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## Sub-theme:

9. Triple Helix indicators
9.2. Indicators for the measurement of knowledge and innovation.

## Title:

# Triple Helix Dynamics in Peripheral Regions: Evidence from Wales

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This essay is part of my PhD study at the University of Wales. My research interests include innovation and regional development, university-industry interactions, absorptive capacity at the firm level, entrepreneurial behavior, new business creation, and the role of SMEs in peripheral regions. The research project I work on is funded by The National Endowment for Science Technology and the Arts (NESTA). Based on the premise that determining the source and forms of innovative activity in the economy is essential in developing better policy, the aim of the project is to make a contribution both to the theoretical discourse of business innovations and public policy debates concerning their generation, adoption and diffusion in peripheral regions. In particular, my PhD focuses on assessing and exploring the dynamics and applicability of government - industry - university interactions as key actors in determining business innovation at the regional level.

## Keywords:

Sectoral innovation; innovation metrics, regions, Wales.

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[1] However, for certain statistical results obtained via ONS please see pertinent disclaimer that applies.

## Introduction

Etzkowitz asserts that "innovation has broadened from a focus on product innovation within firms to organisational changes within the triple helix"[2]. Within this triple helix three main actors/ organisations can be depicted: industry – academia – government. Within this model, industry has a wealth generator role, academia a novelty production role, and government represent the public control.[3] Therefore, within the triple helix the firm is the engine of the economic growth. The firm-formation is regarded as central to innovation strategy. The role of the firms and in particular the 'start-up ones' become important to advancing technology, creating employment and growth. Via firm-formation innovation become the central focus of the organisation.[4]

The triple helix approach highlights the contributions of the main actors to firm-formation. But what is crucial is the growth and development of any firm. And in order this to occur (that is maximising the chances) the role of the firm becomes important. Understanding the determinants of the innovative firm becomes fundamental. Triple Helix assist into this by guiding and depicting the main actors and making this understanding more tangible.

The role of the firm is important. Actually, there are the dynamics among small and medium firms and the established large firms as well as the entrepreneurial starts up. Whilst Etzkowitz recognises the importance of upgrading the capabilities of small and medium sized firms, as well as those of well established large firms, he places greater emphasis on the dynamics of the start-up processes. However, leading business historians have highlighted the importance of established firms versus entrepreneurial firms. In particular, Alfred Chandler (1992, pp. 97-98) asserts that "established firms in recent years have played a greater role in the creation of new industries than entrepreneurial start-ups because the time and cost of commercialising technologically complex new products and processes in not in invention or research but in development. The commercialising of new product or process, in itself a continuing learning experience, rests on cumulative organisational learning in the development, production and marketing of earlier products".[5]

It is fair to say that Etzkowitz[6] and Chandler both agree upon the fundamental role of the firm (either SME, large, entrepreneurial start-up) for economic development.[7] The firm is the unit of analysis and should be the unit of analysis, as Chandler emphasises, the firm is "the process of production and distribution, for increasing productivity and propelling economic growth and transformation" with the role of "an instrument of economic growth and

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[2] Etzkowitz, H. (2008). *The Triple Helix: University-Industry-Government Innovation in Action.* New York: Routledge.

[3] Leydesdorff, L. and M. Meyer (2006). Triple Helix indicators of knowledge-based innovation systems: Introduction to the special issue. *Research Policy* 35(10): 1441-1449.

[4] Etzkowitz op.cit p. 57.

[5] Chandler, A. D. (1992). Organizational Capabilities and the Economic History of the Industrial Enterprise. *Journal of Economic Perspectives* 6(3): 79-100.

[6] Etzkowitz emphasises perhaps the important role that universities plays, in new firm-creation. But again, the *output* is the firm.

[7] This argument goes back to Schumpeter (1934, and 1942) work. In-house R&D and entrepreneurial activities lead to creative distractions and new creation. The new combinations by entrepreneurs is the fundamental element for long-term economic growth.

transformation, and assist in developing policies and procedures for maintaining industrial productivity and competitiveness in an increasingly global economy" (p.99). As Ahlstrom (2010, p.11) asserts "the main goal of business is to develop new and innovative products that generate growth and deliver important benefits to an increasingly wind range of the world population".[8] It is upon these fundamental premises that this paper is based upon and willing to build upon also.

Whilst much have been written about the importance of innovation and how it leads to economic growth and prosperity, studies of innovation systems tend to focus primarily on those regions which have effectively introduced innovations in the past. The innovation systems approaches, as well as the triple helix one both propose that supporting the interactions among key actors, such as universities, industry and government is fundamental in enhancing innovation activity in peripheral regions. This paper is build upon this premise.

Furthermore, in terms of methodological orientations within the field of innovation studies, there is now well addressed in the innovation literature that conventional innovation metrics, such as R&D expenditure and patents, provide an incomplete understanding of innovation activity (NESTA, 2009). The National Endowment for Science Technology and the Arts (hereafter NESTA) has developed a new Innovation Index that measures the UK's innovation performance. Based on the NESTA Innovation Index (NESTA 2009) this study uses a triple helix dimension for measuring innovation. The three dimensions – metrics, that is, a) access to knowledge b) capacity to build innovation and c) the ability to commercialise innovation, are viewed as the 'triple helix metrics' for measuring innovation. We developed this terminology (i.e. *triple helix metrics*) as an effort to further contribute to the triple helix model of innovation and extend it into a more quantitative scope.

The purpose of this research is twofold. First, it aims to examine the relationships among the triple helix actors within different sectors and regional settings. This addresses the following questions. What are the dynamics among the triple helix actors within different sectors and regions? Do enterprises collaborate with universities and public research institutions/government? Do some regions collaborate at a different level/intensity compared to other regions? Do some sectors take more advantage of government support? How does the enterprise perceive the level of interaction with the two main actors within a triple helix perspective? Do some sectors perceive this interaction of a higher level of importance than other sectors? Secondly, it provides a *triple helix metrics* for measuring innovation and the contribution of the main actors.

[8] Ahlstrom, D. (2010). Innovation and Growth: How Business Contributes to Society. *Academy of Management Perspectives* 24(3): 11-24.

# 2. State of the Art

## Networking dynamics within the Triple Helix Spheres

The contribution of networking to firm innovativeness is of great importance. Hewitt-Dundas (2006) finds that the ability of the small firm to innovate is related to networking.[9] Not only small and medium sized firms benefit from networking. Large firms also benefit. This statement is confirmed by various scholars dealing with innovation studies. For example refer to the review studies of Becheikh et al. (2006)[10], Pittaway et al. (2002).[11] Within these studies, the correlation between innovativeness and the collaboration with various actors, such as universities, suppliers, customers, research institutions has been positive.

Therefore, it would be safe to state with some confidence that networking provide an outstanding contribution to the firm innovativeness. This can be justified by considering the number of studies that find a positive correlation between networking and innovation. Some of these studies include: Beugelsdijk and Cornet, (2002)[12]; Coombs and Tomlinson (1998)[13]; Kaufmann and Todtling (2001)[14]; Landry et al., (2002)[15]; Ritter and Gemunden, (2003)[16]; Souitaris, (2002).[17]

## 2.1 Inter & intra – industry interaction

Medina et al. (2006, pg.277) assert that for a company in order to maintain an innovative edge in a contemporary rapidly changing globalised environment the following three points are critical: a) working closely with clients, b) collaborating with other companies and organisations, and c) applying informal communication processes.[18] Communication is important and can be distinguish between internal communication, that is communication within the same organisation and external communication that is communication with the same industry or different industry.

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[9] Hewitt-Dundas, N. (2006). Resource and capability constraints to innovation in small and large plants. *Small Business Economics* 26(3): 257-277.
[10] Becheikh, N., R. j. Landry, et al. (2006). Lessons from innovation empirical studies in the manufacturing sector: A systematic review of the literature from 1993-2003. *Technovation* 26(5/6): 644-664.
[11] Pittaway, L., M. Robertson, et al. (2004). Networking and innovation: a systematic review of the evidence. *International Journal of Management Reviews* 5/6(3/4): 137-168.
[12] Beugelsdijk, S., Cornet, M. (2002). A far friend is worth more than a good neighbour: proximity and innovation in a small country. *Journal of Management and Governance* 6 (2), 169-188.
[13] Coombs, R., Tomlinson, M. (1998). Patterns in UK company innovation styles: new evidence from the CBI innovation trends survey. *Technology Analysis and Strategic Management* 10 (3), 295-310.
[14] Kaufmann, A., and Todtling, F. (2001). Science-industry interaction in the process of innovation: the importance of boundary-crossing between systems. *Research Policy* 30, 791-804.
[15] Landry, R., Amara, N., Lamari, M. (2002). Does social capital determine innovation? To what extent? *Technological Forecasting and Social Change* 69, 681-701.
[16] Ritter, T., Gemunden, H.G. (2003). Network competence: its impact on innovation success and its antecedents. *Journal of Business Research* 56, 745-755.
[17] Souitaris, V. (2002). Technological trajectories as moderators of firm-level determinants of innovation. *Research Policy* 31, 877-898.
[18] Medina, C. C., A. C. Lavado, et al. (2005). Characteristics of Innovative Companies: A Case Study of Companies in Different Sectors. *Creativity & Innovation Management* 14(3): 272-287.

Communication variables determine organisational innovativeness. Monge et al (1992) study utilises equity theory, expectancy theory and the theory of reasoned action in order to predict the number of innovative ideas contributed by members of the organisations.[19] In particular, they used communication[20] and motivational variables[21] on data collected on five firms using multivariate time series techniques. They find that communication variables are causes of organisational innovation. In contrary, motivational variables did not cause organisational innovation.

Entrepreneurs and large firms are key drivers of innovation.[22] Innovation is a key driver of economic growth and competitiveness. Risk taking entrepreneurs and innovative firms are key drivers of economic development and growth by taking advantage of global innovation systems. As Linden et al., (2009) argue global innovation create value for investors and well paid jobs for knowledge workers, when the market remains dynamic, with innovative firms and risk taking entrepreneurs.[23]

Not to innovate is to die.[24] Firms must innovate in order to survive. Moreover, as Freeman asserts, some firms choose not to innovate.[25] The consequence of this is simple, but detrimental. If a firm does not innovate then the competitors will do so.

A new or improved innovative product does not necessarily need to be manufactured in-house. That is, does not need to be an 'offensive innovator'.[26] But can take advantage of other suppliers that can have an input in that innovation. However, the firm need to innovate in order to be able to benefit from global innovation network.[27]

In the 21st century on 'offensive' strategy is not the norm. As Freeman (1986) asserts "only a small minority of firms in any country are willing to follow an 'offensive' innovation strategy." One good example could be Apple Ipod. This innovative product is the 'output' of many different 'inputs'. That is, the *product design*, *software development*, *product management* and *marketing* are performed in-house. However, the *manufacturing* and other components are outsourced. Each supplier provides its own innovative part. At the end, the innovative product will have the brand, and in this particular example is that of Apple Ipod (see Linden et al, 2009 for a detailed analysis).

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[19] Monge, P. R., M. D. Cozzens, et al. (1992). Communication and Motivational Predictors of the Dynamics of Organizational Innovation. *Organization Science* 3(2): 250-274.
[20] a) level of information and b) group communication
[21] a) perception of equity, b) expectations of benefits, and c) perceived social pressure.
[22] Schumpeter (1939; 1942) op.ct.
[23] Linden, G., K. L. Kraemer, et al. (2009). Who Captures Value in a Global Innovation Network? The Case of Apple's iPod. *Communications of the ACM* 52(3): 140-144.
[24] Freeman, C. (1986). Innovation and the Strategy of the Firm. *Product design and technological innovation*. R. Roy and D. Wield. Milton Keynes, Open University Press: 98-104.
[25] Or to put in his worlds "they elect to die" Freeman (1986) op.cit, pg. 98.
[26] Freeman (1986) asserts that there are various strategies that firms may follow in order to innovate. One of them is the 'offensive' innovator. This type reflect the firm strategy with the following characteristics: The firm has *strong* in-house R&D and place great emphasis on patent protection. Freeman, C. (1986). Innovation and the Strategy of the Firm. *Product design and technological innovation*. R. Roy and D. Wield. Milton Keynes, Open University Press: 98-104.
[27] Linden et al., (2009) op.cit.

## 2.2 Government – industry interaction

Evidence suggests that government policies have a positive effect on innovation (Coombs and Tomlinson, (1998)[28]; Lanjouw and Mody, (1996)[29]; Oyelaran-Oyeyinka et al., (1996)[30]. A study by Hsu (2005) finds evidence of a positive effect of the interaction between the government and national research institutes.[31] He examines the Taiwan industrial innovation system and provides a conceptual model using as an example the Taiwan's largest research organisation.[32] The model highlighted two major components. First the selection of technology development targets and methods of technology R&D and commercialisation, and second the components of the national innovation system which included the research organisations, the government, academia, industry, government, and international organisations.

Courvisanos (2009) recognises the strong political focus on public innovation and provides a policy framework that identifies what government support as innovation policies.[33] Courvisanos asserts that political aspects have a dual role. They both improve but also damage public innovation policies. Furthermore, with emphasis on the triple helix dynamics, Etzkowitz (2008) asserts that the role of government in the triple helix firm is at an embryonic state and its effectiveness is rather low.[34]

## 2.3 University – industry interaction

Universities and research institutions have an important role on innovation[35] [36]. However, Drejer and Jorgensen (2005) state that traditionally the focus of university and research institutes have not been the development of the innovation process of the firms, rather just the provision of scientific and technical knowledge.[37] The focus now has changed. The third mission addresses exactly this shift. The third mission addresses the entrepreneurial role of the university, departing from the classical teaching or research focus. There are various factors that motivate universities to collaborate with industries. Two are of main importance and diachronic. Gibbons et al., (1994) argued about the financial pressure that motivates the

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[28] Coombs, R., Tomlinson, M. (1998). Patterns in UK company innovation styles: new evidence from the CBI innovation trends survey. *Technology Analysis and Strategic Management* 10 (3), 295-310.
[29] Lanjouw, J.O., Mody, A. (1996). Innovation and the international diffusion of environmentally responsive technology. *Research Policy* 25, 549–571.
[30] Oyelaran-Oyeyinka, B., Laditan, G.O.A., Esubiyi, A.O. (1996). Industrial innovation in sub-Saharan Africa: the manufacturing sector in Nigeria. *Research Policy* 25, 1081–1096.
[31] Hsu, C.-W. (2005). Formation of industrial innovation mechanisms through the research institute. *Technovation* 25(11): 1317-132
[32] The Industrial Technology Research Institute (ITRI).
[33] Courvisanos, J. (2009). Political aspects of innovation. *Research Policy* 38(7): 1117-1124
[34] Etzkowitz (2008) op.cit., p.53. This is supported from recent empirical evidence.
[35] Vuola, O. and A.-P. Hameri (2006). Mutually benefiting joint innovation process between industry and big-science. *Technovation* 26(1): 3-12.
[36] Bozeman, B. (2000). Technology transfer and public policy: a review of research and theory. *Research Policy* 29(4/5): 627.
[37] Drejer, I. and B. H. Jorgensen (2005). The dynamic creation of knowledge: Analysing public-private collaborations. *Technovation* 25(2): 83-94.

universities to engage more in collaborations with the industry.[38] In addition, another stimulus arises from the government which encourage them to undertake more research related to boosting firm innovativeness and competitiveness.[39]

Firms do not innovate on their own. Firms collaborate with a wider network including universities. This is evidenced via various innovation surveys, such as Community Innovation Survey (CIS). Whilst commonsense would suggest that there is benefit to be gained from university-industry collaboration the complexities associated with university-industry collaborations makes it more difficult to measure in a tangible manner. That is, does the collaboration itself enhance business innovative capabilities? Therefore, this relationship is not straightforward. The higher the collaboration with University research, the higher the perceived innovation effect on the firm level.[40] One of the complexities is the nature of the University that the firm is collaborating with. Firms often do not perceive the collaboration with local and regional universities as a source of leading-edge information.[41]

D'Este and Patel (2007) have examined the channels through which academic researchers interact with industry.[42] They used a survey with a sample of 4337 university researchers in the UK including ten scientific fields[43] and found that University researchers interact with industry in a variety of ways. They grouped these methods of interaction in five categories: a) creation of new physical phasilities, b) consultancy and contract research, c) joint research, d) training, and e) meetings and conferences. They concluded that these interactions, between industry partners and university were evenly spread across UK regions, and that individual characteristics of university researchers, such as previous experience of collaboration and academic status, play an important role in explaining the frequency of interaction between them and industry partners.

Innovation surveys have been used as an important tool in order to uncover the connections between University research and business innovation. Whilst Innovation surveys provide useful information about the connections between university research and business innovation only a relatively small proportion of firms collaborate with universities.[44] In

[38] Gibbons, M., C. Limoges, et al. (1994). *The New Production of Knowledge: The Dynamics of Science and Research in Contemporary Societies*. London: Sage Publications.
[39] Tether, B. S. (2002). Who co-operates for innovation, and why An Empirical analysis. *Research Policy* 31(6): 947-967.
[40] (DTI, 2006)
[41] DTI op.cit
[42] D'Este, P. and P. Patel (2007). University-industry linkages in the UK: What are the factors underlying the variety of interactions with industry? *Research Policy* 36(9): 1295-1313.
[43] These included the following: chemical engineering; chemistry; civil engineering; computer science; electrical and electronic engineering; general engineering; mathematics; mechanical, aeronautics and manufacturing engineering; metallurgy and materials; and physics.

[44] DTI. (2006). *Innovation in the UK: Indicators and Insights*. Department of Trade and Industry.

addition, these connections given its complexities[45] "are not well understood and are worthy of further research".[46]

## Methodology

To address the above questions, secondary data analysis was performed. Some of the advantages of using secondary data are economically, time saving, and allow the researcher to test hypothesis (Bryman and Bell, 2007). In particular, data were obtained via a two-level research strategy. Firstly, we used NESTA Innovation Index as our sample frame. That allowed us to select the pertinent sectors for the scope of the study. In particular, within NESTA Innovation Index (2009) nine sectors are covered. Figure 1 depicts those sectors.

Figure 1:

| | | |
|---|---|---|
| **Accountancy services** | **Construction** | **Legal services** |
| **Architectural services** | **Consultancy services** | **Software & IT services** |
| **Automotive** | **Energy production** | **Specialist design** |

Secondly, we used the UK Community Innovation Survey, part of the wider Community Innovation Survey (CIS). In particular we used the latest wave of the survey (CIS 6). CIS6 covers the period 2006 to 2008. These data were obtained from the Office for National Statistics (ONS). In addition, for the scope of this paper we identified the identical SIC (2003) enterprises that NESTA Innovation Index covers UKIS 2009 covers as well. Next we grouped the above nine sectors into three broader groups as follows: One group resulted in so called Traditional Knowledge Intensive Business Services (KIBS), the second group into Technological (Tech) KIBS, and the third group into Other. Figure 2 shows those classifications.

Figure 2: Industry classification by sector

| Traditional KIBS | Technological (Tech) KIBS | Other |
|---|---|---|
| Accountancy services | Software and IT services | Automotive |
| Architectural services | Specialist design | Construction |
| Consultancy services | | Energy production |
| Legal services | | |

Table 1 below provides the sample utilising the NESTA Innovation Index data.

[45] Laursen, K., & Salter, A. (2004). Searching high and low: what types of firms use universities as a source of innovation? *Research Policy*, 33(8): 1201-1215.
[46] DTI op.cit p. 30

Table 1: Industry classification by region

| | | Industry Classification | | |
|---|---|---|---|---|
| | | Traditional KIBS | Tech KIBS | Other |
| **Region** | Wales | 25 | 16 | 21 |
| | England | 658 | 328 | 281 |
| | Scotland | 65 | 22 | 36 |
| | Ireland | 27 | 8 | 6 |
| **Total** | | 775 | 374 | 344 |

Source: NESTA Innovation Index.

UKIS 2009 covers twelve regions within UK. We decided to group those into four 'group regions' to facilitate our analysis as follows: Wales, England, Scotland, and Northern Ireland. The table below provides the sample utilising the UK Innovation Survey 2009 (ONS).

Table 2: Industry classification by region

| | | Industry Classification | | | |
|---|---|---|---|---|---|
| | | **Traditional KIBS** | **Tech KIBS** | **Other** | **Total** |
| Region | Wales | 78 | 16 | 95 | 189 |
| | England | 837 | 278 | 912 | 2027 |
| | Scotland | 98 | 32 | 108 | 238 |
| | Northern Ireland | 60 | 33 | 105 | 198 |
| | Total | 1073 | 359 | 1220 | 2652 |

Source: ONS

Table 3: Industry classification by size

| | | **Size of Enterprise** | | | |
|---|---|---|---|---|---|
| | | Small 10-49 employees | Medium 50-249 employees | Large 250+ employees | Total |
| Industry Classification | Traditional KIBS | 587 | 281 | 205 | 1073 |
| | Tech KIBS | 189 | 105 | 65 | 359 |
| | Other | 556 | 404 | 260 | 1220 |
| | Total | 1332 | 790 | 530 | 2652 |

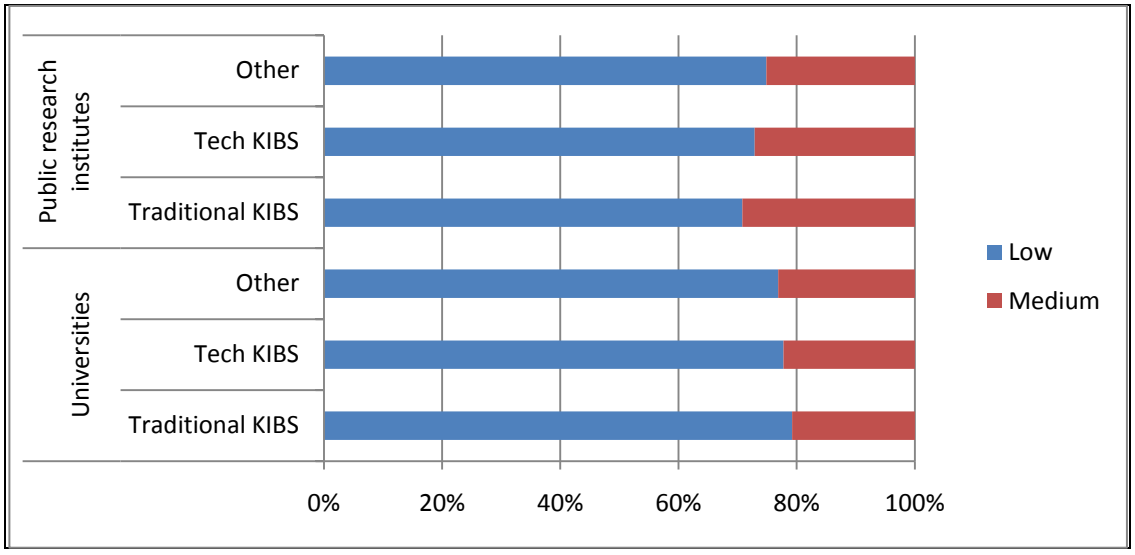
Source: ONS

## Findings and interpretation

### Collaboration for innovation

This section aims to depict the level of collaboration for developing innovation. Data from UK Innovation Survey (CIS6) confirmed that enterprises do collaborate within a *triple helix system* of innovation perspective. However collaboration within the main actors (i.e. universities and government/public research institute) is rather weak. In particular, CIS asks enterprises a number of questions with regard this part (i.e. collaboration with external partner as sources of knowledge for innovation). Within the triple helix actors, nearly 80 per cent of enterprises reported that they do collaborate with universities and public research institutes. These enterprises were asked about the importance of collaboration for innovation. The vast majority of enterprises, across all sectors, reported the importance for collaboration with either of these major actors as being "low". Around 20 per cent of all enterprises reported the level of importance as "medium". We did not report "high" values, simply because those enterprises that reported the importance for collaboration for innovation as being "high" were less frequently reported. This poses a question for a 'weak' interconnection among the triple helix actors.

Figure 3: Collaboration for innovation within the triple helix spheres

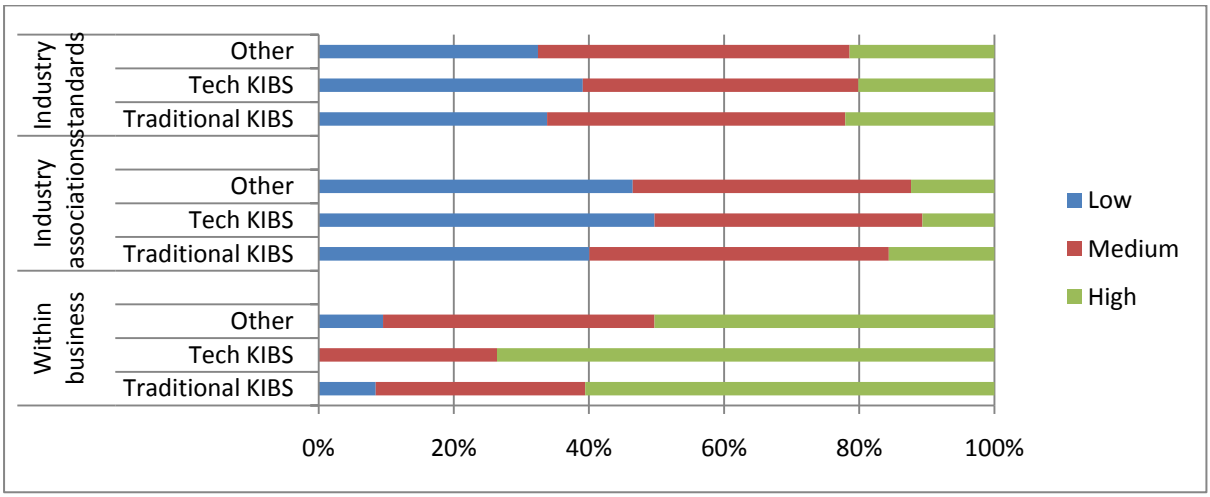



Source: ONS UK Innovation Survey 2009

On the other hand, when we considered a wider framework, that is, interactions beyond the triple helix actors, then the level of importance shifted a lot. In particular, it is evidenced the perceived importance within the enterprise group (intra-inter business collaboration); industry associations, and industry standards. Traditional KIBS reported higher perceived value from intra-business collaboration.

When we considered collaboration for innovation beyond the triple helix actors, then enterprises reported collaboration within businesses, industry associations and industry standards as the most important actors.

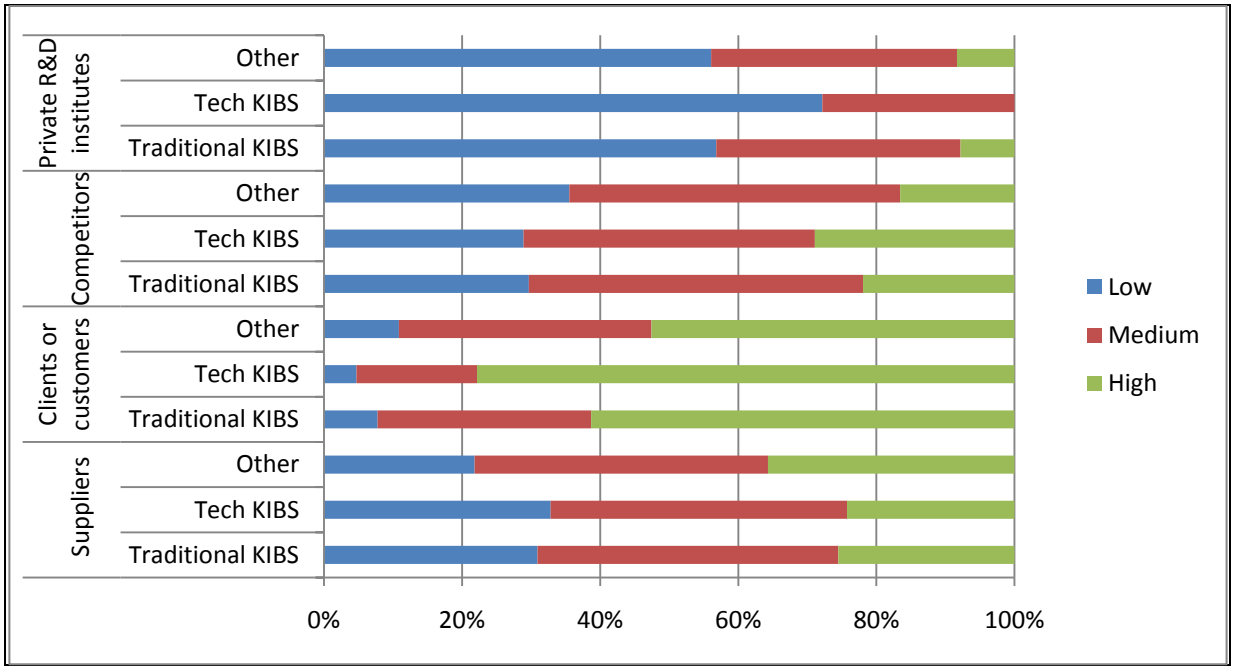
Figure 4: Collaboration for innovation outside the triple helix spheres




Source: ONS UK Innovation Survey 2009

The importance of clients or customers for innovation was depicted within all sectors. Tech KIBS value this source for innovation as the highest one, when compared to the other sectors. The importance of competitors as source of innovation is acknowledged within all three sectors. Concluding, private R&D institutes seem to be of less importance as source of innovation when compared to the previous ones.

Figure 5: Collaboration for innovation




Source: ONS UK Innovation Survey 2009

The above figure provides an overall picture for the businesses in the UK (as for the specific sample group that we have selected, addressing the nine sectors only. Next we provide further evidence but this time we provide further for a less competitive[47] and peripheral region, that

[47] For the *UK Competitiveness Index*, see Huggins (2010).

of Wales. The results are presented in such a way that allows the reader to easy compare among sectors (three grouped ones and among regions as well).

### Triple Helix Metrics

Government, public research institutes, universities, higher education institutions, can support enterprises in improving innovation in a number of ways. There can be important input towards facilitating the enterprise to access knowledge, build innovation and commercialise innovation. These can be captured and therefore measured with three metrics as proposed below. We build the *triple helix metrics* as follows. We categorise *accessing knowledge*, *building innovation* and *commercialising innovation* into triple *helix metrics*. Then we fit the a) 'use of external partners in accessing knowledge' into accessing knowledge category; b) 'use of external partners in building innovation' into building innovation category; and c) 'use of external partners in commercialisation' into commercialising innovation category.

Figure 6: Triple Helix Metrics

| TRIPLE HELIX METRICS | | | |
|---|---|---|---|
| **Categories** | Accessing Knowledge | Building Innovation | Commercialising Innovation |
| **Attributes** | Universities and HEIs in accessing knowledge | Universities and HEIs in building innovation | Universities and HEIs in commercialisation |
| | Government in accessing knowledge | Government in building innovation | Government in commercialisation |

Source: Developed by the author. Categories and attributes derived from NESTA Innovation Index. Roper, S., Chantal, H., Bryson, J. R., & Love, J. (2009). Measuring sectoral innovation capability in nine areas of the UK economy, ***Report for NESTA Innovation Index Project***: pp. 1-86. London: NESTA.

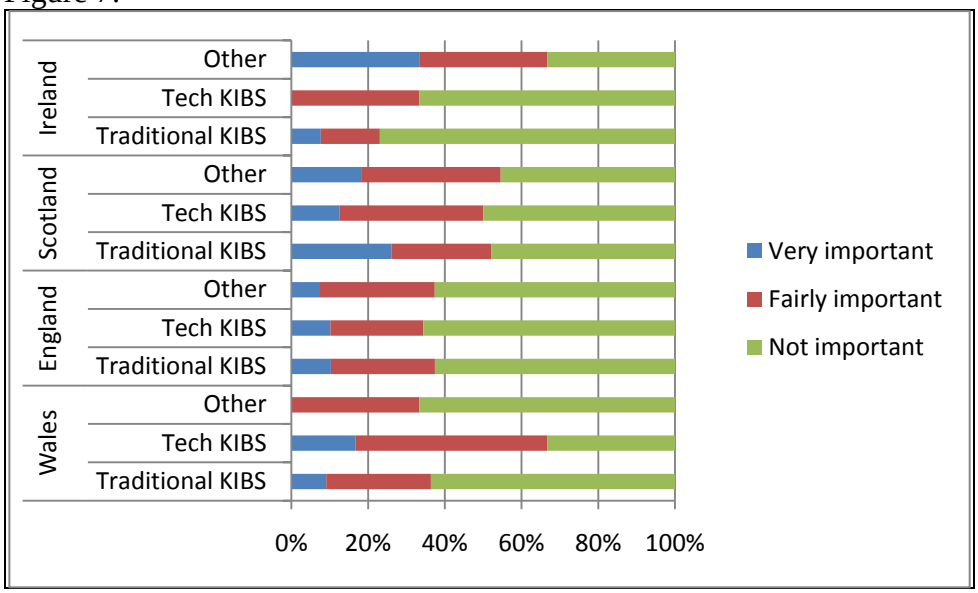
**Accessing knowledge**

This category indicates the perceived importance of universities and government in supporting enterprises in accessing knowledge.

<u>Universities and HEIs in accessing knowledge</u>

Firms were asked to indicate how important universities are as a source of ideas and information needed to develop new or improved products, services, or processes. Figure 7 shows the percentage of firms that indicated the university source as being "very important", "fairly important" or "not important". Within all three sectors, firms were consistently reporting as "not important" sources of ideas and information obtained from universities This holds for all four regions as well.

Figure 7:

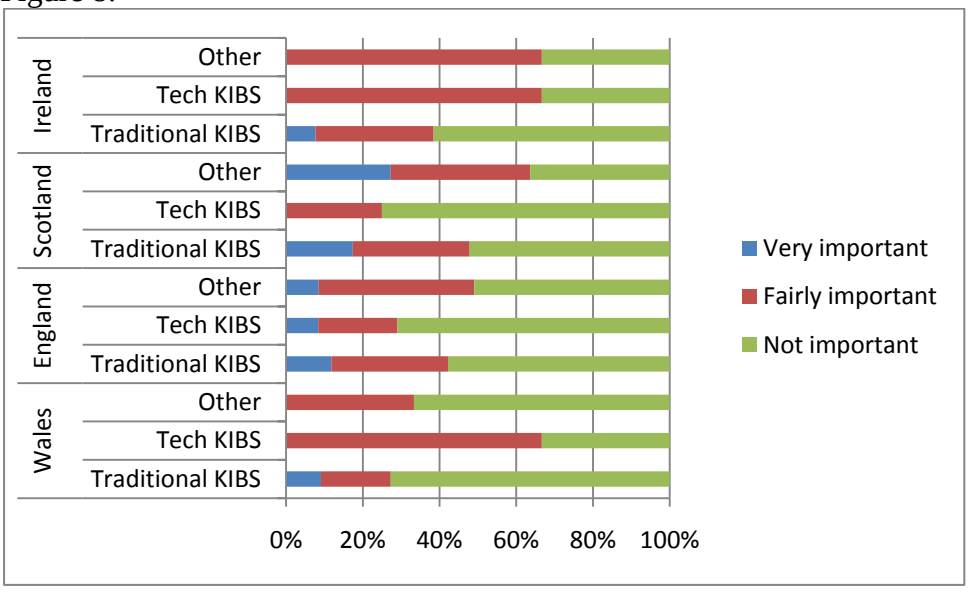



Source: NESTA Innovation Index.

Government or public research institute in accessing knowledge

Firms were asked to indicate how important government or public research institutes are as a source of ideas and information needed to develop new or improved products, services, or processes. Figure 8 shows the percentage of firms that indicated government source as being "very important", "fairly important" or "not important.

Figure 8:



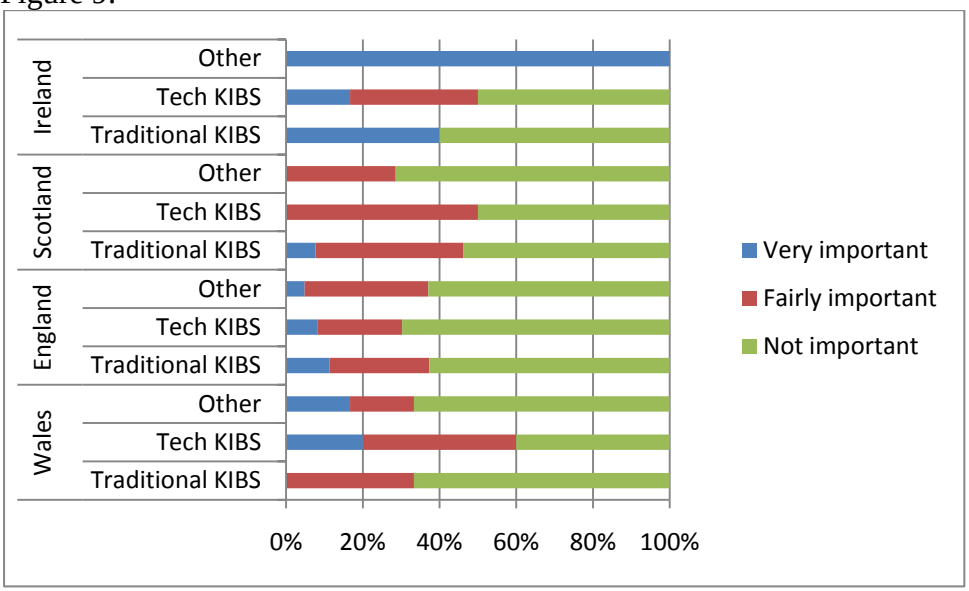

Source: NESTA Innovation Index.

**Building Innovation**

Universities and HEIs in developing innovation

Firms were asked to indicate how important universities have been in helping to develop new or improved products, services, products and services or processes. Figure 9 shows the percentage of firms that indicated collaboration with universities in helping to develop new or improved products, services, processes as being "very important", "fairly important" or "not important. Within all three sectors, and cross regional, universities have not been very important in helping enterprises developing innovation.

Figure 9:

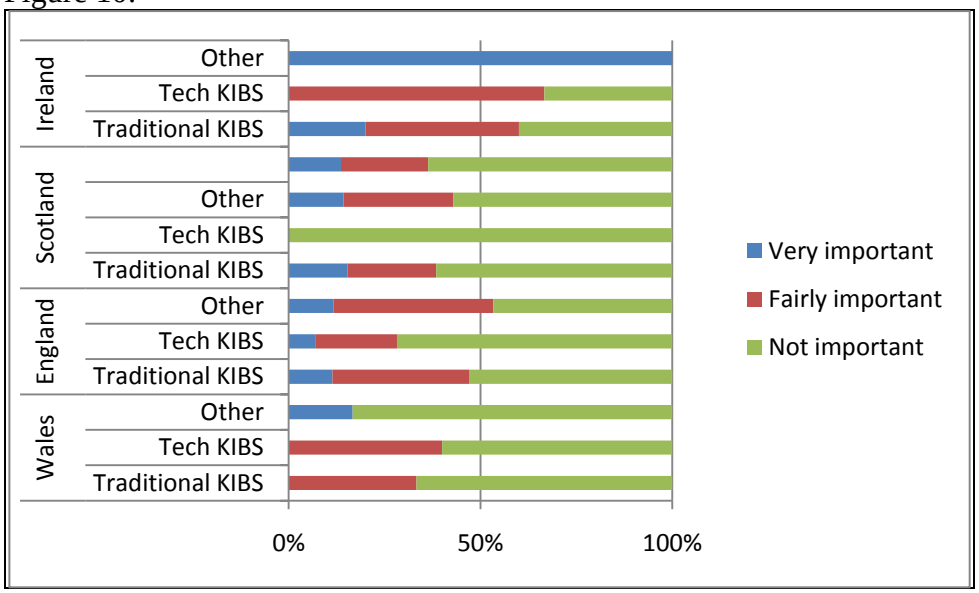



Source: NESTA Innovation Index.

Government or public research institutes in developing innovation

Firms were asked to indicate how important government and public research institutes have been in helping to develop new or improved products, services, products and services or processes. Figure 10 shows the percentage of firms that indicated collaboration with government and public research institutes in helping to develop new or improved products, services, processes as being "very important", "fairly important" or "not important. Within all three sectors, and cross regional, government or public research institutes have not been very important in helping enterprises in developi9ng innovation. Within the regional settings of Wales for example, neither Tech KIBS, nor Traditional KIBS indicated government support to be very important. However, when interpreting this figures caution needed, since the sample size is not large and therefore not representative. This is supported within the regional settings of Ireland. Sector Other had indicated the support from the government as being "very important".

Figure 10:




Source: NESTA Innovation Index.

**Commercialising Innovation**

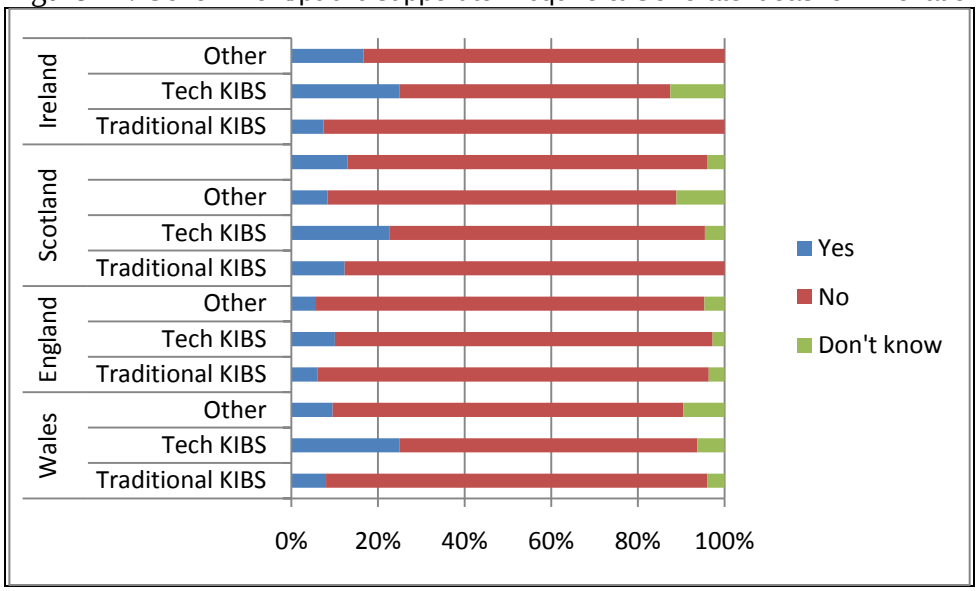
Within this attribute, NESTA Innovation Index does not directly address how important universities have been in helping firms to commercialising the new or improved products and services, or processes.[48] However, we addressed this is under the general attribute of *government and public support*. This is a rational decision given the fact that the majority of HEIs within the regions under study are public universities.

Within this attribute we explored further the government support into specific elements. That is, to what extent the government support the enterprises in order to acquire and generate ideas for innovation.[49] Firms were asked to indicate if they had received any public or government support to help acquire and generate the ideas and information needed to develop new or improved products, services and /or processes. Figure 11 shows the percentage of firms by sector and region that received public support in acquiring and generating ideas and information to develop innovation.

[48] Within the types of external partners that the study identified were: suppliers, competitors, dealer networks or agents, market research agents, advertising agencies, leasing companies, professional and trade associations (NESTA Innovation Index Report, p. 82).

[49] We believe that this is of great importance, especially in evaluating government innovation policies. So, the aim is in delivering not just financial support, but support around accessing knowledge, developing innovation and commercialisation.

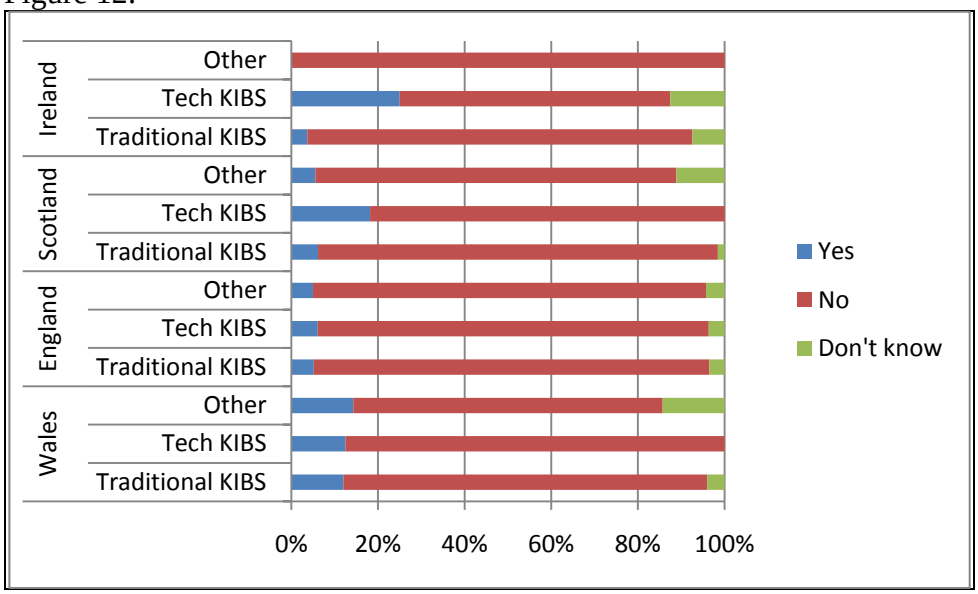
Figure 11: Government/public support to: Acquire & Generate ideas for innovation




Source: NESTA Innovation Index

Next, firms were asked to indicate if they had received any public or government support to help them use the new knowledge to create new or improved products, services and or processes. Figure 12 shows the percentage of firms by sector and region that received public support in helping the enterprise in using the new knowledge in creating new of improved products.

Figure 12:

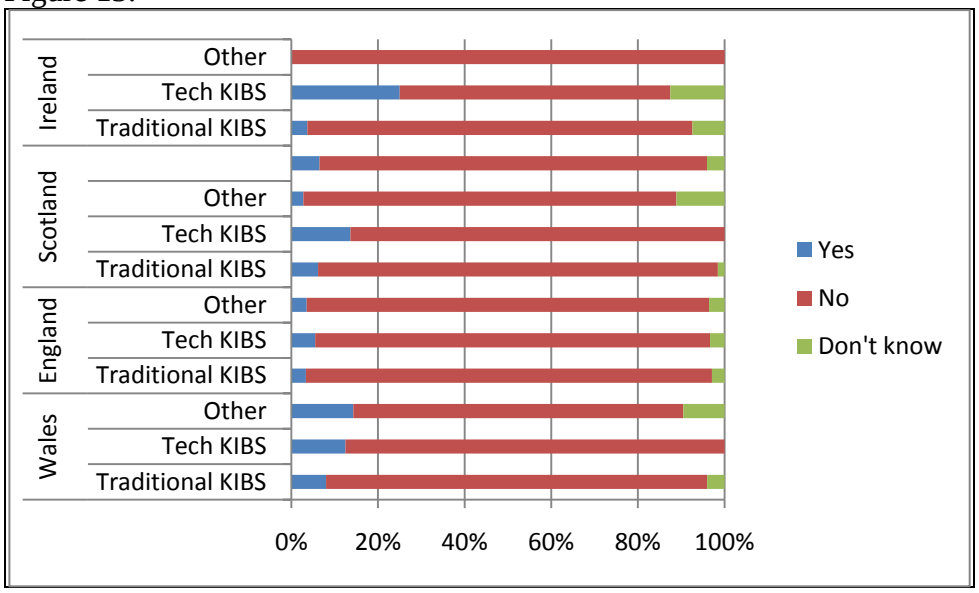



Source: NESTA Innovation Index.

Firms were asked to indicate if they had received any public or government support to help the enterprise to sell the new or improved products, services processes. Figure 13 shows the

percentage of firms by sector and region that received public support in helping the enterprise selling the new or improved products, services and or processes.

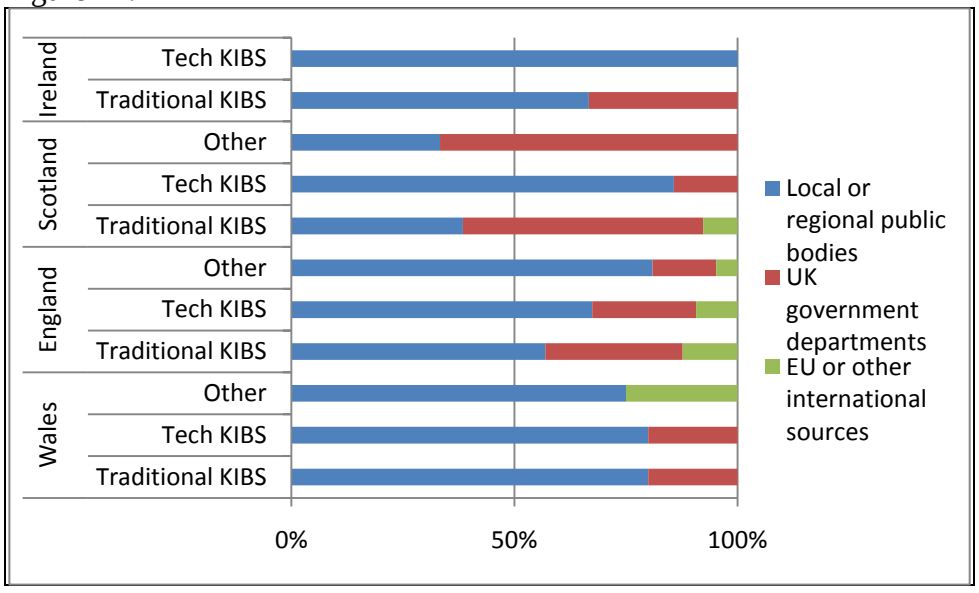
Figure 13:




Source: NESTA Innovation Index.

For those firms that had received public support they were asked to indicate the source of the support that is local or regional Government, central government or other European international sources. Results are shown in figure 14.

Figure 14:




Source: NESTA Innovation Index.

Firms in Wales co-operate and collaborate with various stakeholders. What is of importance though is the fact that the most frequent partners for collaboration were suppliers and clients/customers. The number of corporation partnership is lower for universities and

government or public research institute. Only a limited number of firms perceived the role of universities and government as important source for the innovative activities. This was the case across regions and sectors.
Tech KIBS firms tend to be the most innovative ones, and those firms are those that make the most out of the relationship with the triple helix actors. This holds for the regional dimension is introduced into the analysis as well.

The *triple helix metrics* methodology facilitate in defining the attributes that triple helix actors need to direct their efforts. This does apply for external partners, such as HEIs and government, but businesses as well. The former have been provided evidence within this essay. Regarding the later, NESTA Innovation Index provide evidence from the industry side, and in particular nine different sectors (Figure 1). For example, sectors that underperformed score low for all three metrics, that is: a) the ability to access knowledge, b) the building capability, and c) the commercialising capability (e.g. Accountancy sector). In contrast, sectors that over-performed such as IT and Software, within those sectors in contrary, innovative activity was above the average sectoral one, however, the variation among businesses within the sector was great. This can indicate that there is a scope for utilising knowledge within the sector (intra-sectoral innovation). And within those sectors (e.g. Accountancy and Legal services) that there was a low innovative activity and the variation among the firms was not that great, can indicate that there is a scope for utilising external knowledge – that is from different sectors (inter-sectoral innovation).[50]

Another aim of the triple helix metrics is to evaluate public policy – innovation policy as well as universities' contribution. From the evidence provided herein, both theoretical (from the literature) and practical (latest UK Innovation Survey) was to provide a tangible and objective way of evaluating. Whilst the scope herein was not to evaluate innovation policy of Wales, or UK, (this is work in progress) next we found it useful to provide evidence of what it is the priorities of HEIs in Wales. In particular, table 4 shows the economic development priorities for HEIs in Wales. As it can be seen, only 45 per cent of HEIs in Wales collaborate with industry and no more that 36 per cent support SMEs.

Now that we have looked the *business perspective*, it would be useful to see the HEI views. On the Higher Education Business Community Interaction (2008) survey, one of the questions that HEIs in Wales where asked was to indicate those areas that HEI as a whole is making the greatest contribution to economic development. The table below shows the percentage of HEIs in Wales and their economic development priorities.

[50] See NESTA Innovation Index, for further analysis of sectoral innovation.

Table 4: **Economic development priorities (percentage of HEIs)* 2006-07 & 2007-08**

| **Areas of activity: Wales** | **2006-07*** | **2007-08**** |
|---|---|---|
| Access to education | 64 | 45 |
| Meeting regional skills needs | 55 | 64 |
| Research collaboration with industry | 45 | 45 |
| Supporting SMEs | 36 | 36 |
| Graduate retention in local region | 27 | 27 |
| Support for community development | 27 | 9 |
| Attracting inward investment to region | 9 | 9 |
| Attracting non-local students to the region | 9 | 9 |
| Developing local partnerships | 9 | 9 |
| Spin-off activity | 9 | 9 |
| Technology transfer | 9 | 18 |
| Management development | 0 | 9 |
| Meeting national skills needs | 0 | 0 |

*Source: HE-BCI (2008, p.12). Respondents were asked to select the top three areas of priority in terms of making an economic impact. **Source: HE-BCI (2009, p.13). Respondents were asked to select the top three areas of priority in terms of making an economic impact.

Only one HEI in Wales indicated the knowledge transfer as one of the top three priority of making the greatest contribution to economic development. Within Wales, the Higher Education Funding Council for Wales' (HEFCW's) Third Mission Fund supports these interactions. The above table allows us to track any changes between the two reports (2006-07 and 2007-09). Whilst in 206-07 report HEIs in Wales were seeing access to education as the highest overall economic priority, this has fallen by around 20 per cent from the previous one. As for the 2007-08 period, meeting regional skills needs has become the highest priority. Overall though, three seems to be at the highest priority of HEIs in Wales, namely: access to education, meeting regional skills, and research collaboration with industry. However, only 45 per cent of HEIs in Wales had research collaboration with industry as a top three priority. It is interesting that there has been no increase whatsoever for 'research collaboration with industry' and 'supporting SMEs' during the above periods.

To conclude, with reference to Wales, one factor that could explain the weak interaction in terms of sources of knowledge for new ideas, development process, and commercialisations can be attributed to the fact that the economic priorities set by the HEIs in Wales. This paper puts forward that in order the two major actors (i.e. universities and government) to connect fully to the knowledge economy they need to fully address and further support industry, and especially SMEs in accessing knowledge for innovation, therefore become a source of innovation and not a barrier. Secondly, support the industry in the development of the new

ideas and processes services, and further support the firms to place any new innovations into the market and help the firm to commercialise those successfully.

Furthermore, policymakers tend to focus on the size of the firm primarily rather the firm dynamics (e.g dynamics within SME) that might have great potentials to grow. Recent research (NESTA 2009 on Business Growth) confirms that it is valuable that policy making to be directed towards those firms with highest potential to grow. [51] We propose that in order to maximise this likelihood, strengthening the triple helix relationships is of great importance. And one way of achieving that is directing the university and government support towards achieving *best fit* within the *triple helix metrics*.

## Conclusion and policy implication

This preliminary investigation aimed to indentify the role of universities and government in business innovation. This secondary data analysis thus provides valuable information for determining the role of the triple helix model of innovation within peripheral regions. Evidence shows that the inter-relationships between government, businesses and universities need to be further strengthened. This is confirmed by earlier studies using CIS data (e.g. Freel et al. 2009). Such results can be of importance for innovation policy makers. Higher education institutions and government/local authorities need to further develop the capacity to contribute more to the innovative activities of businesses in peripheral regions. Innovation is the only way forward for regional development.

Although universities have been found to be drivers of knowledge within Wales (e.g. Huggins et al, 2010), Welsh businesses perceive interaction with universities as sources of innovation to be of the least importance. Addressing this would be a small, but important step towards improving Welsh performance and offer important lessons for other lagging regions. This is directly linked with the Higher Education Strategy in Wales. The Minister for Children, Education and Lifelong Learning Mr Leighton Andrews (Andrews, 2010) highlighted the importance of innovation within peripheral regions. In particular, he added that:

> "We remain convinced that radical change to structure, organisation, and delivery is the only way to transform the impact of higher education on Wales's prosperity and well being."

Furthermore, policy makers should be aware of the wider innovation metrics beyond the conventional R&D spending and number of patents. Identifying and measuring sectoral and regional innovation via a *triple helix metrics*, as proposed herein, allow the policy makers to compare the levels of innovation capability and develop pertinent policies and strategies. Whilst our initial aim was to provide an account of the regional setting of Wales, the metrics developed herein, and based on the nine sectors that we were using data for, confirm that not only Wales, but other regions within the UK seem to have a weak performance based on the proposed triple helix metrics. The next step would be to model and test this proposition in a larger sample and in a number of different industries.

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[51] NESTA. (2009). *Business Growth and Innovation: The wider impact of rapidly-growing firms in UK city regions.* pp. 1-50. London: NESTA.

## Direction for future research

Triple helix dynamics are of great importance for enhancing innovation. Whilst herein we have provided evidence of a rather less strong links among the triple helix actors as measured using the metrics proposed herein, important recent initiatives have taken place. The most recent move towards this is the University of Wales' initiative in opening an office in Silicon Valley to support Welsh business have a presence in Silicon Valley.[52]

This paper adds to the debate and challenge of measuring innovation in peripheral areas by providing evidence from the peripheral region of Wales, but also some reference to other UK regions as well. However, this paper is not without any limitations. One limitation of this research is the use of secondary data only. Primary research, would further add to the dynamics of triple helix metrics. Another limitation of this study is that it provides evidence of triple helix metrics within particular sectors only. In addition, the validity of the *triple helix metrics* of innovation as proposed herein will be further enhanced by using a different sample frame and testing it in various regional settings (e.g. EU, USA, Asia) and utilise a representative sample from different industries in Wales and other regions within UK and internationally. Furthermore, using network analysis for mapping the strength of each sector would be a useful way forward.

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