Scottish Enterprise

Innovation in Scotland:

Analysis of the Community Innovation Survey 2011

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Summary

This paper is an analysis of the 2011 UK Innovation Survey, which covers the period 2008-10. The 2011 results are not directly comparable with previous surveys as the 2011 survey was based on SIC 2007 for the first time and there were changes to methodologies and the definition of innovation activity. Nevertheless, the results show that Scotland's innovation performance still tends to lag that of the UK as a whole, and an important theme arising from this and earlier surveys is the tendency for Scottish firms to operate in local and national markets. Lower proportions of innovation active companies co-operate on innovation outside their local area and export performance is below the UK average. Given the substantial volume of evidence on the link between innovation and exporting, it is important to understand what is driving these trends in Scotland.

Analysis shows that the tendency to operate in local markets is driven by smaller firms in Scotland. A higher proportion of large firms operate in international markets than in the UK as a whole (Scotland ranks in 1st place out of 12 UK regions for operating in international markets and exporting). In addition, a higher proportion of large firms co-operate internationally than in the UK as a whole. Analysis also showed differences in Scotland's innovation activity performance depending on sector.

Results suggest that small firms' underperformance is driving Scotland's overall level of performance and the geography of innovation co-operation suggests that small firms are not exploiting either exporting or international supply chain opportunities. Scotland's business base is dominated by firms such as retail and personal services, which tend to have low spatial clustering and low proportions of innovation active firms. Therefore, it is likely that the characteristics and structure of Scotland's business base is an important influence on exporting, innovation and competitive performance.

Introduction

This paper is an analysis of the published Scottish results and Office for National Statistics (ONS) microdata[1] of the 2011 UK Innovation Survey, which covers the period 2008 to 2010. Innovation is considered to be an essential component of improving Scotland's competitiveness and economic performance. In 2007, the Scottish Government's Economic Strategy noted that Scotland's average GDP growth rate had lagged the UK and comparable small European economies for 30 years, prompting development of a strategic framework for innovation in Scotland, setting out the Government's approach to supporting innovation to improve Scotland's capacity to stimulate and support greater demand for innovation[2]. More recently, the refreshed Scottish Government Economic Strategy (2011) reaffirmed the importance of innovation in boosting economic growth[3] [4].

There are many different theories and models of economic growth but they are consistent in identifying the role that innovation plays as a driver of growth, with empirical research showing that innovation[5] is a core condition for both business competitiveness and the wider growth of the economy[6]. The positive effects of innovation on productivity, employment and turnover have been widely reported. For example, the 2010 Annual Innovation Report estimated that innovation accounted for 63 per cent of annual labour productivity growth in the UK between 2000 and 2008[7]. NESTA research suggests that innovation is a key source of growth for the UK's highest growth firms and that innovative firms grow twice as fast, both in employment and sales, as firms that fail to innovate[8].

[1] This work contains statistical data from ONS which is Crown Copyright. The use of the ONS statistical data in this work does not imply the endorsement of the ONS in relation to the interpretation or analysis of the statistical data. This work uses research datasets which may not exactly reproduce National Statistics aggregates
[2] Scottish Government, Innovation for Scotland 2009
[3] Scottish Government Economic Strategy 2011
[4] National Performance Indicators
[5] in the form of performance improvements in products, processes, services and systems
[6] BIS, Economics Paper 15: Innovation and Research Strategy for Growth
[7] BIS, Annual Innovation Report 2010
[8] NESTA, Business Growth and Innovation

The UK Innovation Survey

The main official data source for measuring innovation is the biennial UK Innovation Survey. To date, seven surveys have been undertaken. The 2011 survey is the fourth bi-annual survey, 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 years[9]. The survey provides a consistent set of results across the UK, enabling analysis of Scotland's performance to be benchmarked against the UK and the other UK government office regions. The data ultimately feed into the Community Innovation Survey (CIS), which allows Europe's innovation progress to be monitored and Scotland to be compared to other European countries.

The UK Innovation Survey is conducted every two years by the ONS on behalf of the Department for Business, Innovation & Skills (BIS). It is a voluntary survey of a sample of UK businesses with 10 or more employees covering most of the private sector. The survey excludes the public sector and membership organisations, firms with fewer than 10 employees and the private sector elements of industry divisions SIC 01 to 03 (Agriculture, Forestry & Fishing) and SIC 84 to 99 (Education, Human health & social work activities, Arts, entertainment & recreation and Other service activities). As the survey is voluntary, firms are not obliged to respond, which can potentially lower response rates.

In 2011, more than 28,000 private sector enterprises across the UK, including more than 2,000 in Scotland, were sampled. The survey achieved a response rate of 50.2% in Scotland, just below the 51.1% response rate achieved for the UK. Response rates and the number surveyed are shown in table 1 below, together with the weighted sample size. Weighting is used to compensate for the businesses that did not respond to the survey and those not selected for the sample so that the weighted number of firms represents the total business population. On average each respondent represents 12 enterprises in the population and the fairly large sample sizes should provide reasonable assessments of innovation performance among all firms with 10+ employees.

Table 1: Survey Response Rates, Scotland and the UK, 2008-10

	Number Surveyed	Responses Received	Response Rate	Weighted Sample
UK	28,079	14,342	51.1%	171,480
Scotland	2,179	1,093	50.2%	13,493

Source: BIS, UK Innovation Survey 2011 Statistical Annex

The 2011 survey data were collected using a sample based on the Standard Industrial Classification 2007 (SIC 2007) for the first time alongside some sampling changes. In addition, two other changes were made:

1. the sample was based on four, rather than three, size classes by splitting medium size firms into two classes with 50 – 99 employees and 100 – 249 employees;

2. the sample base was updated, bringing new firms into the selection from which to draw the survey and a large proportion of businesses received the survey for the first time, resulting in a higher number of non-responses to questions[10].

This has had an effect on regional differences, however, BIS has emphasised that regional innovation rankings usually vary considerably from survey to survey, reflecting the region's industrial make-up and the associated variability in business and product life cycles across sectors[11].

[9] UK 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.
[10] According to BIS, around half of respondents in the 2009 survey were common to the 2007 survey compared with less than a fifth common to 2011 survey and the previous survey in 2009. Previous surveys were showing respondents were 'learning' how to complete the form and demonstrating a good understanding of the questions.
[11] UK Innovation Survey 2011 – First findings

The achieved sample for 2011 had fewer large firms than the previous survey, reducing the response rate for large businesses (50% compared to 75% in 2009). Combined with the new sampling methodology, there was a change in the numbers of businesses selected across the UK regions[12], although the achieved Scottish sample size was only just below that of the 2009 survey (table 2).

Table 2: Achieved Survey Sample Sizes by region (un-weighted)

Region	no of firms 2011	no of firms 2009	2011 sample as % of 2009 sample
UK	14,342	14,281	100.4
North East	487	959	50.8
North West	1,612	1,236	130.4
Yorks & Humber	1,147	1,169	98.1
East Midlands	998	1,136	87.9
West Midlands	1,183	1,286	92.0
East	1,300	1,157	112.4
London	2,279	1,519	150.0
South East	1,966	1,409	139.5
South West	1,142	1,227	93.1
Wales	581	981	59.2
Scotland	1,093	1,184	92.3
Northern Ireland	554	1,018	54.4

Source: BIS, UK Innovation Survey Statistical Annexes 2011 and 2009

Definition of Innovation

Historically, the most common and well known measure of innovation has been the ratio of national expenditure on R&D to GDP[13]. However, it is now recognised that innovation takes place through a number of business practices such as introducing new or improved products and processes or allocating resources to innovation[14], and that a large share of firms develop their process, product, organisational or marketing innovations without carrying out any R&D[15]. The UK definition for 'innovation active' in the 2011 survey is the same as the Eurostat definition. Firms are innovation active if they:

- have Introduced a new or significantly improved product (goods or service) or process;
- are engaged in innovation projects that are not yet complete or abandoned;
- have new and significantly improved forms of organisation, business structures or practices and marketing concepts or strategies.

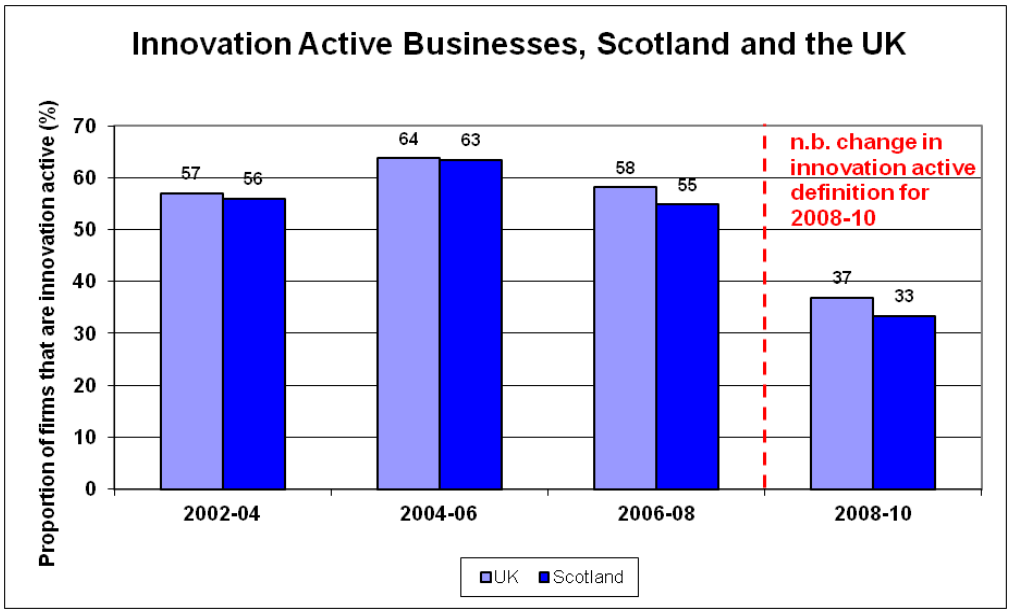
The measure of expenditure on, and activities linked to innovation (such as internal R&D, training, acquisition of external knowledge or machinery and equipment linked to innovation activities), is excluded from the definition used in the 2011 survey. The measure of 'broader innovation' includes both innovation active firms and firms with expenditure and activities link to innovation.

Scotland's Performance

The changes in definition and methodology mean that the 2011 results cannot be directly compared with previous surveys. However, generally Scotland has lagged the UK average in the proportion of businesses that are innovation active over successive surveys, as figure 1 shows. It also suggests that the gap in performance may be growing. In the surveys covering the years 2002-2006 Scotland's performance was closer to the UK average, but the gap has increased over the last two surveys.

[12] UK Innovation Survey 2011 – First findings
[13] European Commission Staff Working Document: A Rationale for Action, European Commission 2010.
[14] First Findings from the UK Innovation Survey 2011
[15] Measuring Innovation: A New Perspective

Figure 1: Innovation Active Businesses, Scotland and the UK, 2002-2010



Source: BIS

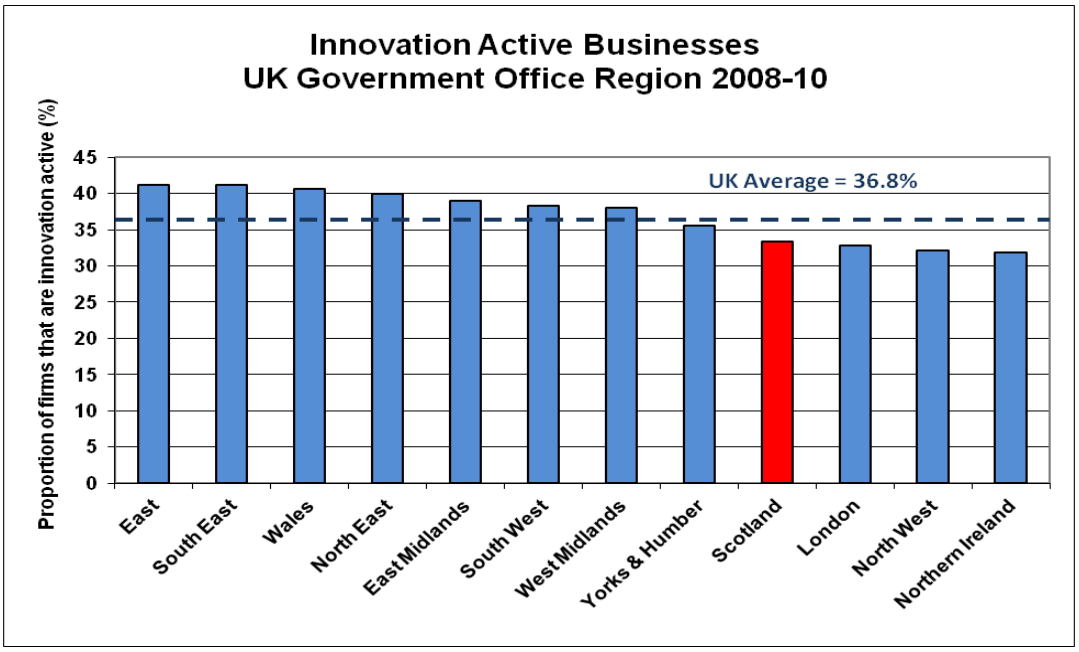
Scotland ranked in 9th place out of 12 UK regions for the latest survey covering the period 2008-10 and has ranked between 9th place and 11th place for the three previous surveys, although it is worth highlighting that smaller sample sizes for the regions lead to bigger standard errors[16] in the results than for the larger UK sample. Therefore, differences between regions may not be significant.

Figure 2 illustrates an almost 10 percentage point difference between the highest and lowest performing UK regions in the period 2008-2010 with no individual region's performance skewing the data. Four regions were around the UK average. East and South East England were the two highest performing regions, each with 41.2% of businesses that were innovation active. The South East was also the highest performing region in the previous survey. Northern Ireland had the lowest proportion of innovation active firms in the period 2008-2010 and also had the lowest proportion in the previous survey. Scotland has been in the bottom quartile of UK regions over the last two surveys.

Figure 3 shows that Scotland also lies in the bottom quartile of European countries for the proportion of firms that are innovation active. The EU proportions of innovation active firms taken from the CIS differ from those in the UK Innovation Survey as they are based on a smaller sectoral coverage. Comparing Scotland with the CIS on a like-for-like sectoral basis gives in a proportion of 38.7% of businesses innovation active in Scotland compared to an EU average of 52.9%.

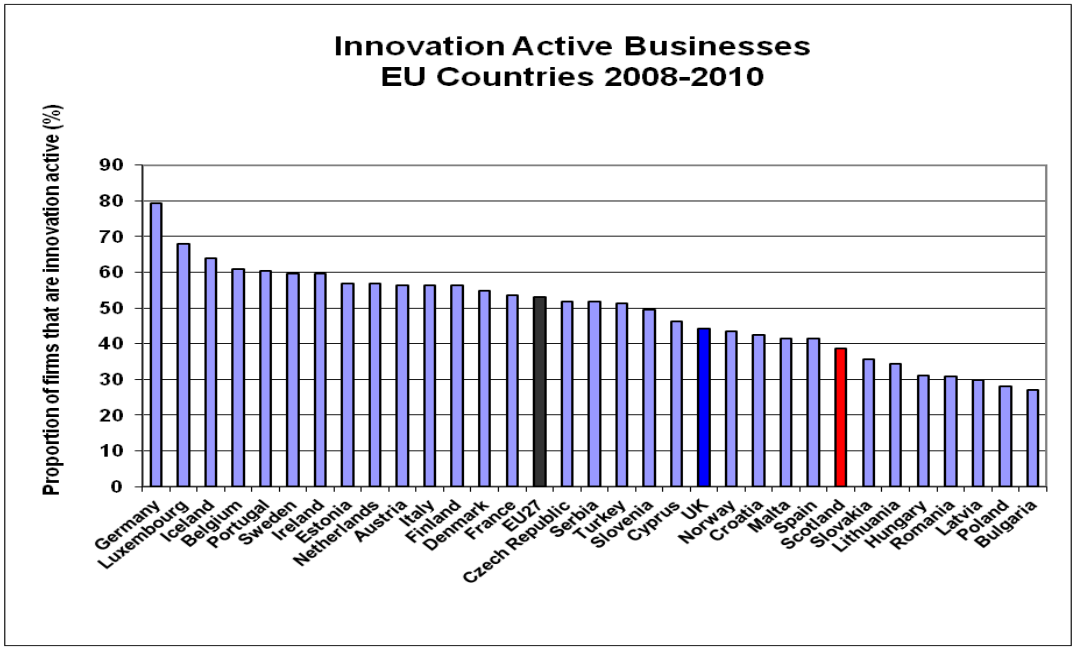
[16] The standard error is used to calculate the confidence interval for the range of values in which the population mean is expected to lie.

Figure 2: Innovation Active Businesses, UK Regions, 2008-2010



Source: BIS, UK Innovation Survey Statistical Annex 2011

Figure 3: Innovation Active Businesses, Scotland and other EU Countries, 2008-2010



Source: Eurostat, Scottish Government

Main Indicators

Compared to the UK average, the performance of Scotland's businesses lagged that of the UK's in all the main survey indicators over the period 2008-2010, detailed in table 3.

Table 3: Main Survey Indicators, Scotland and the UK, 2008-2010

	% of Businesses	
Indicator	**Scotland**	**UK**
Innovation Active	33.3	36.8
Engaged in activities[17]	29.4	33.1
Product Innovator	15.1	18.7
Process Innovation	8.0	10.3
Product or Process Innovator	18.0	21.5
Product and Process Innovator	5.1	7.5
Broader Innovator[18]	35.0	38.6
Wider Innovator[19]	29.5	30.8
Abandoned or Incomplete	8.7	9.0
Abandoned activities	4.0	4.3
Incomplete activities	6.4	6.5

Source: BIS, UK Innovation Survey Statistical Annex 2011

Overall, for Scotland's innovation activity rate to match that of the UK then Scotland would need an additional 500 innovation active companies:

Differences in Motivation for Innovation

The results show quite a large divergence between Scotland and the UK in businesses' motivation for innovation. The emphasis for businesses in Scotland is on updating products, cost reduction, reducing environmental impact and meeting regulatory requirements, as table 4 shows. A much lower proportion of businesses in Scotland are innovating to increase their ranges of goods or services.

[17] Engaged in Activities refers to expenditure or activity in areas such as internal research and development, training, acquisition of external knowledge or machinery and equipment linked to innovation activities.
[18] Broader innovators include innovation active business and businesses engaged in activities or expenditure in areas such as internal research and development, training, acquisition of external knowledge or machinery and equipment linked to innovation activities.
[19] Wider innovators are firms with new and significantly improved forms of organisation, business structures or practices and marketing concepts or strategies.

Table 4: Motivation for Innovation, Scotland relative to the UK

Motivation for Innovation	Scotland Relative to UK = 100
Increasing range of goods or services	**82**
Entering new market	98
Increasing market share	97
Improving quality of goods or services	100
Improving flexibility for producing goods or services	101
Increasing capacity for producing goods or services	100
Increasing value added	96
Reducing costs per unit produced or provided	**120**
Improving health and safety	104
Reducing environmental impact	**115**
Replacing outdated products or processes	**112**
Meet regulatory requirements (including standards)	**115**

Source: BIS, UK Innovation Survey Statistical Annex 2011

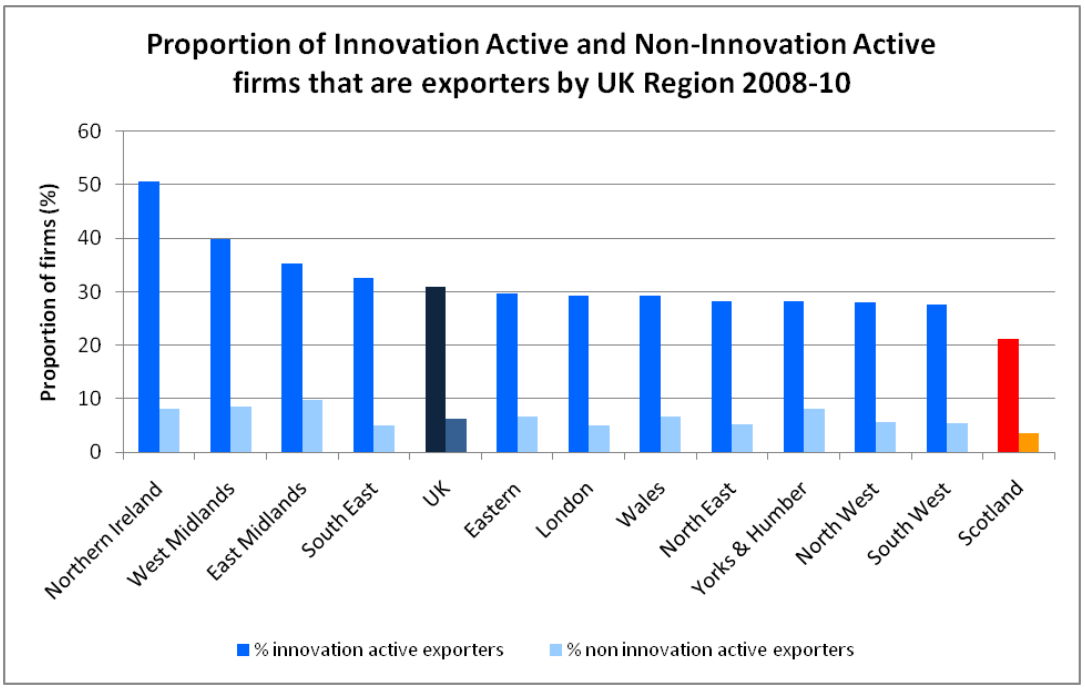
The key question is why there is such divergence in some of the motivating factors. Potentially, this could be related to the more local nature of Scottish firms' customer base (i.e. less need to cater for differing customer needs in overseas markets).

At the aggregate level, for firms with 10 or more employees, there are other differences between the results for Scotland and those of the UK, including firms':

- **Markets** – an important theme arising from this and previous surveys is the tendency for Scottish firms to trade in local and domestic markets. A lower proportion of Scottish firms have international markets than the UK average. Across the UK regions, only Northern Ireland had a higher proportion of firms with local markets than Scotland, although Ireland also has a high proportion of overseas exporters.

- **Exporting** – Scotland's innovation and export performance is below the UK average. The survey showed that only 9.4% of firms with 10+ employees were exporters compared to 15.3% in the UK as a whole. Within Scotland and across the UK as a whole, a higher proportion of innovation active firms were exporters than non-innovation active: 75% of innovation active firms exported compared to 25% of non-innovation active in Scotland (around the UK average). However, not only does Scotland have a lower proportion of firms that are overseas exporters than other UK regions, compared to other UK regions Scotland also has the lowest proportion of exporters that are innovation active (21% compared to 31% in the UK), as figure 4 shows.

Figure 4: Innovation Active and Exporting by UK Region, 2008-2010



Source: ONS microdata

These results have raised some key questions, such as:

- Does the more local nature of Scottish firms' customer base suppress the development of new products, goods and services?

- Why are Scottish firms less likely to be exporters? Does Scotland have fewer innovators because it has fewer exporters, or are there fewer exporters because there are fewer innovators?

At the UK level in general, the proportion of large firms engaging in all types of innovation activities was higher than small and medium sized firms with a noticeable difference between the factors motivating large and small/medium enterprises[20]. There were also variations in the proportion of innovation active businesses depending on industry sector. For example, distribution and services, financial intermediation, wholesale trade, real estate and renting & business activities had the highest share of innovation active businesses and retail had the lowest.

Like the UK, the proportion of innovation active firms in Scotland varies depending on firm size and industry sector; therefore, we need a better understanding of Scotland's performance by size/sector as well as a better understanding of the contribution of innovation to exporting to help answer the key questions highlighted above.

The Importance of Scale in Innovation

The view that the size of the firm is important for innovation dates back to Schumpeter, more than 60 years ago. The premise was that bigger firms have more of an incentive to spend on innovation than smaller ones and companies with more market power may also be willing to invest in innovation[21], therefore, large firms would be more innovative than their smaller counterparts.

Innovation is generally considered to increase more than proportionately with firm size because[22]:

- Large fixed costs related to innovation can only be covered if sales are sufficiently large;

[20] UK Innovation Survey 2011 – First findings, BIS
[21] Scale and Innovation in Today's Economy, Progressive Policy Institute
[22] Innovation, Firm Size and Market Structure, OECD

- Economies of scale and scope[23] can be achieved through innovation (economies of scale lower the average cost per unit; economies of scope lower average costs for a firm producing two or more products making product diversification efficient)
- Large diversified firms are in a better position to exploit innovations because they have more resources at their disposal
- Large firms can undertake many projects at one time and spread the risks of R&D
- Large firms have better access to external finance to fund innovation

Innovation is higher in concentrated industries because:

- Firms with market power are better able to finance R&D from their own profits
- Firms with greater market power can more easily appropriate the returns from innovation and have better motivation to innovate

Evidence to support the Schumpeterian hypothesis is mixed. Research evidence suggests there are positive linkages between concentration/size and innovative activity when certain conditions are met, for example, where there are high sunk costs per individual innovation project. Some evidence shows financial constraints may restrict innovation in small firms and firms with little market power[24]. However, it has also been reported that while industries which are capital-intensive, concentrated, and advertising-intensive tend to have an innovative advantage in large firms, small firms tend to have an innovative advantage in industries in the early stages of the life-cycle, where total innovation and the use of skilled labour play an important role[25].

The Schumpeterian hypothesis has been contested by many economists and management thinkers, who have argued that being smaller and more competitive is better for innovation, but more recently it appears that innovation activity in today's economy favours big companies over small ones[26]. A key factor is the rise of the innovation ecosystem[27], in which a large core firm invests in key technologies and creates an innovation environment for smaller firms. Examples include the ecosystems that cluster around Apple's iPhone or Google's Android. Multiple parts of the system may be in multiple locations and, competing on a global scale, the innovative ecosystem has the advantages of being better able to handle risk and scale and large enough to defend against unexpected threats. For example, a large firm might buy a firm for its patents, which in turn will be better protected against patent threats. Typically smaller firms are said to have advantages in responding to new market opportunities while larger firms have advantages linked to scale and the availability of specialist resources[28], but it has been argued that economic growth and job growth are increasingly being driven by large-scale ecosystems with globalisation putting more of a premium on size than ever before[29].

Other research emphasises the importance of the ecosystem within which SMEs are operating in either enabling or hindering or hindering innovation[30], with demand conditions in the UK said to be only 'moderately favourable' to innovation as consumer and business demand for innovative products lags other advanced economies. Consumer surveys suggest that UK customers are less likely to purchase innovative products in the next six months than in some other countries and UK firms are less likely to buy high tech products. The UK Government's track record on purchasing advanced technology products and services also seems to be poor compared to other countries. As firms are likely to invest more in innovation when there is a high demand for innovative products, uncertainty of demand is an obstacle to innovation[31].

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[23] Arguments to support the hypothesis of economies of scale and in producing of innovations include positive spillovers between various research projects within a firm, and the positive effect on researchers' productivity of the interaction and complementarities within a large team.
[24] ibid, OECD
[25] Innovation, Market Structure and Firm Size, The Review of Economics and Statistics
[26] Scale and Innovation in Today's Economy, Progressive Policy Institute
[27] Most innovation ecosystems are still based on some kind of geographical concentration of amassed entrepreneurs, investors, talent, universities
[28] SME Innovation, Exporting and Growth, Enterprise Research Centre
[29] Scale and Innovation in Today's Economy
[30] SME Innovation, Exporting and Growth, Enterprise Research Centre
[31] The wider conditions for innovation in the UK: How the UK compares to leading innovation nations, NESTA

For firms of all sizes there is a strong positive association between innovation, exporting and productivity and/or growth, with innovation and exporting working jointly to improve business performance[32], although empirical results on the link between innovation activities and firms' export decisions have been mixed[33]. Firms may decide to innovate in order to export (self-selection)[34] or become more innovative, learning from their participation in foreign markets in order to become more innovative than firms working only in domestic markets (learn-by-exporting)[35]. Some studies suggest a strong positive relationship between exporting and innovation activity in both directions[36]. Another shows the importance of sector, with spending on R&D in non-manufacturing increasing the probability of innovating without a significant impact on whether the establishment exported; and exporting having no direct impact on whether innovation occurred in either the manufacturing or non-manufacturing sector[37]. Generally, therefore, there is not much evidence so far in the literature on the exact direction of causality between exports and innovation[38]. There is a substantial body of economic evidence on the links between innovation, exporting and performance at the firm level[39], but not on the direction.

While the relationship between internationalisation and innovation is strong, only a small percentage of European SMEs are engaged in international activities. The percentage of SMEs involved in international activities is closely related to the size of the firm[40]. The larger the company, the more it tends to internationalise. Recent data from the Scottish and UK Small Business Surveys in 2012 highlight this tendency. This is detailed in table 4.

Table 4: Proportion of SME's that export by size band 2012

	Micro (1-9 employees)	Small (10-49 employees)	Medium (50-249 employees)	SMEs
Scotland	13	22	37	13
UK	17	26	40	19

Sources: Scottish Government, BIS

Given the reported links between firm size, innovation and exporting, the following analysis focuses on the Scottish results from the UK Innovation Survey by firm size with a particular focus on markets, exporting and co-operation partners to try and identify any differences in patterns of activity. Sector is also a factor, and this is examined at an aggregate level thereafter.

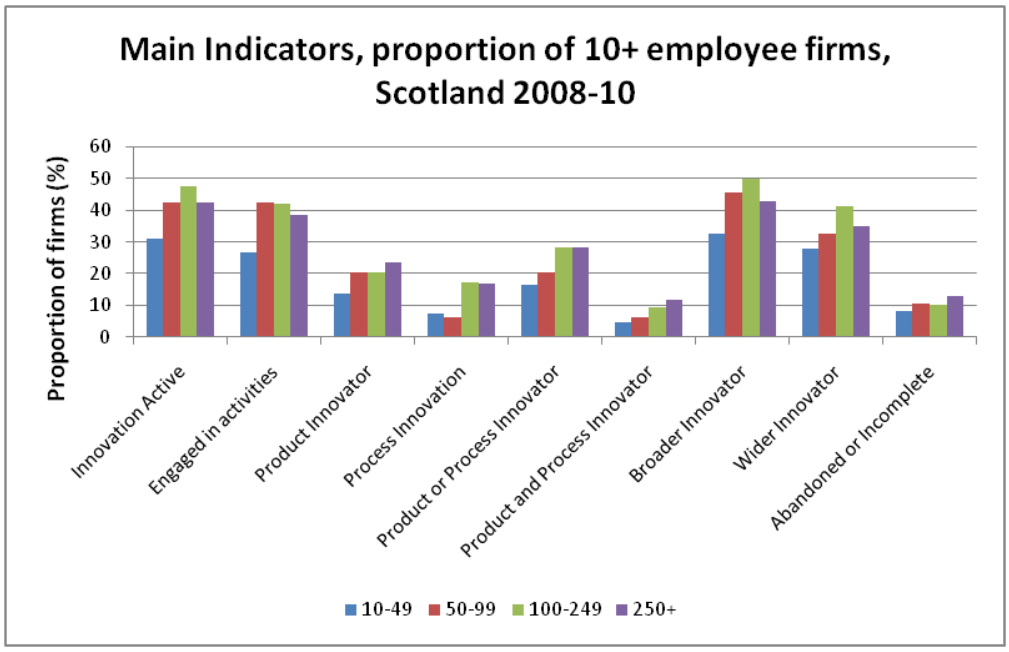
Results by firm size

Previous surveys have shown that innovation activity increases with the size of the firm and the same is true for the 2011 results, as figure 5 illustrates.

- Small businesses (10-49 employees) are less likely to be involved in innovation activities.
- Generally, medium sized businesses (100-249 employees) are most likely to be undertaking innovation activities.
- Large (250+ employee) businesses are more likely to be both product and process innovators.

[32] SME Innovation, Exporting and Growth
[33] Exports, innovation and productivity
[34] From innovation to exporting or vice versa
[35] The Link between Innovation and Export
[36] Causal link between exporting and innovation activity
[37] R&D, Innovation and Exporting
[38] The Link between Innovation and Export
[39] SME Innovation, Exporting and Growth
[40] Internationalisation of European SMEs

Figure 5: Main Innovation Indictors by Firm Size Band, Scotland, 2008-10



Source: ONS microdata

In general, small businesses in Scotland are far less likely to be innovators than small businesses in the UK, and this is why Scotland's overall innovation activity rate was lower than the UK average in 2011. Medium and large Scottish firms' performance was around, or better than, the UK average, as tables 5 and 6 show. Tables 5 and 6 highlight the proportions of businesses by size band for each of the main indicators by firm size band relative to Scotland = 100 and the UK = 100 respectively.

Table 5: Main Indicators by Firm Size, Scotland Indexed relative to all 10+ employee business = 100[41]

Indicator	10-49	50-99	100-249	250+
Innovation Active	93	127	143	127
Engaged in activities	91	145	143	131
Product Innovator	91	135	135	156
Process Innovation	91	75	213	207
Product or Process Innovator	92	113	157	158
Product and Process Innovator	87	118	179	229
Broader Innovator	93	130	143	122
Wider Innovator	95	111	140	119
Abandoned or Incomplete	94	124	115	148
Abandoned activities	102	74	111	107
Incomplete activities	91	138	110	194

[41] Cells with values below 100 are coloured red and indicate that there are lower proportions of firms in this size band than the average for all 10+ employee sized firms

Compared to the UK, table 6 highlights:

- a smaller proportion of product and process innovators in small-medium sized firms, where innovation performance was driven by incomplete activities and new organisational and business structure;
- a bigger proportion of process innovators in large-medium sized firm, where innovation performance was also driven by new organisational and business structures; and

- product innovation and ongoing activity important factors in large firms' innovation performance

Table 6: Main Indicators by Firm Size, Scotland indexed relative to UK = 100

Indicator	10-49	50-99	100-249	250+
Innovation Active	88	101	102	100
Engaged in activities	84	112	105	99
Product Innovator	78	95	82	100
Process Innovation	77	56	108	95
Product or Process Innovator	82	85	95	101
Product and Process Innovator	65	75	82	91
Broader Innovator	87	104	104	97
Wider Innovator	95	92	113	101
Abandoned or Incomplete	96	105	85	109
Abandoned activities	98	61	85	65
Incomplete activities	95	115	74	130

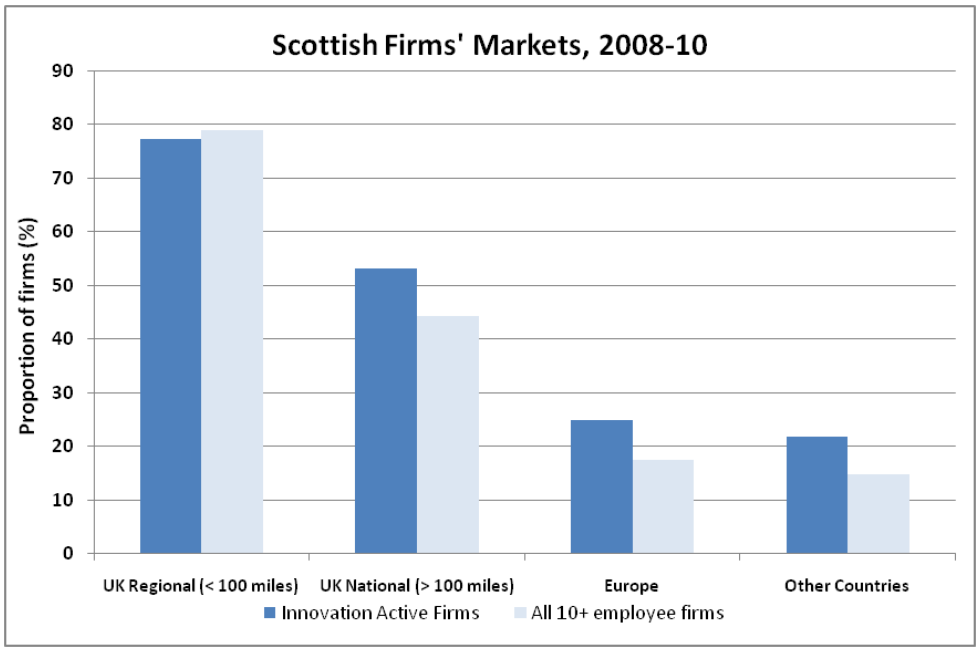
Importance of firm size in other activities relevant to innovation performance

The data show that innovation active firms are more likely to be exporters and collaborate in innovation.

Markets

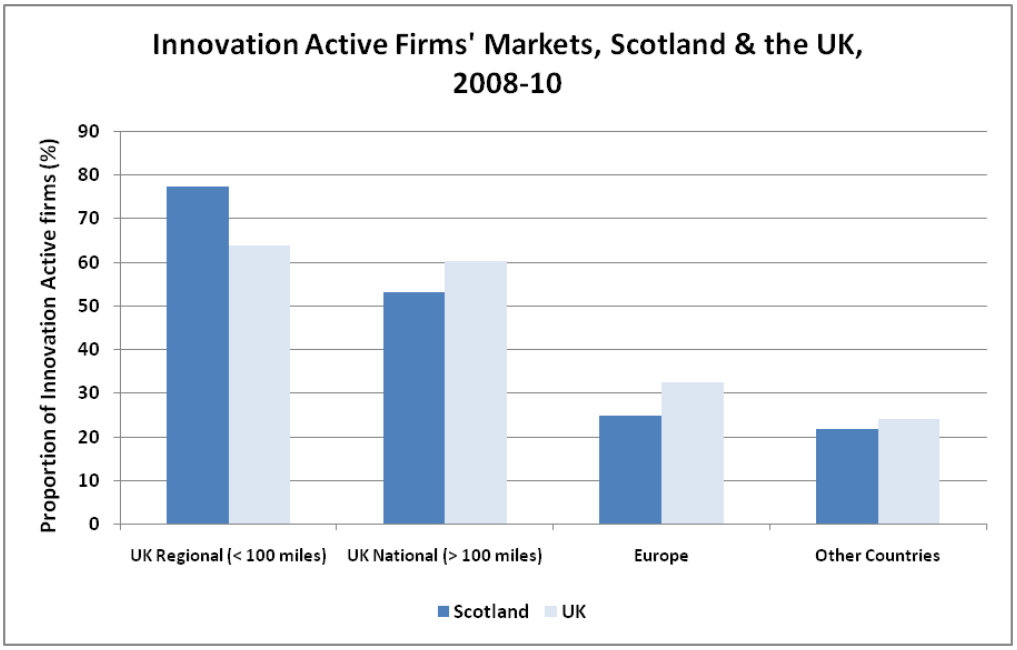
Within Scotland, higher proportions of innovation active firms are active in more markets and have markets outside the UK, than non-innovation active firms (figure 6). When comparing innovation active firms' markets to the UK as a whole, the results show that smaller proportions of Scottish firms have overseas markets when comparing firms with 10+ employees (figure 7).

Figure 6: Markets of Scottish Firms, Innovation Active and All 10+ employee Firms



Source: ONS microdata

Figure 7: Firms' Markets, Innovation Active, Scotland and the UK



Source: ONS microdata

However, once again, there are differences by firm size band within Scotland (detailed in table 7) Three times the proportion of large firms have overseas markets than small firms in Scotland and a larger proportion of large firms in Scotland have overseas markets than the UK average. In fact, Scotland ranked in 1st place out of 12 UK regions for the proportion of innovation active large firms with European markets and markets in other countries.

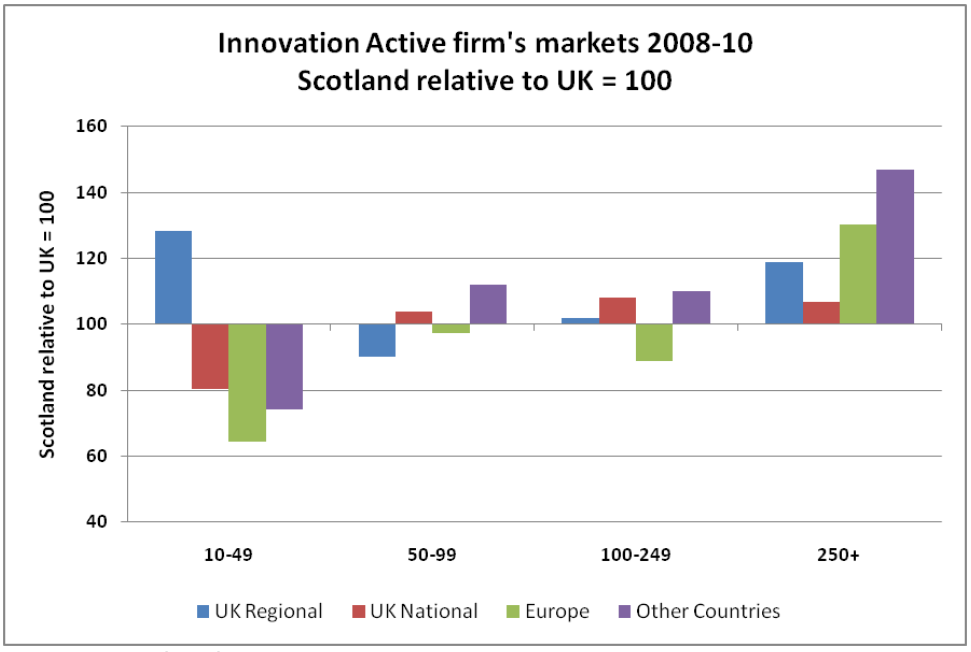
Table 7: Innovation Active Firms' Markets by Size Band, Scotland

Firm Size	UK Regional	UK National	Europe	Other Countries
10-49	82.5	46.0	18.9	15.8
50-99	56.9	70.9	41.4	35.9
100-249	63.8	78.4	40.1	40.3
250+	66.9	84.0	59.3	53.4
All 10+	77.3	53.1	25.0	21.7

Source: ONS microdata

Scotland's large firms outperformed the UK as a whole in 2011, as figure 8 illustrates. The proportion of innovation active firms operating in these four markets is compared to the UK by indexing the Scottish results relative to UK = 100. Any figures below 100 indicate that Scotland has a smaller proportion of firms than the UK and any above 100 shows that Scotland has a larger proportion of firms in these markets than the UK. Scotland is below 100 in most markets and size bands, with the exception of the largest firm size band of 250 or more employees.

Figure 8: Innovation Active Firms' Markets by Size Band, Scotland relative to UK = 100

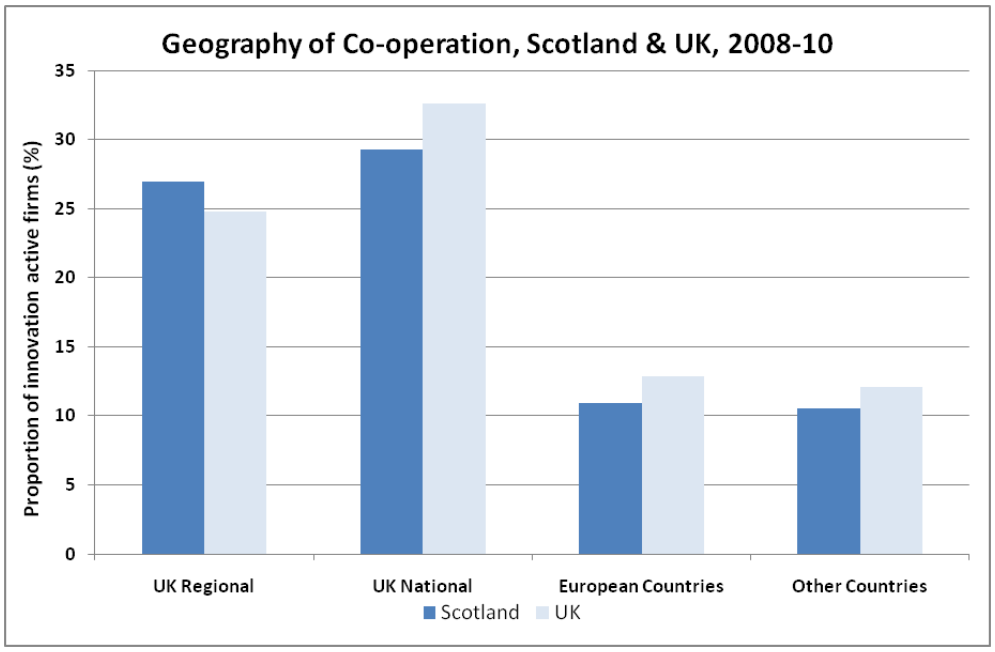


Source: ONS microdata

Firm size and co-operation (innovation active only)

Similar patterns emerge when co-operation and exporting activity is analysed. Co-operation is a key driver of innovation-related knowledge flows. The survey questionnaire asked innovation active respondents whether they had co-operated with different innovation partners and the location of these partners. In terms of geography, a lower proportion of Scottish innovation active companies co-operate outside their local area than the UK as a whole, reflecting the tendency towards local markets. Figure 9 highlights this.

Figure 9: Geography of Co-operation Partners, Scottish and UK firms



Source: ONS microdata

Once again, the tendency for Scotland to lag the UK is driven by small firms, which suggests that small firms are not exploiting either exporting or international supply chain opportunities. Table 8a shows that although the average percentage of innovation active firms co-operating internationally is 10% (with European partners) and 11% (other countries) the proportion of large firms co-operating internationally is around three times this figure.

In fact, a higher proportion of large innovation active firms in Scotland co-operate internationally than for UK firms as a whole. This is highlighted in table 8b, which compares Scotland's performance relative to the UK by size band. Table 8b indexes Scotland's performance relative to the UK and also highlights that a lower proportion of Scotland's small firms have a co-operation partners in UK national markets.

Table 8a: Co-operation by Geography (any partner) by Firm Size Band, Scotland

	Proportion of innovation active co-operators in Scotland				
	10-49	50-99	100-249	250+	All 10+
UK Regional	26.4	23.5	28.4	43.8	27.0
UK National	25.0	34.0	47.5	57.9	29.3
European Countries	7.5	*	*	33.7	11.0
Other Countries	7.4	*	*	33.8	10.5

Source: ONS microdata
* data withheld due to small sample sizes

Table 8b: Co-operation by Geography (any partner) by Firm Size Band, Scotland relative to UK

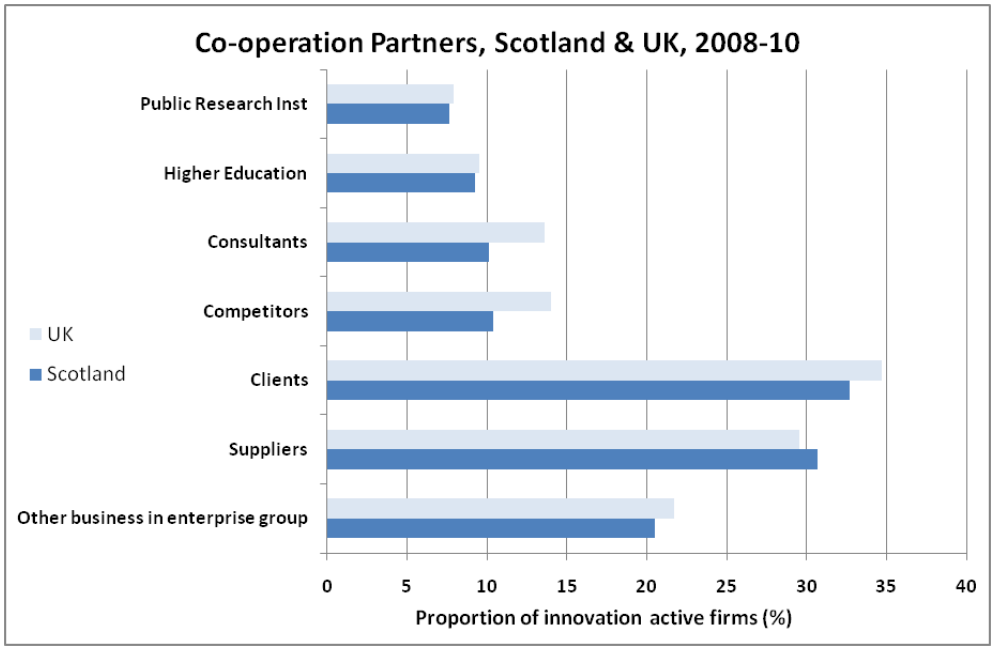
	Innovation active co-operators, Scotland relative to UK=100				
	10-49	50-99	100-249	250+	All 10+
UK Regional	109	92	107	140	109
UK National	83	89	110	111	90
European Countries	68	*	*	118	85
Other Countries	69	*	*	132	87

Source: ONS microdata
* data withheld due to small sample sizes

Co-operation by Partner

Across all size bands, a higher proportion of firms in the UK are co-operators than in Scotland, the only exception being co-operation with suppliers as figure 10 demonstrates.

Figure 10: Proportion of Innovation Active Firms' Co-operation Partners, Scotland & UK



Source: ONS microdata

Due to small sample sizes there are limited data available for Scotland by business size band for co-operation partners and geography. However, some data are available for large firms, which show that although a smaller proportion of innovation active firms in all size bands are co-operators with most types of partner compared to UK firms as a whole, the opposite is true for large firms.

- A higher proportion of large innovation active firms in Scotland co-operate with suppliers and clients in European countries than in the UK as a whole.

- A higher proportion of large innovation active firms in Scotland co-operate with businesses within the enterprise group, suppliers and clients in other countries than the UK as a whole and the Scottish average.

Results suggests that small firms' underperformance is driving Scotland's overall level of performance, raising the question of why a lower proportion of small, innovation active businesses are likely to co-operate than UK counterparts, detailed in tables 9a to 9d below.

Table 9a: Proportion of firms with UK Regional Co-operation Partner, Scotland & UK

	All 10+ innovation active		Large 250+ innovation active	
UK Regional	Scotland	UK	Scotland	UK
Other business in enterprise group	9.4	7.8	18.1	11.7
Suppliers	11.5	9.9	15.7	11.5
Clients	14.4	14.0	19.7	17.8
Competitors	5.3	5.3	*	5.2
Consultants	4.0	5.3	*	8.2
Higher Education	5.4	4.2	13.5	8.6
Public Research Inst	3.9	2.6	*	4.7

Source: ONS microdata

Table 9b: Proportion of firms with UK National Co-operation Partner, Scotland & UK

	All 10+ innovation active		Large 250+ innovation active	
UK National	Scotland	UK	Scotland	UK
Other business in enterprise group	10.1	9.9	20.3	20.3
Suppliers	18.1	17.7	35.5	31.4
Clients	18.9	21.4	35.9	34.5
Competitors	4.7	7.6	*	11.9
Consultants	5.9	7.5	20.3	17.9
Higher Education	*	0.8	*	11.0
Public Research Inst	4.0	4.4	11.5	10.4

Source: ONS microdata

Table 9c: Proportion of firms with European Co-operation Partner, Scotland & UK

	All 10+ innovation active		Large 250+ innovation active	
European Countries	Scotland	UK	Scotland	UK
Other business in enterprise group	3.8	5.0	13.5	15.8
Suppliers	6.0	4.9	23.7	15.2
Clients	6.1	7.6	18.2	15.5
Competitors	1.2	2.1	*	5.0
Consultants	0.8	1.5	*	6.0
Higher Education	*	0.8	*	2.3
Public Research Inst	*	0.6	*	2.0

Source: ONS microdata

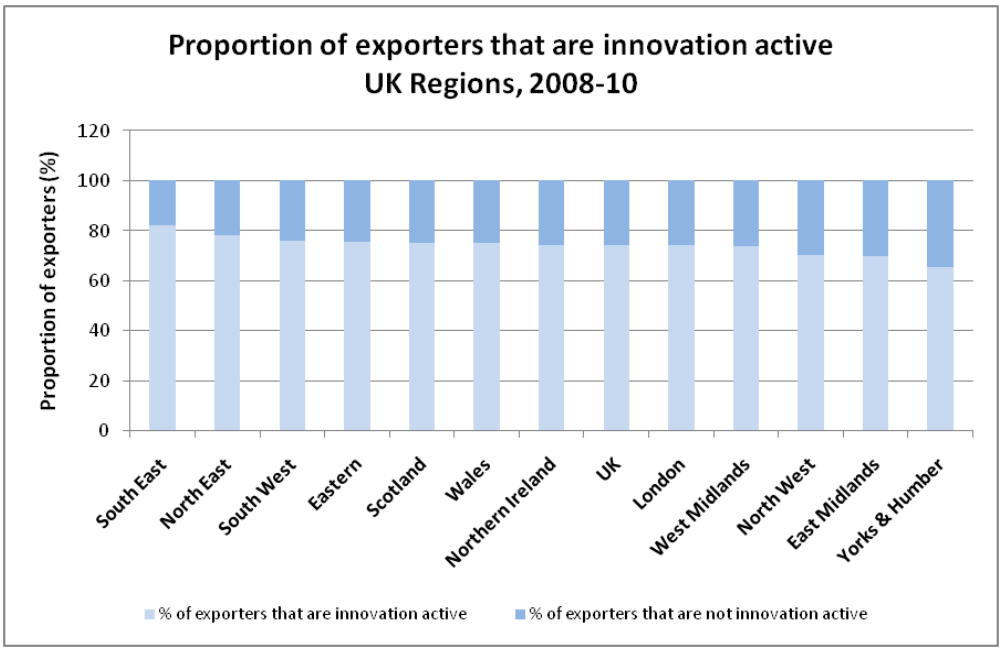
Table 9d: Proportion of firms with Co-operation Partners in Other Countries, Scotland & UK				
	All 10+ innovation active		Large 250+ innovation active	
Other Countries	Scotland	UK	Scotland	UK
Other business in enterprise group	4.8	5.7	22.4	15.8
Suppliers	5.2	4.7	16.8	11.1
Clients	4.9	6.8	18.0	13.9
Competitors	0.7	2.2	*	3.7
Consultants	1.6	2.0	*	4.8
Higher Education	2.3	1.7	*	2.3
Public Research Inst	*	1.5	*	2.1

Source: ONS microdata

Exporting and Innovation Activity

Innovation active firms are more likely to be exporters than non-innovation active firms. On average, based on all firm size bands across the UK, three quarters of exporters were innovation active (figure 11).

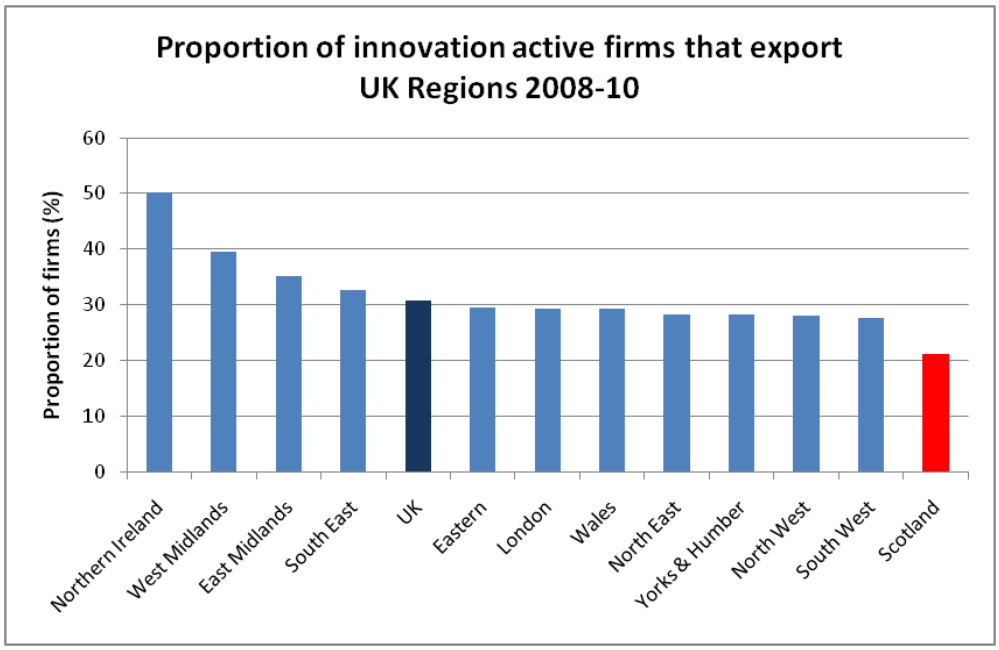
Figure 11: Proportion of Innovation and Non-Innovation Active Exporters by UK Region



Source: ONS microdata

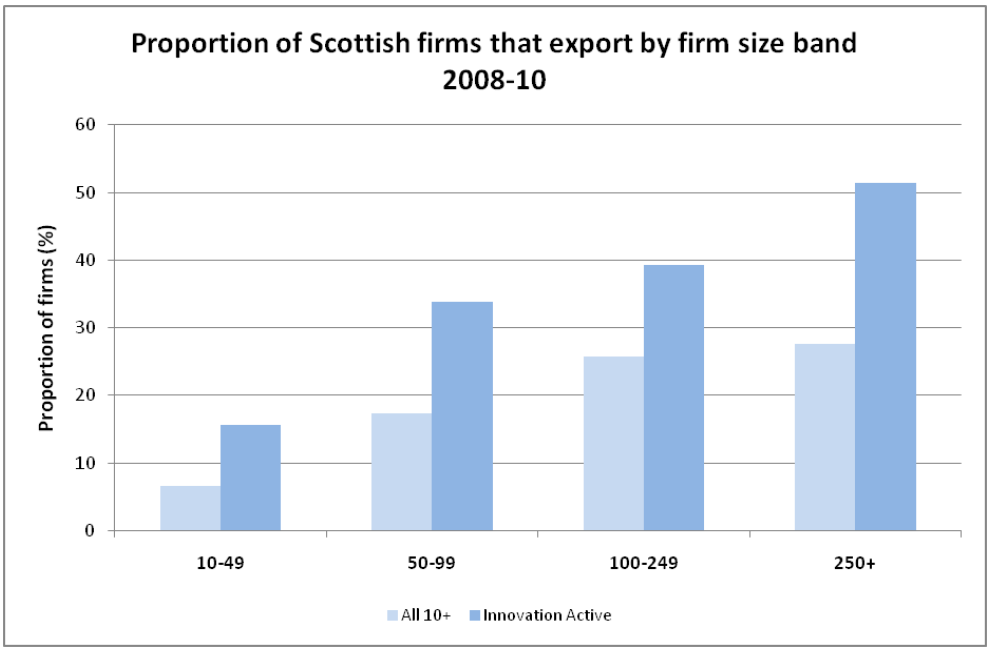
Compared to other UK regions, Scotland had the lowest proportion of innovation active firms that were exporters in 2011, 21.3% of innovation active compared to a UK average of 30.9%, illustrated in figure 12, although a higher proportion of innovation active firms were exporters than non innovation active firms across all firm size bands in Scotland (figure 13).

Figure 12: Proportion of Innovation Active Exporters by UK Region



Source: ONS microdata

Figure 13: Proportion of Exporters, Innovation Active and Non Innovation Active, Scotland



Source: ONS microdata

However, by firm size band, Scotland ranked in:

- 12th place out of 12 government office regions for small (10-49 employee firms), the lowest proportion of innovation active exporters;
- 11th place for small/medium (50-99 employees);
- 9th place for medium/large (100-249 employees), and

- 1st place in large 250+ employee firms, the highest proportion of innovation active exporters out of 12 UK regions.

The results by UK region are detailed in table 10.

Table 10: Proportion of innovation active firms that are exporters by size band by UK Region

UK Region	10-49	50-99	100-249	250+	All 10+
North East	25.7	33.1	44.0	35.1	28.3
North West	25.2	38.4	41.9	34.0	28.1
Yorks & Humber	23.9	39.2	43.2	45.9	28.3
East Midlands	32.6	43.7	46.6	46.5	35.2
West Midlands	36.5	47.5	53.9	51.1	39.6
Eastern	27.4	42.3	38.2	32.7	29.5
London	28.3	35.0	31.9	29.6	29.3
South East	31.4	35.3	40.1	36.9	32.6
South West	23.5	41.9	52.0	36.2	27.6
Wales	25.5	42.6	49.2	41.2	29.2
Scotland	**15.7**	**33.8**	**39.3**	**51.4**	**21.3**
Northern Ireland	49.9	70.5	36.3	31.3	50.3
UK	**28.3**	**39.9**	**42.5**	**38.6**	**30.9**

Source: ONS microdata

The Importance of Sector for Innovation

Previous results of the UK Innovation Survey have highlighted differences in innovation performance depending on sector and the 2011 results for the UK are no exception, as table 11 shows.

Table 11: UK industry sectors with the highest and lowest proportion of innovation active firms

Highest performing sectors	% innovation active	Lowest performing sectors	% innovation active
Manufacture of electrical and optical equipments	61.6	Real estate activities	31.0
Telecommunications	59.0	Construction	30.6
Research and experimental development	56.3	Transport	28.5
Electricity, gas and water supply	55.9	Retail Trade (excluding cars and bikes)	28.5
Computer and related activities/ ICT	54.0	Hotels & restaurants	28.4
Manufacture of fuels, chemicals, plastic metals and minerals	48.4	Renting of machinery, equipment, personal and household goods	26.0

BIS, UK Innovation Survey Statistical Annex 2011

Generally, the proportions of innovation active companies are higher in engineering based manufacturing and knowledge based services. A similar theme emerges from other research reports, which highlight knowledge intensive sectors and those with strengths in R&D. For example:

Research published by BIS[42]:

- Manufacture of pharmaceuticals, medicinal chemicals and botanical products
- Manufacture of television and radio receivers, sound or video recording or reproducing apparatus and associated goods
- Software consultancy & supply
- Other computer related activities
- Research and experimental development on natural sciences and engineering
- Labour recruitment and provision of personnel

OECD Innovation Scoreboard[43]:

- Research and development
- Chemicals and chemical products
- Insurance and pension funding
- Coke and refined petroleum products
- Television and communication equipment
- Financial intermediation

Top 100 Global Innovators[44]:

- Semiconductors & electronic components
- Chemicals
- Computer hardware
- Consumer products
- Machinery
- Telecommunications equipment

Results by Sector in Scotland

The 2011 results for Scotland reflect similar differences across the sectors. Due to small sample sizes the headline innovation measures for Scotland have to be reported at a fairly high level of sector aggregation. The sectors and proportion of firms by indicator are detailed in table 12. Indexing the sectors' results relative to Scotland (table 13) highlights the highest proportions of innovation active firms are in Mining, Quarrying & Utilities, Manufacturing and Finance & Business Information.

[42] The distribution of innovation activity across UK industry, BIS
[43] OECD Science, Technology and Industry Scoreboard 2011
[44] The Economist online, Nov 2011

Table 12: Proportion of firms by indicator and sector, Scotland

Indicator	Mining, Quarrying, Utilities	Construction	Elec, Opt, Fuels, Metals	Other Manufacturing	Hotels, Restaurants, Transport, Storage	Wholesale & Retail	Finance, Business & Information	Scotland
Innovation Active	50.5	34.5	43.1	36.6	25.0	28.4	40.6	33.3
Engaged in activities	47.5	27.1	37.2	34.9	22.1	24.7	37.2	29.4
Product Innovator	:	11.1	25.5	21.4	:	:	20.3	15.1
Process Innovation	:	9.5	17.8	11.8	:	:	11.3	8.0
Wider Innovator	38.3	29.4	35.3	31.1	22.4	25.1	37.7	29.5
Broader Innovator	56.6	35.3	43.1	38.3	26.4	31.8	41.8	35.0

Source: ONS microdata

Table 13: Proportion of firms by indicator and sector relative to Scotland = 100

Indicator	Mining, Quarrying, Utilities	Construction	Elec, Opt, Fuels, Metals	Other Manufacturing	Hotels, Restaurants, Transport, Storage	Wholesale & Retail	Finance, Business & Information
Innovation Active	**151**	**103**	**129**	**110**	75	85	**122**
Engaged in activities	**161**	**92**	**126**	**119**	75	84	**126**
Product Innovator	:	**74**	**168**	**141**	:	:	**134**
Process Innovation	:	**118**	**221**	**146**	:	:	**141**
Wider Innovator	**130**	100	**120**	**106**	76	85	**128**
Broader Innovator	**162**	**101**	**123**	**109**	75	91	**119**

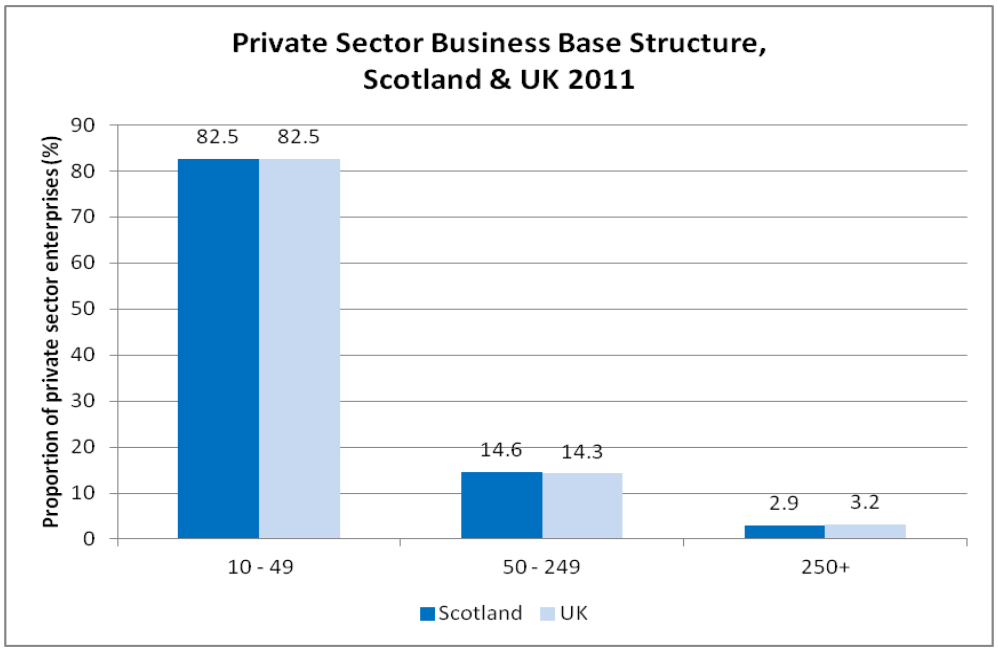
Source: ONS microdata

Size and Structure of Scotland's Private Sector Business Base – Implications for Innovation Activity

The 2011 survey results reveal differences in innovation performance by size and by sector in Scotland, which may help explain Scotland's relatively low proportion of innovation active firms. Comparing the distribution of private sector firms by firm size band in all the sectors covered by the survey shows very little difference between Scotland and the UK's business base structure (figure 14).

However, there are some differences between the sectors. Table 14 shows Scotland's private sector business base by size band and sector indexed relative to the UK = 100. Most size bands and sectors are around 100, therefore, roughly on a par with the rest of the UK. However, it is notable that Scotland has a much higher proportion of large firms than the UK in the sectors with the highest proportion of innovation active firms and a much lower proportion of small firms. These variations in Mining, quarrying & utilities, Manufacturing and Finance & Insurance, may help to explain Scotland's better innovation performance than the UK in the large size band and worse performance in small companies.

Figure 14: Distribution of Firms by Size Band, Scotland and the UK 2011



Source: Nomis, UK Business Counts

Table 14: Scotland's Business Base by Size and Sector indexed relative to UK = 100

Sector	10 - 49	50 - 249	250+
Mining, quarrying & utilities	87	120	195
Manufacturing	92	122	129
Construction	98	115	121
Motor trades	101	96	78
Wholesale	99	108	73
Retail	100	108	63
Transport & storage	100	103	88
Accommodation & food services	101	99	54
Information & communication	103	89	73
Financial & insurance	101	89	113
Property	95	145	79
Professional, scientific & technical	102	89	99
Business administration & support	100	101	94
Total Private Sector	100	102	90

Small Firm Analysis by Sector

In 2011 Scotland had 7.7% of the UK's small (10 – 49 employee) private sector firms in industry sectors covered by the Survey. An analysis of the distribution of small firms in the highest and lowest performing sectors across the UK shows that Scotland has high proportions of total UK small businesses in a number of the lowest performing sectors, including:

- Hotels & Restaurants

UK Region	% of UK Business Base
London	12.9
South East	12.6
South West	12.0
Scotland	11.4
North West	10.0
Yorks & Humber	8.0
East	7.2
West Midlands	6.2
East Midlands	6.0
Wales	5.6
North East	4.1
Northern Ireland	4.1

- Construction

UK Region	% of UK Business Base
South East	14.8
North West	10.7
East	10.3
Scotland	**9.7**
South West	9.6
London	8.8
Yorks & Humber	8.7
West Midlands	7.7
East Midlands	7.2
Wales	4.6
Northern Ireland	4.1
North East	3.8

- Transport

UK Region	% of UK Business Base
South East	13.2
East	12.4
North West	10.4
Yorks & Humber	9.3
London	9.3
Scotland	**9.0**
South West	8.6
West Midlands	8.2
East Midlands	7.9
Wales	4.8
North East	3.7
Northern Ireland	3.0

Perhaps more importantly, Scotland has low proportions of total UK small businesses in a number of the highest performing sectors, including:

- Computer, Electronic and Optical products

UK Region	% of UK Business Base
South East	25.8
East	17.1
South West	10.1
North West	7.8
West Midlands	7.8
East Midlands	6.5
Yorks & Humber	6.5
London	5.1
Wales	4.6
Scotland	**4.6**
North East	2.8
Northern Ireland	1.4

- Computer Programming, Consultancy and Related activities

UK Region	% of UK Business Base
London	24.8
South East	24.6
East	9.9
North West	7.7
South West	7.4
West Midlands	6.6
East Midlands	5.5
Yorks & Humber	4.6
Scotland	**4.6**
Wales	1.8
North East	1.4
Northern Ireland	1.2

- Telecommunications

UK Region	% of UK Business Base
London	27.1
South East	21.9
East	13.5
North West	9.4
West Midlands	5.2
Yorks & Humber	5.2
Scotland	**5.2**
South West	4.2
East Midlands	3.1
North East	2.1
Wales	2.1
Northern Ireland	1.0

Information service activities

UK Region	% of UK Business Base
London	26.0
South East	20.5
East	11.0
North West	8.2
Scotland	**6.8**
East Midlands	5.5
South West	5.5
West Midlands	5.5
Yorks & Humber	5.5
North East	2.7
Wales	2.7
Northern Ireland	0.0

As Scotland's business base structure has relatively more firms in sectors that are less innovation active. It is also worthwhile pointing out that the low innovation performance sectors (Construction, Transportation & storage and Accommodation & food service activities), across all firms size bands, accounted for less than 5% of Scotland's international exports in 2011 while the high performing sectors (Manufacture of computer, electronic and optical products, Telecommunications) accounted for 8.5%. If Scotland had a bigger proportion of small companies in the higher innovation performance sectors, Scotland's innovation and export performance might improve.

A common theme among these high performing 'knowledge intensive' sectors is that they tend to be concentrated in the East and South East of England, and their share of UK small businesses is higher than the regions' total shares of UK small businesses (East and South East have 9.5% and 14.4% respectively). It is also worth noting that these two regions have the highest proportions of innovation active businesses across all 10+ employee size bands out of all the UK regions: at 41.2% their proportions of innovation active firms are almost 8 percentage points ahead of Scotland.

Research shows that the UK's deepest and strongest clusters are found in the south east of the country[45]. These include financial services, software, biotechnology and motor sport, and the presence of so many of the stronger clusters in the southeast is not simply to do with the size of these economies. Research and development in the UK is clustered in the southeast of the country. For some of the south eastern clusters (for example, biotechnology/pharmaceuticals and ICT/electronics) the presence of R&D contributes to those clusters' depth. The south east of the country is also associated with e-commerce: There are a significant number of small businesses in this industry with London and the South East sharing around 50 per cent of all the firms. While south eastern clusters tend to be more service based the northern clusters tend to be built around more traditional manufacturing. For example, analysis identified a small chemical cluster in Scotland. In the north east of Scotland, North Sea oil and gas has supporting industries geographically close. However, unlike the South East, excluding oil and gas, Scotland's clusters were considered to be diversified, small and more or less independent, lacking the advantages of specialisation, such as economies of scale, brought about by well developed and integrated clusters.

Using employment as a measure, in 2011, some of the knowledge intensive service industries such as information and communication and professional, scientific and technical activities tended to display a spatial pattern illustrating clustering of activity in the Greater South East area of England. Information and communication was clustered in London and the South East and Scotland had the highest concentration of employee jobs in mining and quarrying, mainly concentrated in Aberdeen City and Aberdeenshire[46]. In the UK, industries that are geographically concentrated are mostly knowledge intensive service industries, along with a variety of supporting services and activities[47]. The geographical concentration has come about through the co-location of large numbers of individual firms within each industry, and has implications for the economy: while it often has a positive impact on productivity it will also lead to an uneven economic geography. This will most likely include rates of innovation activity.

The ONS note that while there is geographic concentration in some industries, employment in other industries is spread relatively evenly across all areas of the country. Geographically concentrated industries tend to produce tradable goods or services (or are vertically linked to such industries). For firms that need to be close to their customers, such as, for example, hairdressers, there is little geographic concentration; therefore, there is a distinction between those industries that need to be located close to their customers[48]. Analysis of Scotland's business base highlights the strength of sectors such as retail, construction, wholesale, administrative support and accommodation & food service: these sectors tend to have low spatial clustering and low proportions of innovation active firms, and probably help explain the lower proportion of small innovation active firms in Scotland.

[45] Business Clusters in the UK - a first assessment
[46] The Spatial Distribution of Industries, ONS
[47] The Geographical Concentration of Industries, ONS
[48] ibid

Conclusions

Scotland's innovation activity rate has continued to lag that of the UK as a whole over successive innovation surveys. In 2011, Scotland would have needed around 500 more firms with 10 or more employees to be innovation active in order to match the UK proportion of innovation active. Analysis suggests that this is probably a consequence of the size and structure of Scotland's business base.

Compared to the UK, Scotland's businesses have different motivations for innovating. They tend to trade more in local markets and there are fewer exporters, which is likely to have a negative impact on innovation activity since innovation active firms are more likely to be exporters and collaborate in innovation. Although there is not much evidence on direction of causality in the link between exporting and innovation, innovative companies are more likely to be exporters and exporters are also likely to innovate.

Analysis shows that poor performance in exporting trends is primarily driven by small firms in Scotland as larger firms outperformed the UK as a whole. Although Scotland has a smaller proportion of firms with international markets and fewer exporters than the UK average, there are differences by firm size band within Scotland:

- Three times the proportion of large firms have overseas markets than small firms in Scotland
- A higher proportion of large firms in Scotland have overseas markets than the UK average
- A higher proportion of large firms co-operate internationally than the UK average
- A higher proportion of large firms co-operate with suppliers and clients in other countries than the UK average
- Scotland has the highest proportion of innovation active exporters in the largest firm size band out of twelve UK regions
- Scotland has a relatively high proportion of larger firms and relatively low proportion of smaller firms in innovative sectors

Analysis suggests that Scotland's business base structure, firm sizes and the distribution of industry sectors, will have an impact on overall innovation performance. Larger firms' innovation performance in Scotland was around or better than the UK average, which is probably due to Scotland having a relatively bigger share of large firms in sectors with higher proportions of innovation active firms. However, this is offset by a relatively smaller share of small firms in innovation active sectors. Much of Scotland's business base is characterised traditional, non high-tech or knowledge intensive industries. There is by a lack of geographically concentrated, vertically linked industries and the business base is dominated by firms that need to be close to customers such as retail and personal services, which tend to have low spatial clustering and low proportions of innovation active firms. Given the structure of the business base, potentially, Scotland lacks the innovation ecosystems that create innovation environments for smaller firms.