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Regional Policy and University Knowledge Transfer: Perspectives from Devolved Regions in the UK

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Abstract

This paper constitutes a policy analysis of university knowledge transfer-related initiatives in the devolved regions of Scotland and Wales. Both regions are seeking to develop science-based innovation strategies in which universities play a central role. Scotland appears fairly well advanced in this regard, whilst in Wales the establishment of regional networks linking actors has been more problematic to establish. It is concluded that whilst devolution has facilitated significant supply-side intervention, future intervention will require a stimulus in the demand for university knowledge. Furthermore, policies will be required to pay more attention to the global environment within which knowledge flows.

Key words: devolution; knowledge transfer; knowledge commercialization; universities; Scotland; Wales.

Introduction

Recent political and academic discourse concerning *devolution* has tended to stress the economic advantages of the transfer of power from national to sub-national institutions, characterized as the ‘economic dividend’ of devolution (Rodríguez-Pose and Gill, 2005). In the UK context, devolution in Scotland and Wales since 1997, resulting in the establishment of the Scottish Parliament and the National Assembly of Wales in 1999, has introduced a partially devolved system of higher education, science and research. Although the divergence of higher education policies predates devolution in the UK, this has become more marked over the last decade (Universities UK, 2008). Nevertheless, it is notable that whilst some powers and responsibilities related to science and innovation policy are devolved to regional governments, national (and transnational) governments still tend to retain a significant influence.

National and regional debates on the role of regional science and innovation systems, and the role of universities and higher education institutions (HEIs), are intrinsically linked to these wider issues over governance and devolution, which constitute a multi-level governance (MLG) structure of science and innovation policy (Perry and May, 2007). The institutional multi-level dimensions of devolution processes conditioned by different forms of ‘economic governance’ (Jones et al., 2005; Cooke and Clifton, 2005; Goodwin et al., 2005) and knowledge transfer and exchange between different actors constituting innovation systems warrants further investigation and analysis. Knowledge transfer and knowledge exchange are seen as priority areas for research and innovation policy development (European Commission, 2007; ESRC, 2009). The effects of regional devolution on higher education, research funding and the

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3 management of knowledge transfer are a growing area of policy concern (Universities
4 UK, 2008). This paper focuses on Scotland and Wales, both of which have developed
5 distinctive institutional mechanisms as part of the political devolution process.
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10 The focus of the paper is primarily a policy level analysis of university knowledge
11 transfer activities and initiatives, and the extent to which these have been accelerated
12 by devolution. Scotland and Wales clearly have different histories and different
13 processes of devolution, and it is not the primary purpose of this paper to compare
14 these directly, but to use devolution as the backdrop for better understanding how
15 regional policy in relatively autonomous political settings can play a role in shaping
16 distinctive forms of intervention. The paper aims to highlight the different structures
17 and institutional mechanisms through which knowledge capabilities are constructed,
18 and identify different patterns of interactions through which innovation systems are
19 emerging.
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30 The paper seeks to address the following broad empirical questions: (1) To what
31 extent have policies and strategies for innovation and science, knowledge transfer
32 from HEIs in Scotland and Wales evolved post-devolution? (2) What are the main
33 initiatives, in terms of public policy programmes and resources, made available to
34 catalyze university knowledge transfer performance? and (3) In what ways have
35 processes of devolution impacted on the development of innovation systems in
36 Scotland and Wales respectively? By reviewing policy discourses and the
37 development of policy initiatives over the last decade, this paper critically examines
38 how empowered regional policy *should* and/or *could* facilitate more effective regional
39 innovation systems and also impact on the development of the knowledge transfer
40 performance of HEIs. Attention is drawn to the development of regional science and
41 innovation policies, and the strategies implemented by the two case study regions in
42 terms of mobilizing regional innovation and knowledge capabilities, and supporting
43 universities to effectively transfer their knowledge.
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56 The paper is structured as follows. The second section provides a review of the
57 literature and presents our conceptual framework concerning 'multi-level governance
58 relations' of science and innovation policy associated within a regionally devolved
59 context. The sections following the literature present an analysis of developments in
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Scotland and Wales largely based on the key concepts and issues raised by the study, namely: governance and regional devolution; regional innovation and science policy; the characteristics of the university sector and university knowledge transfer policies; the evolution of policy; the role of complementary innovation infrastructure; and the relative 'performance' of universities in terms of knowledge transfer. The final section discusses the findings from a theoretical perspective by critically examining the university knowledge transfer in the regional policy framework. The paper concludes with issues for future research concerning the development of regional innovation systems and key policy implications.

Governance and the Regionalization of Innovation and Science Policy

In recent years, both policy and academic attention have been drawn to the processes of globalization, the rise of knowledge-based economy, and the 'hollowing out' of the state (Jessop, 2004), with the growing significance of city-regions (Scott, 2001; Turok, 2008) and of locality and spatial proximity in economic development and innovation processes (Huggins and Izushi, 2007). Science policy has not traditionally been considered a 'legitimate policy target of devolution and regionalization processes', whereas the division of responsibility over innovation and technology policy seems to be more complex (Perry and May, 2007, p1042). Although some powers and responsibilities related to science and innovation policy are devolved to regional governments, national (and transnational) governments still tend to retain significant influence, especially with regard to the social shaping of the 'national science base' (Pavitt, 1998). The power structures in which these institutions interact affects how innovation systems operate regionally and nationally in the globalizing knowledge economy (Kitagawa, 2007).

In many regions, universities are viewed as the core of the knowledge base and at the heart of the knowledge economy, acting as key elements of innovation systems, supporting science and innovation-based regional growth (Huggins et al., 2008). Consequently, university-industry interactions often seem to have been 'subsumed into broader analytical and normative policy debates' concerning innovation and local and regional development (Srinivas and Viljamaa, 2008). To be effective, policy initiatives to promote regional innovation require detailed knowledge of the locality and the engagement of a range of regional and non-regional actors. However, as

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3 Chatterton and Goddard (2000) argue, the issue of territoriality is not so
4 straightforward for universities. To begin with, three spatial levels of activities can be
5 distinguished in the higher education landscapes, namely, international, national and
6 regional/local. These three levels are not exclusive but complement each other.
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12 Today universities virtually always hope to be part of 'an international knowledge
13 network', but increasingly even the most traditional and prestigious ones look to their
14 region and locality for support, and also claim credit for adding to the area's economic
15 and social strength (Lawton Smith, 2007; Kitson et al., 2009; Huggins et al., 2008).
16 For example, universities have an important role to play in preserving local jobs,
17 diversifying the local economy and attracting inward investors. Universities as
18 knowledge infrastructures affect the knowledge flows between themselves and other
19 institutions and actors at different geographical scales. The internationalization of
20 university-industry relations has been rapidly developing, and as Etzkowitz (2002)
21 argues 'the triple helix' interaction between university-industry-government is a move
22 towards a new global model for the management of knowledge and technology, where
23 an internationalization strategy emerges within domestic policy structures. In this
24 context, one could argue that universities may fulfill a useful role in blurring the line
25 between these different levels by 'regionalizing' world class and small high
26 technology firm relationships, and by making knowledge available to actors whose
27 innovative locus is much more regional in character.
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42 Nevertheless, in order for regions to operate through global network nodes, and as
43 part of a global-regional innovation system, communities surrounding universities
44 need to have the capability to absorb and exploit the science, innovation, and the
45 technologies generated by the universities (Florida, 1999). There are often
46 considerable differences in the capability of universities to effectively transfer their
47 knowledge, and of regional businesses to effectively absorb such knowledge
48 (Huggins, 2008). In general, firms and regions are better placed to innovate if they
49 have built up 'the right resources and capabilities' (Driver and Oughton, 2008). This
50 process is also conditioned by structural, institutional and social factors that interact
51 within regions (Boucher et al 2003), and the articulation of regional policies and the
52 ability of universities to effectively mobilize stakeholders for innovation (Uyarra,
53 2010). Therefore, any regional innovation system development needs to be seen as
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3 part of the 'co-evolution' process between 'global and national structures' and
4 'global-national-regional interactions' (Sotarauta and Kautonen, 2007). Whilst
5 recognizing the multi-spatial context within which innovation actors are embedded, in
6 this paper we seek to concentrate on how policy influences the regional segment of
7 interaction between innovation actors, especially universities. In other words, and as
8 Figure 1 presents, we seek to examine the extent to which regional science and
9 innovation policies in devolved regions have embraced 'regional' university
10 knowledge transfer policies as means of building their regional innovation systems.
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Figure 1 About Here

In general, although there is recognition that universities are potentially key players in achieving economic transformation, the underlying policy perspective is that they are often under-utilized. In the field of higher education, UK policy over the last decade has witnessed a growing alignment between the 'third stream' activities of universities and regional economic development (NCIHE, 1997; Charles, 2003; Goddard and Chatterton, 1999). Indeed, recent years have witnessed a plethora of policy interventions highlighting both national and regional government commitment to science and technology, and the importance of the higher education sector in achieving a step change in the UK's innovation performance by facilitating the growth of the knowledge economy. The last decade has witnessed the transfer and commercialization of university-generated knowledge taking a stronger role within government policies at a number of levels (Lambert, 2003; Sainsbury, 2007; Wellings, 2008; Kitson et al. 2009).

It has been pointed out, however, that there is a still a lack of understanding of how to create effective impacts through knowledge transfer from universities, and the role of regions as part of these processes (Porter and Ketels, 2003). Also, there has been little systematic analysis of differences in the relative contribution of HEIs and their knowledge across UK regions (UNITE Network, 2006; Huggins and Johnston, 2009). There are considerable differences in capabilities across regions and firms to 'effectively absorb knowledge' from universities (Huggins et al., 2008). Furthermore, the recent Sainsbury Review identified the complexity and fragmentation of the mechanisms for knowledge transfer and exchange as a barrier to business engagement.

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5 There has been a growing evidence base, both in the academic literature and policy
6 documents, indicating that economic development and the welfare of regions can be
7 enhanced through universities' various engagement with the local economy, including
8 research, infrastructure development, education, effective industry-university
9 partnerships, technological innovation and community development (Kelly et al.,
10 2002; Universities UK/HEFCE, 2001; Benneworth and Charles, 2005; Lawton Smith
11 and Bagchi-Sen, 2006; Huggins et al., 2008; SURF et al., 2006; Kitson et al., 2009).
12 An emerging policy concern seems to be 'the need to align or match regional
13 knowledge producing networks with regional firms' (Uyarra, 2010). However, recent
14 work has also begun to question the high level of policy expectations, with little
15 understanding of the actual processes of knowledge flows, and the extent to which
16 regional economic development can be actually achieved through the utilization of
17 university knowledge (Power and Malmberg, 2008; Huggins, 2008).
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30 Moreover, there is a lack of clear understanding of the influence of devolution
31 processes on regional knowledge flows from universities. These processes are
32 conditioned by a number of factors including the size of the region; the nature of the
33 regional scientific infrastructure; the types of firms and structure of the industrial
34 base; the scientific/technological fields of importance in regions (Crespy et al., 2007),
35 and the institutional multi-scalar dimensions of governance processes. Devolution,
36 defined as 'the relative transfer of power and responsibility from the nation state
37 downward to other units of government and governance' (Jones et al., 2005, p.398),
38 adds further to the dynamics of institutions in the regional science and research
39 landscape, and opens up a number of issues concerning power-relations, different
40 forms of economic governance and public policy. As pointed out by Jones et al (2005)
41 and other contributors in the special issue on devolution and economic governance in
42 *Regional Studies*, the structures and strategies of devolved economic governance are
43 interrelated in a complex way (Jones et al., 2005), shaped by patterns of
44 intergovernmental interaction and existing governance structures between national
45 and sub-national actors. For instance, when comparing economic development
46 financing and devolved state action across the UK, Cooke and Clifton (2005) identify
47 emerging and different 'institutional structures of economic governance'.
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A burgeoning literature has emerged on sub-national governance in an attempt to interpret these developments (e.g. Keating, 1997; 2005; Pike and Tomaney, 2004, 2009; Jones et al., 2005; Lobao et al., 2009). One of the central questions for regional policy in the devolved policy context in the UK is ‘whether there is sufficient fiscal decentralisation and capabilities within the regions for regional governance structures to promote growth and convergence’ (Frenz and Oughton, 2005). Devolution in Scotland and Wales has introduced a partially autonomous system of higher education, science and research, whilst the situation for the English regions - without an elected regional government structure - remains ‘fluid and variable’ (Perry, 2007). In England, with the establishment of Regional Development Agencies (RDAs), ‘central government-sponsored regionalism’ and ‘politicization of economic governance’ (Jones et al., 2005) co-exist with processes concerning the ‘territorialization’ of higher education, specifically at the regional level (Warren, et al., 2010).

Methodology and Evidence Base

The methodology underlying the remainder of this paper takes a mixed methods approach, combining qualitative and quantitative data collection and analysis. The qualitative component relates to a content review of policy documentation emanating from the devolved administrations in Scotland and Wales, as well as the agencies of these administrations. In the main, this documentation relates to the public policy strategies concerning economic development, higher education, science and technology, innovation, and the knowledge economy. In line with the framework indicated by Figure 1, the documents were reviewed to ascertain the underlying policies and strategies relating to university knowledge transfer and university-industry interaction, or the extent to which university knowledge transfer and university-industry interaction activities form a component of associated regional strategies. This process provided a systematic means of building an evidence base concerning the appropriate policies being formulated in each region following the initiation of political devolution.

The quantitative component relates to the collection and analysis of university-level information concerning general financial data, as well as more specific data on the income received by universities for knowledge transfer and commercialisation

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3 activities. At the outset we seek to analyse the value added generation by each
4 university in the UK, with a view to aggregating this data at a regional level, in order
5 to ascertain any regional differences, which are presented in Table 1. As a means of
6 achieving this we utilise a consolidation of the annual financial accounts of all
7 universities in the UK made available by the Higher Education Statistics Agency
8 (HESA) relating to overall income, expenditure, and employment data, which allows
9 us to calculate the value added generated by each university, and therefore the
10 contribution of the university sector in each region to total regional Gross Value
11 Added generation. In a corporate context, value added is the wealth created by a firm,
12 which can be measured in a number of ways, but generally reflects sales less costs of
13 bought-in goods and services. Specifically, firm-level value added can be calculated
14 from a company's accounts by adding together operating profit, employee costs,
15 depreciation, and amortisation and impairment charges. Applying a similar
16 methodology, we calculate university value added by adding together surplus,
17 employee costs, and depreciation. This allows us to gauge regional differences in
18 university wealth-generating capacity.
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33 The methodology for analysing the knowledge transfer and commercialisation (KTC)
34 income received by universities consists of an evaluation of secondary data sourced
35 from the annual Higher Education and Business Community Interaction Survey
36 (HEBCIS) which is made freely available by the Higher Education Funding Council
37 for England (although the dataset also covers institutions in Northern Ireland,
38 Scotland, Wales, and Northern Ireland). The HEBCIS dataset covers all universities in
39 the UK and consists of a number of indicators relating to knowledge transfer and
40 commercialisation indicators. In this paper we draw of these metrics to assess how
41 universities in Scotland and Wales are performing regarding their knowledge transfer
42 and commercialisation activity. This is largely based on the income universities
43 receive as a result of undertaking these activities including that received from
44 collaborative research involving both public funding and funding from business,
45 contract research, consultancy contracts, facilities and equipment related services,
46 courses for business and the community, and IP income from patent and licensing
47 activities. In the analysis presented in this paper (Tables 2-4) knowledge transfer and
48 commercialization (KTC) income is defined as including (figures in the parenthesis
49 are the percentage of income by type covering total KTC income across the UK
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3 higher education sector):collaborative research (28.3%), contract research (33.2%),
4 consultancy contracts (12.2%), facilities and equipment related services (3.9%),
5 courses for business and the community (20.6%), and IP income (1.7%). This
6 methodology provides us with as robust as possible an evidence base concerning the
7 relative engagement of universities in KTC activity, at least based on the income
8 received for such activity.
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15 16 **Governance and Regional Devolution in Scotland and Wales**

17 The Scottish Government was established in 1999 as the Scottish Executive, from the
18 extant Scottish Office. Following the 2007 Scottish Parliament election, the Scottish
19 Executive was renamed as the Scottish Government by the new Scottish National
20 Party administration. Scotland has a long-established regional development agency
21 (Scottish Enterprise) established in 1991, combined with a ‘world-class research base’
22 (Lyll, 2007). In 2005, Higher Education expenditure on R&D (HERD) was £688
23 million. Scotland's HERD as a percentage of GDP ranked top out of all the UK
24 regions. However, there has been a significant gap in business R&D expenditure
25 between Scotland and the UK and the OECD averages (Scottish Government 2008a).
26 Scotland is also characterized by ‘low levels of connectivity between knowledge
27 generating and applying organizations’ (Roper et al, 2006).
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38 Scotland was the first region in the UK to seize the opportunity to develop a regional
39 science policy. The regional science policy model in Scotland is promoting new
40 *institutionalized* strategies of universities and the funding council, including
41 knowledge exchange activities and strategic approaches to research funding and
42 resources in order to compete in a globalizing knowledge economy, with an increased
43 emphasis upon their regional policy agendas through the devolution processes. In *A*
44 *Smart Successful Scotland* (Scottish Executive, 2001a), three key themes are
45 identified: (1) Growing Businesses; (2) Ensuring Global Connections and (3)
46 Enhancing learning and skills of Scots. A “Global Connections Strategy” (Scottish
47 Executive, 2001b) sets out Scotland’s strategic direction for taking advantage of the
48 opportunities in the knowledge economy and ensuring that Scotland is a globally
49 integrated economy.
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4 In Wales, the National Assembly for Wales became operational in 1999. The National
5 Assembly has responsibility for developing economic policies within the context of
6 central UK policy frameworks, giving policy makers in Wales more autonomy than
7 before. Of the twelve regions in the UK, Wales is the least competitive with the
8 exception of only North East England (Huggins and Izushi, 2008). It has the lowest
9 level of Gross Value Added per Capita of all UK regions, coupled with levels of pay,
10 productivity, employment and economic activity that are all significantly below the
11 UK average. A lack of regional innovation is identified as a major barrier restricting
12 the growth of the regional economy, which is manifested by relatively low levels of
13 investment in R&D.
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23 The Welsh Assembly Government's Action Plan for Innovation (WAG, 2002) was
24 one of the first post-devolution policy documents to outline an innovation strategy,
25 with particular emphasis given to the development of incubator facilities through the
26 'Technium' initiative. Ten Techniums were established throughout Wales housing the
27 full range of incubator support services, and through a combination of specific and
28 non-sector specific incubators they have been designed to allow a balance between
29 clustering and broader networking. The management of seven of the Techniums
30 involves Swansea University, and links with regional academia are considered key to
31 their potential success. Techniums are a key strand of the region's economic
32 development and innovation strategies. This has ensured support from the highest
33 levels of government and academia. The long-term goal for the Techniums is for them
34 to be the foci across Wales for innovation in the knowledge-based industries.
35 However, in some ways, government intervention in the area of university knowledge
36 transfer Wales did not radically alter until 2008-09 (this is discussed in more detail
37 below).
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51 **Regional Innovation and Science Policy**

52 In the field of science, technology and innovation policy, the Scottish Parliament
53 inherited 'both a suite of existing UK policies and also a distinctive Scottish trajectory
54 in regional innovation policy and economic development', characterized as
55 'concurrent power' (Lyall, 2005). In January 2001, the Minister of Science published
56 *A Science Strategy for Scotland* (Scottish Executive, 2001c). The Science Strategy
57 stresses the need to maintain a strong science base and increase the effective
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3 exploitation of scientific research. This resulted in increased resources for university
4 science as well as increased funding for knowledge exploitation initiatives such as the
5 Proof of Concept awards and Royal Society of Edinburgh (RSE) Enterprise
6 Fellowships (Lyll, 2005).
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12 A key recent policy development in Scotland is that of 'research pooling'. This is a
13 regional response to create 'international research excellence' by 'pooling' specific
14 areas of research excellences that are seen to be of strategic importance to Scotland
15 across universities in the region. The development of 'research pooling' initiatives is
16 interesting against the background of devolution as well as the globalization of
17 science, technology and innovation policy on the one hand, and changing higher
18 education policies and environment in the UK on the other (Kitagawa, 2009).
19 Research pooling initiatives may be seen as strategic instruments to enhance research
20 capacity and competitiveness of both universities and the region (and sub-regions),
21 attracting students and professors from abroad, and fostering links to global
22 knowledge flows. ScotCHEM, one of the research pooling initiatives funded by SFC
23 and the universities in Scotland, has developed an industry-led collaboration between
24 the universities involved in the research pooling and the chemical industry sector. In
25 the first year, this will fund 31 industry PhD studentships in chemistry to be hosted in
26 small and medium sized enterprises (SMEs) within Scotland's chemical industry
27 sector.¹
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42 Even prior to pre-devolution, there has been a strong policy focus from the Scottish
43 Government, for agencies to 'work in partnership with the universities and research
44 institutes to identify and to help take forward promising new commercialization
45 opportunities as they emerge from the research base' (Reeves et al 2009). These
46 agendas were further developed by the new administration in 2007 as part of the
47 Government Economic Growth Strategy (GES), which sets the target to raise
48 Scotland's GDP growth rate to the UK level by 2011 and to match GDP growth rate of
49 the small independent EU countries by 2017. The recent publication by the Scottish
50 Government of 'Science for Scotland' (2008b) further endorsed the promotion of
51 commercialization from research bases. The Scottish Government sees the
52 contribution of higher education sector in Scotland as 'a sector in its own right' and
53 higher education has been identified as one of the seven key sectors of the Scottish
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economy. There has been a growing commitment to knowledge exchange from academic sector, promoted by the funding council. The Scottish Government has acknowledged that knowledge exchange can and should be used to improve Scotland's social and economic well-being (SFC, 2007).

In Wales, alongside the Technium programme policy intervention has further supported and encouraged commercialization developments through the Wales Spin-Out Programme, which concentrates on the development of arrangements designed to create high quality businesses from the higher education sector. Complementary to the Spin-Out Programme, the 'Know How Wales' initiative, launched in 1999, provides a gateway to university facilities and expertise for existing companies seeking assistance to expand or establish new products and markets. The Lambert Review (Lambert, 2003) identifies the role of Know How Wales as good practice in linking business and academia. In 2001, the Knowledge Exploitation Fund (KEF) was launched to work within the Welsh university community (and further education institutions) to 'generate a more entrepreneurial and innovative culture; produce more skilled trainers; increase the training interaction with Welsh industry and accelerate the commercial exploitation of research'. KEF had an annual budget of £16 million including European Structural Funds support (WAG, 2004).

In general, university knowledge transfer in Wales has formed a key strand of innovation and science policy, and probably more so than in Scotland. A key reason underlying the focus on universities as agents of knowledge transfer is that Wales only has two public sector research establishments: the Institute of Grassland and Environmental Research (IGER) at Aberystwyth, and the Centre for Ecology and Hydrology (CEH) at University of Wales, Bangor. The Science Policy strategy for Wales was not published until (WAG, 2006), with it stating that: 'no one now builds new government research establishments...It may be a regrettable situation but it is a situation which has to be faced.' (p. 4). However, the coalition Welsh Assembly Government of Labour and Plaid Cymru established in 2007 resulted in a reversal of this view, with the WAG stating 'we will work to establish a National Science Academy...we will establish new National Research Centres. (WAG, 2007, p. 25). However, despite the pronouncements apparent development of such an academy and research centres have been to slow to emerge.

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5 Indeed, the indications are that rather than new funding being made available, finance
6 will consist of that already allocated by WAG. For instance, more than £3 million is
7 due to provided to a number of Welsh universities to establish a Wales Institute of
8 Visual Computing (WIVC) with the aim of developing an internationally-leading
9 research capacity. Although this is applauded, it would be appear that connecting
10 universities strengths is something which should be additional to, rather than instead
11 of, proposed new knowledge and research infrastructure funded thorough already
12 allocated finance. This has led some to claim that ‘by seeking to develop a Knowledge
13 Economy ‘on the cheap’, the Assembly Government risks losing out to competitor
14 economies across Europe and within the UK’ (HEW, 2008).
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25 **The University Sector**

26 In Scotland, there are 20 universities and higher education institutions, which are
27 funded by SFC. Scottish universities are generating significant income from
28 knowledge transfer activities. In the two year period between 2005 and 2007, the total
29 reported income from knowledge exchange activities amounted to £583 million,
30 consisting of external research grants, contracts and consultancy (64%), licensing
31 (4%), venturing (8%), enterprise (2%), CPD (18%) and outreach (4%) (Scottish
32 Government, 2008c). The Scottish Funding Council (SFC) was established in 2005
33 by combining the roles of the former Scottish Further Education Funding Council
34 (SFEFC) and the Scottish Higher Education Funding Council (SHEFC). SFC invests
35 more than £1.7 billion in 2009-10 in universities and colleges in Scotland. For
36 universities, allocations are split into two main elements: a *Horizon Fund* for
37 investments in ‘projects that are intended to bring economic, social, cultural and other
38 benefits to Scotland, which includes funding in support of knowledge exchange; and a
39 *General Fund*, which provides universities with a flexible funding stream to support
40 their core activities of teaching, research and knowledge transfer’ (SFC, 2009). SFC
41 adopts a broad view to knowledge transfer, more frequently referred to as ‘knowledge
42 exchange’, which includes public engagement, cultural engagement and public policy
43 as well as commercialisation and technology transfer. Funding for knowledge transfer
44 (£25 million per annum) has been income metric-led with a growing strategic element.
45 SFC’s new Horizon Fund² will mean that the strong majority of funds will be project-
46 based including a new SFC Innovation Voucher Scheme.
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5 The higher education sector in Wales consists of 11 institutions (previously 12, until
6 the merger in 2007 of the Royal Welsh College of Music and Drama). The annual
7 economic contribution that Welsh universities make to the regional economy is
8 estimated to be more £2 billion, when direct and indirect effects are taken into
9 consideration, supporting over 23,000 jobs (HEW, 2009). The university sector is by
10 far the major producer of R&D in Wales, with Cardiff University spending the
11 majority of the total university R&D expenditure. In general, there has been little
12 history of interaction between the higher education sector and businesses in the region,
13 with universities often targeting large-scale industrial research projects rather than
14 providing services for SMEs in their localities, which is often considered by
15 universities to be non-cost-effective in comparison to working with large firms.
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26 In general, higher education policy in Scotland is largely devolved, while in Wales
27 powers over higher education are devolved to the Welsh executive body, the Welsh
28 Assembly Government, but not until now to the National Assembly for Wales,
29 although this could happen in the future (Universities UK, 2008). In general, a key
30 concern for the devolved administrations is that despite increased autonomy, the
31 nature of geographic variations across the UK in the demand for higher education
32 mean that English universities are becoming markedly better funded in comparison to
33 institutions in Scotland and Wales. This is especially pronounced in Wales, which still
34 does not have full legislative power for the higher education sector, where the
35 investment gap with England has been estimated to be of the order of £60 million
36 annually (Universities UK, 2008).
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48 More specifically, the funding bodies in the devolved administrations (e.g. SFC in
49 Scotland and HEFCW in Wales) have recognized the impact of the concentration of
50 research funding in a few institutions in England on their institutions' competitive
51 ability to bid for those research funds available on a UK-wide basis (Universities UK,
52 2008, p.47). The UK Government's policy to shift research funding to a fewer number
53 of departments is likely to lead to a major redistribution of research activities and to
54 bring about highly differential effects (Universities UK, 2003). In England, as a result
55 of its funding mechanisms, there has been a growing concentration of research
56 funding in a few institutions such as Cambridge and Oxford Universities, and Imperial
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3 College, further intensifying resources in the so-called “golden triangle”.
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5 Consequently, there is growing ‘variability’ in the capability of universities to conduct
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7 research and to transfer knowledge in their regions and beyond (Huggins, 2008). This
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9 conditions not only on institutional research profiles but also regional research
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11 capacity and diversity.

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14 Table 1 highlights the value added per employee by universities in the UK aggregated
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16 at a regional level. Significantly, average value added per employee for universities in
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18 both Scotland and Wales is less than the overall UK average. The final column of
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20 Table 1 indicates the relative contribution of GVA generated by the higher education
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22 sector to regional GVA as a whole. Across the UK’s regions, the higher education
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24 sector in Wales is the biggest contributor to regional GVA, providing 1.36% of total
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26 regional GVA. The contribution of the higher education sector in Scotland to regional
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28 GVA is also above the UK average, but it is considerably less than that in Wales.
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30 These differences have a clear bearing on policies promoting the role of universities
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32 as catalysts of economic development. In particular, it suggests that while the more
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34 competitive regions may be able to benefit from being the home of the majority of the
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36 UK’s most prestigious and wealthiest universities, more lagging regions - such as
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38 Wales and to a lesser extent Scotland - are likely to contain a greater concentration of
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40 institutions that are less able to compete in the higher education marketplace with
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42 their more prestigious counterparts.

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Table 1 About Here

University Knowledge Transfer Policies

Since its inception in 2001/2, Knowledge Transfer Grant (KTG) is the main funding stream for knowledge transfer/exchange in Scottish HEIs. In 2008-09, the KTG totaled £21.5 million for universities and £3 million for colleges. The grant supports the infrastructure universities and colleges need to maximise active knowledge exchange with third parties. Funding is largely allocated on the basis of the relative volume of income from knowledge exchange activity as measured by SFC’s metrics (HEFCE, 2008). Cullen (2009) argues that KTG has contributed to ‘a much greater awareness of KT, a much broader understanding of the range and objectives of KT and, importantly, an embedding of KT within the institutional strategy’. The SFC

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created a new strategic knowledge exchange grant in 2008-09 - the *Strategic Priority Investment in Research and Innovation Translation* (SPIRIT), and this will be set at £3.8 million in 2009-10 and will enable strategic knowledge exchange projects to be targeted. SPIRIT meets SFC's corporate plan objectives to 'improve the flow of knowledge, expertise and ideas, to businesses, enterprises and public services' and to 'work with key partners to develop knowledge exchange activities that enhance innovation in public policy and practice in Scotland and strengthen the policy community' (SFC, 2006). SPIRIT will facilitate a range of strategic knowledge exchange investments including projects of national priority as well as those prioritized by SFC.

In addition to KTG and SPIRIT, SFC also has a small grant which targets the promotion of knowledge transfer (PKT). The PKT grant (£470k in 2007-08) is used to promote good practice in, raise awareness of, and improve information about, research expertise, commercialization and knowledge exchange more generally. The grant funds initiatives such as Interface, Technology Ventures Scotland and Connect, as well as research and evaluations that provide an evidence base for policy development. Funded projects are often joint activities with other stakeholders recognizing that they sit at the boundary between the supply of, and demand for, knowledge and innovation support. For example, *Interface* – the knowledge connection for business – was set-up in 2005 and is funded by SFC. It is a central point of access for industry to Scotland's research base that provides a service designed to address the growing demand from businesses seeking to engage with academia for knowledge and expertise. SFC also funds the Scottish Institute of Enterprise (SIE), which aims to promote an entrepreneurial culture in higher education by providing opportunities for students and researchers to obtain business and management skills, and so enhance the contribution of higher education to growth in the economy.

Scottish Enterprise has taken several proactive approaches to strengthening the commercialization of the Scottish academic research base through initiatives such as the Intermediary Technology Institutes, the Enterprise Fellowship Programme and the Proof of Concept awards. These programmes were set up to address the gap between where Scotland has considerable strength in its science base but less success in

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3 commercialization (Roper et al., 2006; Lyall, 2007). In 1999, the Proof of Concept
4 Fund was established and provided £33 million of funding in 2004 available over a
5 six year period. When the Proof of Concept Programme was first established there
6 were no comparable initiatives within the UK or mainland Europe. Due to the
7 relatively weak business demand for state of the art research, it was considered to be
8 critical that new companies were created 'to ensure the most promising ideas
9 emerging from the research base are taken forward'. The Proof of Concept
10 Programme responds to this opportunity by providing funding support for technical
11 activity, protection of IP, market assessment and business model development
12 (Reeves et al., 2009). An independent evaluation undertaken in 2006 found that the
13 Programme generated £125 million gross value added (GVA) for the Scottish
14 economy.³

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27 The key post-devolution knowledge transfer and commercialization activities funded
28 in Wales included: Centres of Excellence for Technology and Industrial
29 Collaboration; the Wales Spinout Programme; a Patent and Proof of Concept Fund;
30 Collaborative Industrial Research Partnerships; Technology Transfer Networks, and
31 Technology Transfer Centres. University knowledge transfer policy in Wales is
32 supported via the Higher Education Funding Council for Wales (HEFCW)'s Third
33 Mission Fund, with the bulk of the funding allocated on a formula basis. From 2008, a
34 substantial increase in the support available for third mission activities has been
35 available via the Welsh Assembly, which was successful in attracting around £50
36 million from the European Regional Development Fund (ERDF) for two knowledge
37 exploitation and transfer programmes jointly branded as Academia for Business (A4B)
38 (HEFCE, 2008).

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49 This is a major policy overhaul with existing funded activities repackaged under the
50 two programmes: Knowledge Exploitation Capacity Development; and Knowledge
51 Transfer and Industrial Research. Overall, A4B is supported by a six-year £70 million
52 funding package from the Welsh Assembly Government and the ERDF. A4B is
53 advertised as consisting of 'the best elements' of previously funded programmes,
54 particularly the Knowledge Exploitation Fund and the Centres of Excellence. A4B
55 aims to support a range of activities in higher and further educational institutions to
56 develop more effective knowledge transfer mechanisms, to commercialize their
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3 Intellectual Property, develop new products and processes, increase business
4 investment in R&D and develop and exploit the research base. Key targets for A4B
5 are: to stimulate new business ideas and help launch as least sixty new products and
6 processes onto the market; act as a catalyst to leverage in an additional £9m of
7 funding into research projects and support more than 120 R&D collaborations; and
8 perhaps most ambitiously to help at least 2,000 businesses to benefit from
9 collaborating and working with universities.
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17 A leading example of knowledge transfer activity in Wales is Cardiff University's 10-
18 year £25 million agreement with Biofusion, a specialist commercialization company
19 listed on the London Stock Exchange's Alternative Investment Market (AIM), to
20 provide a ring-fenced fund to invest in companies spun out from the university's
21 research base. The Wales Gene Park initiative also successfully bid to become one of
22 six prestigious gene parks in the UK. Funded by the Welsh Assembly Government,
23 the UK Government and the NHS, the Park aims to exploit the bioscience expertise of
24 five Welsh universities. The first phase of this development, a virtual gene park, is
25 underway but funding issues appear to have somewhat dogged overall development in
26 light of those expected by the initiative's key players.
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37 The requirement to internationalize the knowledge networks of Wales' universities
38 has most been prominently recognized by the University of Wales federated
39 institutions through the introduction of The Prince of Wales Innovation Scholarship
40 Programme, which aims to 'attract the world's most talented graduates to work with
41 Welsh businesses'. The programme is seeking to recruit 1,000 of the world's best
42 graduates between 2009 and 2012 to help improve research and development
43 capability and cutting edge thinking in Wales. Also, an independent review of the
44 need to improve of the commercialization of the knowledge residing in Welsh
45 universities recommended the creation of advisory panels comprising experienced and
46 successful entrepreneurs, which are currently being piloted in three institutions
47 (Gibson, 2007).
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58 At the time of writing it is impossible to say whether or not the new policy approach
59 in Wales will be more successful than its predecessors, but the capturing of significant
60 European finance for these activities does provide a very real opportunity to develop a

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system of sustained and coherent support, which was a major criticism, recognized by WAG, of previous modes of intervention. Any real semblance of the development of a regional innovation system has been problematic to establish given the apparent dominance of Cardiff University, and more latterly Swansea University, in the area of higher education knowledge commercialization, coupled with a lack business sector actors. Although Wales has had extensive autonomy in recent years to establish policies tailored to creating interventions best suited to catalyzing knowledge-driven regional development, there is as yet little evidence of the accruing of economic returns from these interventions, highlighting the necessity for patience and long-term thinking within this area of policy intervention.

Complementary Innovation Infrastructure

Alongside, university knowledge transfer initiatives, it is important to highlight the complementary innovation infrastructure that regional policymaking has facilitated. In Scotland a key development was the establishment of the Intermediary Technology Institutes (ITIs), which were created with the aim of building on the strengths of the Scottish economy by improving the commercialization of research. Scottish Enterprise committed £450 million investment to the ITIs. ITIs fulfill a coordinating task that helps to identify, commission, and/or acquire and diffuse pre-competitive research. The creation of ITI Scotland in 2003 was a specific intervention by the Scottish Executive to help to address the 'Growing Businesses' theme identified in *A Smart Successful Scotland*, focusing on strengthening the link between Scotland's research base and business innovation and addressing low levels of business R&D(OECD, 2004). A particular emphasis of the ITI is on Scottish universities, research institutes, as well as existing and nascent SMEs in the fields of communication technology and digital media, life sciences and energy sectors. Up to 2009, ITI Scotland committed over £150 million in research programmes (Edgar, 2009) while in 2009, it was announced that Scottish Enterprise would integrate ITIs within the agency's wider research, commercialisation and innovation operations. There are also several innovation schemes to help Scottish universities work with SMEs in response to the problem of weak links between universities and small industry in Scotland. The SFC's new Innovation Voucher Scheme aims to promote interactions between HEIs and SMEs. The Scottish Government's SEEKIT programme is designed to support projects that will promote co-operation in R&D and

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3 knowledge transfer between SMEs and the Scottish public sector science base (e.g.
4 universities, Research Institutes, Technology Transfer Organizations, NHS Trusts etc).
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9 As highlighted above, a key policy development in Wales is the Technium
10 programme. Links with academia are regarded by policymakers as critical to the
11 success of the Techniums, and they provide space for university spin-outs and house
12 possible graduate employers. As Abbey et al. (2008) note, partnership arrangements
13 with Fudan University in Shanghai has actually resulted in two high-technology
14 Chinese firms entering one of the Techniums. Although the early-stage success of the
15 Technium initiative has been disputed (Cooke and Clifton, 2005; Abbey et al., 2008),
16 they at least herald a long-term investment in the knowledge-based infrastructure that
17 is lacking in Wales. Overall, some estimates suggest that the Technium programme
18 has created more than 550 jobs, worth some £74m, with additional estimated benefits
19 of 760 jobs indirectly supported, worth a further £63m (HEW, 2009). However, most
20 of the success has been associated with a small number of Techniums, especially
21 those with close relationships with academia. Techniums with less close links have
22 struggled to find appropriate tenants, and by 2010 WAG was considering a
23 rationalization in their number.
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37 **University Knowledge Transfer ‘Performance’**

38 Table 2 indicates total knowledge transfer and commercialization (KTC) income per
39 HEI employee at a regional level across the UK. The list is headed by Wales, with
40 Scotland also having a level of KTC income per employee above the UK average.
41 Further scrutiny of the data finds that KTC income in Wales has been significantly
42 boosted in recent years due to a rapid rise in collaborative research income received
43 by one institution – Swansea University in connection with the development of the
44 Technium initiative. Despite this boost, HEIs in Wales have only increased their KTC
45 income between 2001/02 and 2006/07 slightly more than the UK average (120.4% cf.
46 118.5%). However, this is a higher rate than that achieved in Scotland over the same
47 period. The English regions of the North West, South, West Midlands, Yorkshire and
48 Humber have shown the biggest increases over the period, although there is
49 significant variability across England as a whole. Perhaps the most marked feature of
50 the data is that for the UK as a whole recorded, KTC income has more than doubled
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3 over a five year period (which may be a result of better accounting on behalf of
4 universities as much as actually increases to income streams).
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9 The right-hand column of Table 2 lists the proportion of commercialization income
10 HEIs source from within their region (with the exclusion of collaborative research
11 income for which source data is unavailable). It is highly noticeable that HEIs in
12 Wales source only 8% of their commercialization income from within the region, far
13 lower than HEIs in any other region (with Scotland on a relative par with most
14 English regions). This potentially indicates the existence of a lack of demand from
15 firms within the region for the types of knowledge Welsh universities are capable of
16 supplying. This confirms the extent to which regional contexts are an important
17 influencing factor on the economic and innovative performance of universities.
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26 Table 2 About Here
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30 In Scotland, three institutions – the universities of Edinburgh, Glasgow, and
31 Strathclyde - account for more than one half of the KTC income received by the
32 higher education sector (Table 3). A further three institutions – Aberdeen, Heriot-Watt,
33 and Dundee – account for a further one third. This indicates a relatively high spread of
34 income and activity across the region's universities, which is in stark comparison to
35 that in Wales where two institutions – Cardiff and Swansea – receive more than two
36 thirds of total income (Table 4). Although this represents a significant concentration
37 of income and activity it is a shift from the previous situation whereby activity was
38 largely dominated by Cardiff University alone. The growth in knowledge transfer
39 activity in Swansea, particularly that associated with the Technium initiative,
40 indicates the development of a more balanced picture of higher education involvement
41 in knowledge transfer in Wales. However, the gap between the universities of Cardiff
42 and Swansea and other HEIs in the region highlight that more needs to be done if
43 Wales is to achieve the level of distributed activity found in Scotland.
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60 Discussion and Policy Implications

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There are a number of policies that governments pursue when seeking to promote innovation, including policy initiatives to foster the commercialization of university research, encouraging firms to invest in R&D, or encouraging the activities of venture capital funds. As Driver and Oughton (2008) argue, the important task for public policy is to characterize accurately the ‘interplay of causal factors in innovation expenditure’, although ‘identifying the nature of what is required (or how to intervene) is methodologically difficult’. The review of policy interventions in the two case study regions identify several similarities, as well as differences, in terms of regional intervention towards strengthening the role of the university sector in constructing regional innovation systems through strengthening knowledge transfer from higher education sector.

As we have discussed, knowledge transfer is seen as one of the priority policy agendas in the UK science and innovation policies. Since their establishment in 1999, the devolved governments in Scotland and Wales have facilitated partnership development between universities and industry to support more effective collaboration between the knowledge and research base and the business community, particularly within identified key regional growth sectors. In both Scotland and Wales, knowledge transfer from higher education sector is promoted as part of regional innovation system development, and each process has been shaped by different policy and politics. Both Scotland and Wales have developed substantial knowledge transfer funding programmes over the decade.

Scotland and Wales share a number of similar industrial structures, constraints in economic development, and to a large extent have developed similar science-based innovation strategies in which universities play central role in terms of commercialization and knowledge transfer. One of the key differences identified in the approaches adopted in the knowledge transfer strategies is based on the economic and institutional conditions in each region. Leading regions for innovation are often those with multiple nodes of research strength including universities, government laboratories, non-profit research organizations, and private-sector R&D units (Youtie and Shapira, 2008). Regions in economic ‘catch-up’ positions, without multiple nodes of knowledge generation, tend to hope that their universities will serve as an ‘anchor tenant’ (Agrawal and Cockburn, 2003) to attract other private-sector R&D facilities.

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Scotland certainly has some research strengths within its universities, primarily in Edinburgh, Glasgow, and the development of research pooling initiatives in Scotland is an exemplar in building critical mass of global ‘research excellence’, with a number of mechanisms in place to further strengthen ‘industrial relevance’ at the regional level (Kitagawa, 2010). In Wales, there is only a single dominant university and a lack of other kinds of research and industrial partners with advanced capabilities with whom the university can interact, although there has been significant policy intervention exemplified by the Technium initiative. Nevertheless, public and private R&D investment levels in Wales remain below par, and the region has the lowest proportion of firms engaged in knowledge-based activities across all UK regions.

There are a number of examples of *institutionalized* strategies for innovation and knowledge transfer in Scotland, connecting knowledge bases and industry, which are promoted, fostered and supported through the process of devolution. However, there are criticisms that Scotland’s ‘post-devolution’ science policy seems to continue to focus on the ‘supply side’, namely the science base in Scottish universities, disregarding the ‘demand side’ role that could be played by firms (Lyll, 2007, Roper et al., 2006). As already mentioned, there are several existing demand side policies, and increasing focus on demand side policies in Scotland, and probably more so in Wales, are required alongside the supply-side intervention that has formed the focus of this paper. This hints at the next phases of intervention devolved regional governments will be required to tackle. Whilst regional policy has clearly incentivized universities to seek engagement with the business community, incentivizing the business community is likely to form a much tougher challenge.

The additional autonomy Scotland has enjoyed, compared with Wales, means that it represents a more advanced and evolving innovation policy model, which is fairly well advanced with regard to its organizational models, which includes infrastructure such as the ITIs. Wales, as well as regions elsewhere, can learn from the Scottish experience of *institutionalized* strategies for innovation and knowledge transfer as well as the collaborative environment fostered by their higher education sector.

Universities, it is clear, have an important role to play at regional level in the development of the knowledge economy within the devolved policy structures.

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3 However, for universities, strategic balance is also important. There is a need to assess
4 the benefits to universities relating the outcomes of knowledge transfer activities to
5 the core mission of teaching and research in their own institutional settings and
6 strategies (Warren et al. 2010). Nevertheless, establishing regional cooperation across
7 universities is considered to be an important element of creating critical mass in less
8 competitive and more peripheral areas (Siegel et al., 2007).
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16 Increasing evidence suggests that the best use of knowledge is made by linking it
17 globally (or least non-regionally/locally) (Huggins and Johnston, 2009). Both
18 Scotland and Wales are encouraging international flows of knowledge by attracting
19 talent from overseas (e.g. Research pooling initiative; The Prince of Wales Innovation
20 Scholarship Programme). In order to embed knowledge transfer from universities as
21 part of wider innovation process in the wider context of economic governance in the
22 globalizing knowledge economies, science and innovation policy should include
23 wider elements of 'proximity' than a geographical one (Boschma, 2005; Wink, 2008).
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31 The complexity of the devolution process derives from the interest-conflicts of the
32 various actors involved, and the differences in legitimacy that they share. Most
33 importantly, the interests of sub-national and national governments tend to be at odds
34 across the component factors of devolution. The balance between these two extremes
35 will depend upon the relative strength, or, in political terms, legitimacy, of the two
36 tiers of government. (Rodríguez-Pose and Gill, 2003). For instance, despite the value
37 that devolution and regional autonomy brings to developing these agendas, there is a
38 certain amount of nervousness among some stakeholders in Wales that the strategic
39 coherence of UK innovation policy promoted by the UK Government may result in a
40 focus that is rather England-oriented, and does not take adequate account of the
41 devolved regions. Although the ability to establish regional policies to catalyze the
42 development of innovation systems requires far more than appropriate resource
43 allocation (Koschatzky and Kroll, 2007), a continued lack of funding does appear to
44 be an on-going constraining factor limiting the engagement of universities in
45 knowledge-based economic development.
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59 There are a number of remaining issues to be investigated in the future. The analysis
60 in this paper has revealed challenges in terms of evaluating the impact of knowledge

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3 transfer and commercialization from research bases in their regions, especially in
4 measuring wider non-quantifiable impacts of policy intervention. The real impact of
5 initiatives such as the construction of business incubators, the delivery of venture and
6 seed funds and regional innovation support services on regional competitiveness may
7 not be achieved for many years after funding ceases (Warren et al. 2010). There is
8 also a need for policymakers at both regional and national levels to recognize the
9 complexity of interactions between the local, national and global levels, the
10 institutional multi-level dimensions, and the co-evolution of science and innovation
11 policy, especially through devolution processes. This has to be combined with spatial
12 resource management and institutional strategies on the one hand, and issues
13 concerning joined-up public policies from multi-level perspectives on the other.
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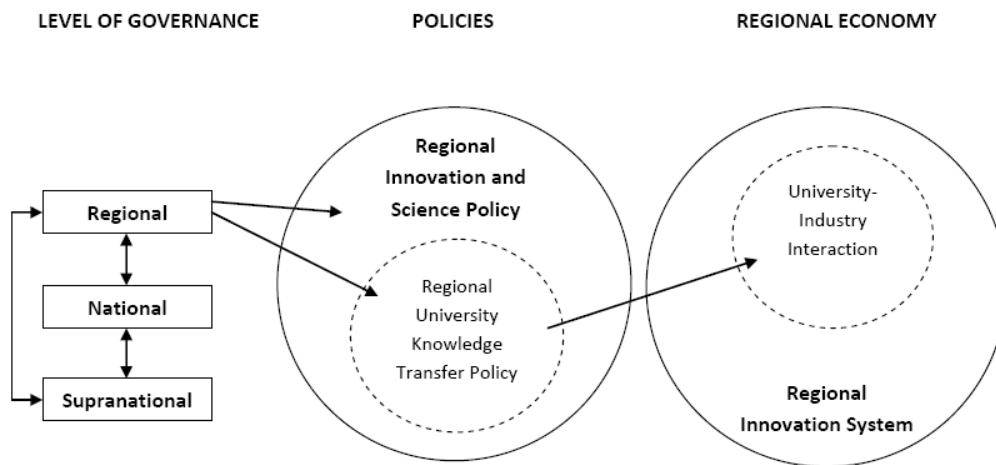
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Figure 1: Governance, Regional Policy and University Knowledge Transfer



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Table 1: Regional Higher Education Value Added 2005/06

Region	University and HEI Value Added per Full Time Equivalent Employee (£)	Total Higher Education Value Added (£000s)	Contribution to Regional GVA (%)
Eastern England	48,016	913,116	0.83
London	47,371	2,558,439	1.30
Northern Ireland	42,488	269,142	1.02
West Midlands	40,183	899,526	1.01
South East	39,982	1,595,976	0.90
<i>Scotland</i>	<i>39,539</i>	<i>969,618</i>	<i>1.07</i>
North East	38,624	511,966	1.32
<i>Wales</i>	<i>38,577</i>	<i>578,773</i>	<i>1.36</i>
East Midlands	37,409	736,900	0.99
North West	37,181	1,174,995	1.06
South West	37,056	712,005	0.80
Yorkshire and the Humber	36,991	1,004,509	1.22
UK	40,759	11,924,965	1.03

Table 2: Knowledge Transfer and Commercialisation (KTC) Income Received by Universities and HEIs per Employee (FTE)

Region	KTC Income per FTE Employee (£)	% Change in KTC Income 2001/02-2006/07	% of KTC Income Generated from each Within Region
<i>Wales</i>	8,751	120.4	8.4
North East	8,417	81.9	21.9
Eastern England	8,175	68.0	23.3
London	7,840	141.6	23.6
<i>Scotland</i>	7,678	107.6	22.6
South East	7,168	116.4	23.0
North West	6,077	179.4	35.1
West Midlands	5,955	162.4	24.4
East Midlands	5,438	63.4	25.5
South West	5,210	170.3	18.2
Yorkshire and the Humber	4,874	144.6	29.8
Northern Ireland	3,692	23.5	59.9
UK	6,717	118.5	

Source: Authors' calculations based on data from the annual Higher Education Business and Community Interaction Survey (<http://www.hefce.ac.uk/econsoc/buscom/hebci/>)

Table 3: Knowledge Transfer and Commercialisation (KTC) Income Received by Universities and HEIs in Scotland

	KTC Income (£000s)	% of All Scotland Total	KTC Income per FTE Employee (£)
University of Edinburgh	41,619	17.9	6,543
University of Glasgow	39,326	16.9	8,401
University of Strathclyde	38,729	16.7	12,533
University of Aberdeen	32,308	13.9	11,475
Heriot-Watt University	22,959	9.9	15,232
University of Dundee	19,819	8.5	6,479
University of St Andrews	9,121	3.9	4,878
Glasgow Caledonian University	8,308	3.6	4,863
Robert Gordon University	7,140	3.1	5,468
University of Stirling	5,813	2.5	3,723
University of Paisley	3,117	1.3	2,993
Queen Margaret University College Edinburgh	2,210	1.0	4,520
University of Abertay Dundee	1,130	0.5	1,892
Glasgow School of Art	552	0.2	1,718
Royal Scottish Academy of Music and Drama	70	0.0	349
Scotland	232,221	100.0	

Source: Authors' calculations based on data from the annual Higher Education Business and Community Interaction Survey (<http://www.hefce.ac.uk/econsoc/buscom/hebci/>)

Table 4: Knowledge Transfer and Commercialisation (KTC) Income Received by Universities and HEIs in Wales

	KTC Income (£000s)	% of All Wales Total	KTC Income per FTE Employee (£)
Cardiff University	49,271	35.6	10,093
University of Wales Swansea	49,224	35.6	25,203
University of Wales, Bangor	11,545	8.3	7,242
University of Wales, Aberystwyth	7,888	5.7	4,813
North East Wales Institute of Higher Education	6,024	4.4	13,589
University of Wales Institute, Cardiff	4,520	3.3	4,245
University of Glamorgan	3,816	2.8	2,366
Swansea Institute of Higher Education	1,949	1.4	4,119
University of Wales, Newport	1,398	1.0	2,044
Royal Welsh College of Music and Drama	1,170	0.8	7,773
Trinity College Carmarthen	950	0.7	3,620
University of Wales, Lampeter	670	0.5	2,744
Wales	138,425	100.0	

Source: Authors' calculations based on data from the annual Higher Education Business and Community Interaction Survey (<http://www.hefce.ac.uk/econsoc/buscom/hebci/>)

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