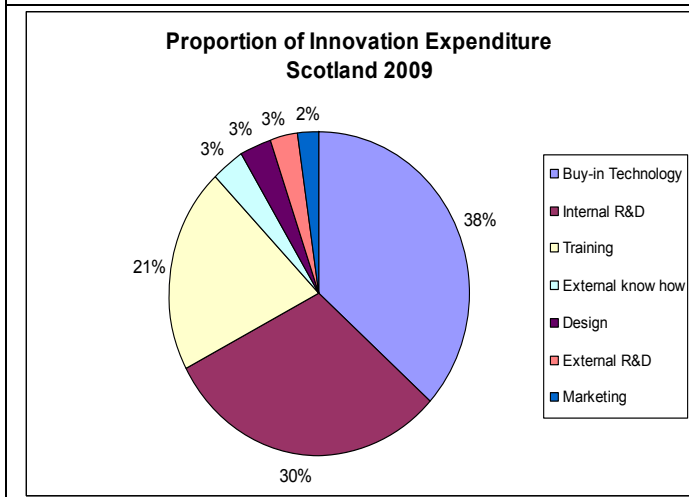
proportion of wider innovators in the largest size band fell to 46.5 per cent in 2009 from 52.5 in 2007. Smaller firms also recorded a fall and remain less likely than large firms to engage in wider innovation.

Broader innovation

Broader innovators are those firms that are either innovation active or wider innovators, or both. Broader innovation gives an overall picture of the level of innovation, both

Figure 4a: Scottish Expenditure in 2009

Figure 4b: UK Expenditure in 2009



Source: ONS

technological and non-technological. Broader innovation levels in Scotland rose between 2005 and 2007 before falling back in 2009 by almost nine percentage points to 57.3 per cent, increasing the gap with the UK. Ranked in 11th place out of the twelve UK regions, this mirrors Scotland's overall innovation activity performance. Only Northern Ireland had lower proportions of 'broader' and 'innovation active' firms.

Scotland did have a higher proportion of broader innovators in the largest firm size band than the UK in 2009. Given that the broader innovation indicator includes firms that are innovation active, the high proportion of large innovation active firms in Scotland is likely to explain the high proportion of large firms that are broader innovators.

Based on the above definitions of wider and broader innovation, the broader innovation indicator can be used to illustrate the extent to which firms engage in wider (strategic) innovation only. This is calculated by subtracting the proportion of innovation active firms from the proportion of broader innovators. Across all the UK regions the proportion of firms engaging only in strategic innovation activity is very low at around 2.3 per cent. The figure for Scotland sits at around 2.5 per cent. This suggests that firms in Scotland tend not to change behaviours or business strategies as an independent means of improving competitiveness. Rather, they tend to introduce strategic, organisational, marketing or management changes in conjunction with other technological innovations.

The results outlined so far have shown that, generally, any differences between the results for Scotland and the UK are relatively small, particularly when considering the narrow range of performance across the UK regions for many indicators. However, there are differences in performance at firm size band level²². Small and medium sized firms in Scotland underperform relative to the UK while large firms

do better, and, for Scotland (and for the UK as a whole), innovation activity increases with firm size.

Innovation inputs and outputs

The 2005 and 2007 surveys highlighted that R&D accounts for only a small proportion of total innovation spend and total innovation outcomes, and that low levels of formal R&D may not necessarily result in low levels of innovation. In terms of how well Scotland performs using innovation expenditure as a measure instead of Business R&D as a percentage of GDP, Scotland performs fairly well compared to the UK as a whole. Calculating total innovation expenditure per employee for all innovation active firms with 10 or more employees, Scotland ranks in 4th place out of 12 UK regions. Scotland had average expenditure of £3,268 compared to £3,018 across the UK as a whole. Therefore, although a slightly lower proportion of Scottish companies invested in innovation they tended to invest more than the UK average. Measuring innovation in this way, Scotland performs better relative to the UK than when measured using Business Enterprise R&D (BERD) figures. BERD data for 2009 shows that Scotland ranks in 10th place among UK regions for expenditure per employee, with average expenditure of £592 compared to a UK average of £1,037²³.

The Innovation Survey 2009 results showed that across Scotland and the UK, bought-in technology was the most frequently cited type of innovation expenditure across most business size bands; although there were differences in the distribution of firms' actual expenditure (figures 4a and 4b). Firms in Scotland had invested a higher proportion of their total innovation expenditure in bought-in technology and training than the UK overall. Other notable differences include marketing and external R&D, where UK firms as a whole invested a higher proportion of innovation expenditure Scottish firms.

Compared to the UK, large firms in Scotland had a greater proportion of expenditure on bought-in technology such as

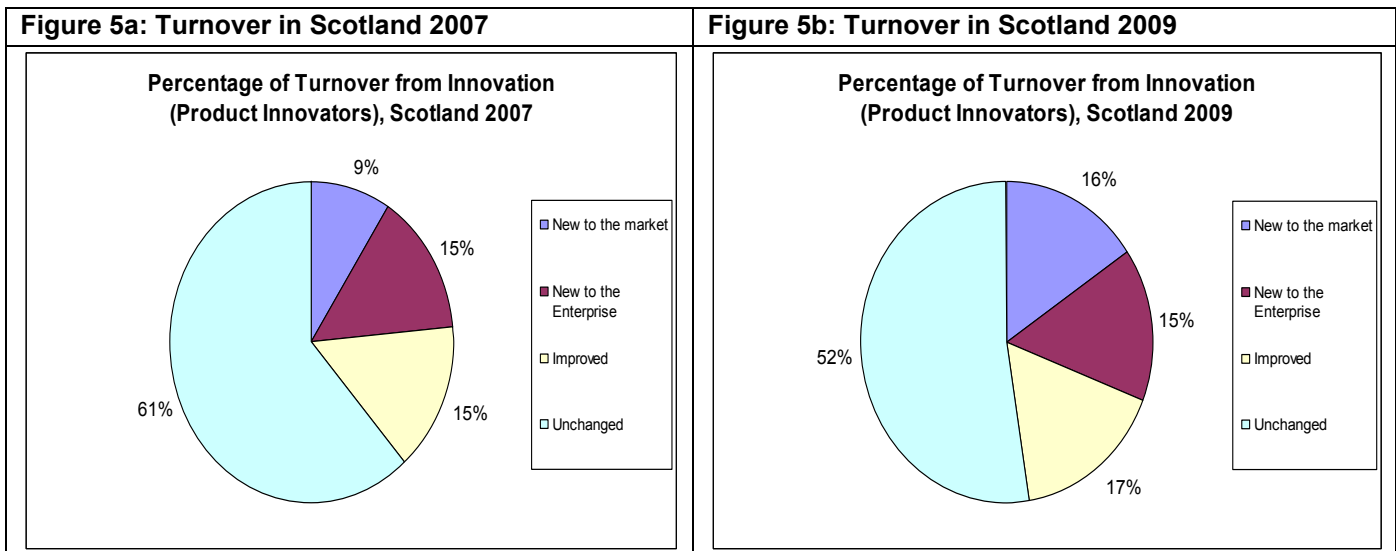
machinery, equipment and software and firms in each size band had a greater proportion of expenditure on training.

This indicates a greater tendency in Scotland for firms to introduce new products on the market or new processes without necessarily performing R&D. Considering trends by size band, large firms in Scotland were more likely to spend on in-house R&D, external R&D, bought-in technology and marketing. In medium sized firms, design and marketing accounted for the greatest proportions of expenditure and in small firms buying in external know-how and training were important. It is likely that the sector breakdown will also influence these results. For example, the UK Innovation Survey 2009 statistical annex shows that financial and business services had the highest proportion of expenditure

in internal R&D while manufacturing had the highest proportion on external R&D and transport and logistics had a high proportion of expenditure in training. This area requires further research and analysis to understand the implications for Scotland.

Affect on turnover of product innovations

The 2005 and 2007 surveys noted that the biggest proportion of firms' turnover was generated from products that were wholly unchanged during the survey period. Less than 40 per cent of turnover was attributed to new or improved products. However, between 2007 and 2009 the proportion increased by almost 9 percentage points in



Source: ONS

Scotland and by 2009 almost half of turnover was attributed to new or improved products in innovation active firms with 10 or more employees. The biggest increase was due to 'new to the market products', although the percentage of turnover from improved products also increased by two percentage points. This is illustrated in figures 5a and 5b.

Small firms in particular had a higher proportion of turnover from 'new to market' and 'new to business' products than medium and large sized companies (table 3), and a higher proportion of firms in Scotland in every business size band had a greater proportion of their turnover from new and improved products than in the UK (table 4).

Calculating the returns from innovation expenditure in turnover terms, table 5 estimates how much turnover (£) is generated for every £1 of innovation expenditure. Clearly, large firms' expenditure on bought-in technology and in-house R&D has produced a higher return on investment in Scotland.

Potentially, some of the difference between Scotland and the UK may be explained by the extent to which products are new to the market, or any differences in the sector

breakdowns between the Scottish and UK samples. Previous reports have shown that some sectors are more innovation active than others. For example, the 2007 results showed that Scottish manufacturing firms were more innovation active while financial and business services firms were less innovation active than the UK average. Some increase in turnover could also be due to the increased investment in the previous survey period since, over the last three surveys, a higher proportion of firms in the largest size band have had innovation-related expenditure in Scotland than in the UK.

Conclusions

The analysis of the 2009 Innovation Survey results highlights a number of interesting findings:

- Innovation activity among businesses in Scotland (and the UK) by 2009 was lower than in 2007, probably due to the onset of the economic downturn
- Scotland's business innovation performance lags the UK as a whole for most innovation indicators

Table 3: Percentage of turnover by product/service type and by firm size band, 2009

Product/service	10-49 employees	50-249 employees	250+ employees	All 10+
New to market	18.5	13.4	11.2	15.7
New to business	16.7	13.1	14.6	15.3
Significantly improved	16.1	16.2	17.8	16.5
Unchanged/modified	48.7	57.2	56.5	52.6

Table 4: Percentage of turnover by Product/Service Type and by Firm Size Band relative to UK = 100, 2009

Product/service	10-49 employees	50-249 employees	250+ employees	All 10+
New to market	112	113	132	117
New to business	112	109	118	113
Significantly improved	105	113	113	109
Unchanged/modified	91	93	89	91

Table 5: Estimated £s of turnover relative to £1 of expenditure, 2009

	10-49 employees	50-249 employees	250+ employees	All 10+
Scotland	£3	£13	£35	£23
UK	£3	£9	£12	£12

- Innovation activity rises as firm size increases – and large firms in Scotland outperform those in the UK as a whole across most innovation indicators
- Lower levels of product innovation in Scotland compared to the UK may be due to industry structure. Differences in industry structure might also contribute to Scotland's relatively lower levels of innovation activity.
- Scottish businesses invest more of their innovation expenditure in 'non-technological' innovation than UK firms
- Scottish firms are more likely 'buy in' technology, and less likely to invest in their own R&D, compared to UK firms
- Scottish firms that do invest in innovation spend more per employee than the UK average
- 'Return on innovation investment' in Scotland is higher than for the UK as a whole.

whole. The tendency for smaller firms to be less innovation active in Scotland than the rest of the UK will have an impact on Scotland's overall results, particularly when weightings are applied to the sample, since small firms have the largest share of the business base.

Large firms in Scotland are more innovation active, have more innovation related expenditure, are more likely to be process innovators and more likely to be strategic innovators than for UK as a whole. However, while the proportion of innovation active large firms has grown in Scotland relative to the UK, the proportion of small firms has fallen, reducing Scotland's overall performance.

To better understand the reasons for differences in performance between businesses of different sizes, and between Scottish and UK performance, a future analysis will examine in more detail factors such as motivation and barriers to innovation. Further analysis by industry sector may also provide some insight into the extent to which the performance in different sectors affects Scotland's overall and product innovator performance.

There has been a tendency for Scotland to lag the UK average over time, although differences in the results for Scotland and the UK are relatively small. However, there are fairly substantial differences between small and large firms' innovation activity levels in Scotland and the UK as a

Endnotes

¹[The Government Economic Strategy, The Scottish Government, 2011](#)

²[Innovation and Growth: Rationale for an Innovation Strategy, OECD, 2007](#)

³[European Commission Staff Working Document: A Rationale for Action, European Commission, 2010.](#)

⁴[Innovation and Research & Development - R&D Business Expenditure, The Scottish Government, 2010](#)

⁵[Measuring Innovation: A New Perspective, OECD, 2010](#)

⁶[European Commission Staff Working Document: A Rationale for Action, European Commission, 2010](#)

⁷[European Commission Staff Working Document: A Rationale for Action, European Commission, 2010](#)

⁸[Ministerial Report on the OECD Innovation Strategy: Innovation to strengthen growth and address global and social challenges, OECD, 2010](#)

⁹[Measuring Innovation: A New Perspective, OECD, 2010](#)

¹⁰[Annual Innovation Report, BIS, 2010](#)

¹¹UK Innovation Surveys were carried out in 1993 for the period 1990-1992, in 1997 for the period 1994 to 1996, and in 2001 for the period 1998-2000.

¹²[UK Innovation Survey 2009 Statistical Annex, BIS, 2010](#)

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¹⁴[First findings from the UK Innovation Survey 2009, Stephanie Robson and Martin Kenchatt, Economic & Labour Market Review, Vol 4, No 3, March 2010](#)

¹⁵[The Community Innovation Survey 4: Profiling Scotland's Innovation Performance, Dr. Mark Freel and Prof. Richard Harrison, The Scottish Government, 2007](#), Weights which are incorporated in the data can only be correctly scaled where information is given by all respondents, however, some respondents may only partially complete a questionnaire. In addition, the survey contains filter questions, inviting only enterprises fulfilling certain criteria to answer parts of the questionnaire and the relevant population for weighting purposes would not be all firms in the IDBR

¹⁶[First findings from the UK Innovation Survey 2009, Stephanie Robson and Martin Kenchatt, Economic & Labour Market Review, Vol 4, No 3, March 2010](#)

¹⁷The standard error is used to calculate the confidence interval for the range of values in which the population mean is expected to lie. Given the larger range of values for Scotland the Scottish population mean might not be very different from the UK population mean.

¹⁸[UK Innovation Survey 2009: Science and Innovation Analysis, BIS, 2010](#)

¹⁹The OECD Glossary of Statistical Terms defines product innovations as the introduction of a good or service that is new or significantly improved with respect to its characteristics or intended

uses. This includes significant improvements in technical specifications, components and materials, incorporated software, user friendliness or other functional characteristics.

²⁰Innovation Survey weighted and non-weighted sector data provided by BIS

²²[UK Innovation Survey 2009 Statistical Annex, BIS, 2010](#)

²³Although, as noted earlier, margins of error are an issue.

²⁴[Innovation and Research & Development - R&D Business Expenditure, The Scottish Government, 2010](#)

