The Economic and Innovation Contribution of Universities: A Regional Perspective

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Abstract

Universities and other higher education institutions (HEIs) have come to be regarded as key sources of knowledge utilisable in the pursuit of economic growth. Although there have been numerous studies assessing the economic and innovation impact of HEIs, there has been little systematic analysis of differences in the relative contribution of HEIs across regions. This paper provides an exploration of some of these differences in the context of the UK's regions. Significant differences are found in the wealth generated by universities according to regional location and type of institution. Universities in more competitive regions are generally more productive than those located in less competitive regions. Also, traditional universities are generally more productive than their newer counterparts, with university productivity positively related to knowledge commercialisation capabilities. Weaker regions tend to be more dependent on their universities for income and innovation, but often these universities under-perform in comparison to counterpart institutions in more competitive regions. It is argued that uncompetitive regions lack the additional knowledge infrastructure, besides universities, that are more commonly a feature of more competitive regions.

Introduction

Universities and other higher education institutions (HEIs) have come to be regarded as key sources of knowledge utilisable in the pursuit of economic growth, with knowledge commercialisation and transfer activities attaining a more important role within universities (Etzkowitz, 2003; Lester, 2005; Huggins et al., 2008a). Furthermore, as knowledge becomes an increasingly important part of regional innovation and development processes, the role of universities has come to the fore of regional innovation and economic development policy (Fritsch, 2002; Cooke, 2004). However, it is often difficult to ascribe improved regional competitiveness to developments in knowledge-based infrastructure (Huggins et al., 2008a; Power and Malmberg, 2008). The transfer and commercialisation of university-generated knowledge is taking a stronger role within government policies at a number of levels (Lambert, 2003; Sainsbury, 2007; Wellings, 2008; Kitson et al., 2009) Many governments and their agencies are turning their attention to the role of HEI knowledge commercialisation in developing innovative, sustainable and prosperous regional (and national economies). However, regional contexts and the universities located within them differ, suggesting that the relevance of these processes in both economic and policy terms will differ across regions and institutions (Howells, 2005; Tödtling and Trippl, 2005). In economic terms, regions may vary in their 'dependence' on the higher education sector as a generator of both income and innovation. In policy terms, there is an underlying assumption that the knowledge

generated by universities can be made best use of by networking it regionally or locally amongst firms and other spatially proximate actors (Lawton Smith, 2007).

Since the 1990s, there have been numerous efforts to estimate the economic impact of particular HEIs on the respective local and/or regional economy in which they are located (SURF et al., 2006). While many studies have focused on the direct and indirect economic impact through employment and university supply-chains, some have given consideration to assessing the impact of HEI knowledge and its transfer and flow to local and regional communities (e.g. Huggins and Cooke, 1997; Charles and Benneworth, 2002; Kitagawa, 2004). However, there has been little systematic analysis of differences in the relative contribution of HEIs across UK regions (UNITE Network, 2006). This is surprising given the increased focus on HEI generated knowledge and research as an important stimulant of economic growth (Etzkowitz, 1998; Bok, 2003), especially for improving the development capabilities and economic performance of regions (Kukliński, 2001; Lawton Smith, 2003; Feldman and Desrochers, 2003; Goldstein and Renault, 2004; Wolfe, 2004; Shane, 2004; Braunerhjelm, 2005). This raised awareness has also occurred at a time when variations in underlying levels of knowledge are further understood to be important determinants of disparities in regional competitiveness (Huggins, 2003; ODPM, 2003; Porter, 2003; Boschma, 2004; Malecki, 2004).

Based on the assumption that regional competitiveness is largely a function of regional innovation levels (Porter, 1990; Huggins, 2003; Huggins and Izushi, 2007), it is possible to establish a number of metrics measuring the relative contribution of HEIs to the economic and innovation performance of their respective regions. This paper develops a range of measures by which to analyse differences in the value added and labour productivity of universities at an institutional and regional level, as well as their knowledge commercialisation capabilities. With the above in mind, the key aim of this paper is to provide an exploration of some of these issues in the context of the 12 UK administrative regions, covering regional differences in both the wealth-generating and knowledge-commercialisation capacity of the higher education sector. The key research questions consist of the following: (1) are there significant differences in the levels of wealth generated by universities across regions? (2) are there significant differences in the levels of wealth generated by different types of

universities across regions? (3) does the economic dependency of regions on their respective higher education sectors vary? (4) are there significant differences in the knowledge commercialisation activities of universities across regions? (5) does the innovation dependency of regions on their respective higher education sectors vary? (6) is there a relationship between the wealth generated by universities and the income they receive via knowledge commercialisation activities? The paper begins by reviewing the literature most relevant to this area of analysis, followed by a presentation and interpretation of the findings and a concluding policy-focused discussion.

Regional Competitiveness, Knowledge, and Universities

The competitiveness of regions refers to the presence of conditions that enable firms to compete in their chosen markets, and for the value these firms generate to be captured within a region (Begg, 1999; Huggins, 2003). Regional competitiveness, therefore, is considered to consist of the capability of an economy to attract and maintain firms with stable or rising market shares in an activity, while maintaining stable or increasing standards of living for those who participate in it (Storper, 1997). As such, uncompetitive regions tend to lag behind their more competitive counterparts in terms of headline indicators such as economic output per capita and employment levels, as well as knowledge-based indicators such as innovation, patenting and densities of knowledge intensive firms (Huggins and Izushi, 2007). They are also more likely to be organisationally and institutionally 'thin', with a lack of innovation-driven public or private sector entities, often with a high dependence on SMEs exhibiting low growth trajectories and operating within only fragmented connections to external sources of knowledge (Sánchez, 1992; Vaessen and Keeble, 1995; Huggins, 1997; North and Smallbone, 2000; Benneworth and Charles, 2005; Tödtling and Trippl, 2005; Lagendijk and Lorentzen, 2007; Virkkala, 2007; Malecki, 2007; Doloreux and Dionne, 2008).

In many nations there are competitiveness disparities across regions. In the UK, this is manifested by the 'North-South Divide', whereby regions in the southern half of the nation, in particular London, South East England and Eastern England, are the nation's core economic drivers, while more northern regions suffer from higher unemployment rates and lower income levels (Huggins, 2003; Huggins and Izushi,

2008). Regions such as North East England, Wales, Yorkshire and the Humber, and Northern Ireland as significantly uncompetitive in comparison with their southern neighbours, and based on a composite index of competitiveness across the UK's regions, only the three regions of the 'Greater South East' are found to be performing above the UK competitiveness average (Huggins, 2003; Huggins and Izushi, 2008). Regional competitiveness variations are usually related to the different industries located and functions performed in these regions, and differences in their supporting environments (Huggins and Izushi, 2007). Such supporting environments consist of, for example, research establishments, business and producer service providers, information and communication technologies (ICT) infrastructure, as well as universities (Cooke, 2004; Tether and Tajar, 2008).

In general, knowledge is now recognized as a key ingredient underlying the competitiveness of regions, nations, sectors and firms (Romer, 1986; 1990; Lucas, 1988; Nonaka and Takeuchi, 1995; Grant, 1996). At its most fundamental level, the knowledge base of an economy can be defined as the capacity and capability to create and innovate new ideas, thoughts, processes and products and to translate these into economic development, i.e. increasing the value of a regional economy and the associated generation of wealth (Huggins and Izushi, 2007). The knowledge development capabilities of economies are increasingly associated with their systems of innovation, both national and regional, with universities considered a part of these systems alongside firms, R&D laboratories and training agencies, etc. (Freeman, 1987, Freeman, 1995; Nelson and Rosenberg, 1993; Cooke et al., 2004; Lawton Smith and Bagchi-Sen, 2006). Such systems are highly embedded since they are based on sets of habits, routines, rules, norms and laws (Johnson, 1992), and highlight the importance of interaction between both exogenous and endogenous factors in either stimulating or limiting the regional development role of universities. The position of universities within regional innovation systems can be conceived as that of 'knowledge transceivers', receiving knowledge from global sources and transmitting it to more localised actors (Cooke, 2005).

As the role of universities in bolstering knowledge communities and shaping innovation cultures has become more widely recognised, regional engagement and innovation capacity have become core themes in university mission statements

(Lawton Smith, 2007). The triple helix model formalises this role and views universities as increasingly 'entrepreneurial' or 'generative' institutions where the spillover of knowledge is the result of strategic internal reorganisation facilitating the development of infrastructure such as incubators or science parks as well as human capital development programmes (Etzkowitz, 2006; Etzkowitz and Zhou, 2006; Gunasekara, 2006). These developments have led to notions of 'entrepreneurial universities' (Etzkowitz et al., 2000; Powers, 2004; Slaughter and Leslie, 1997; Smilor et al., 1993) and 'academic entrepreneurs' (Meyer, 2003; Shane, 2004) that are highly involved in venturing and commercialisation activities such as the establishment of spin-off firms, and the exploitation of intellectual property rights through the licensing of technology and patent registration (D'Este and Patel, 2007; Huggins, 2008).

The discourse on the role universities as knowledge commercialising institutions and key nodes in regional innovation systems is largely reliant on empirical work from exemplar regions, i.e. those regions which are among the most competitive in the world in terms of economic growth rates, workforce qualifications and the number of large, international firms based in new or high technology sectors (Saxenian, 1994; Owen-Smith and Powell, 2004; Gertler and Wolfe, 2004; Lawton Smith, 2003; Garnsey and Heffernan, 2005). However, for every successful region there exist many more 'ordinarily' uncompetitive' regions, In general, the utilisation of university knowledge cannot be expected to be uniform, with not all firms or regions benefiting equally. For instance, regions endowed with a higher density of high-technology firms tend to benefit from university knowledge (Audretsch et al., 2005), with there being a significant correlation between the concentration of high-technology industries and university research in high-technology fields within a region (Nagle, 2007). Others suggest that smaller firms in a region may benefit from spillovers of university knowledge as they have fewer resources with which to generate their own knowledge (Acs et al., 1994).

Policy Context

Porter and Ketels (2003) conclude that there is still a lack of understanding in the UK of how to create effective impacts through knowledge transfer from universities, and the role of regions as part of these processes. It is argued that government in the UK

has failed to fully realise the significant direct and indirect contribution the UK's HEIs make to its local, regional and national economies (Kelly et al., 2002). On the other hand, it is also argued that the performance of many UK HEIs in the area of knowledge transfer and commercialisation activities has not matched their overall potential, partly due to the relatively low level of internal financial and human resources devoted to such activities (Charles, 2003; Charles and Conway, 2001; Wright et al., 2006). This lack of supply-side resources has been coupled with issues concerning the constraining characteristics of HEI knowledge-based venturing, particularly the creation of spin-off firms, whereby their value is primarily linked to the longer-term growth potential derived from scientific knowledge and intellectual property. In their early stages, such ventures lack tangible assets to use as collateral, while their products initially have little or no track record, and are largely untested in markets or subject to high rates of obsolescence (Bank of England, 2002; Huggins, 2008).

Furthermore, the demand-side is considered a significant constraint in stimulating wider processes of knowledge transfer, especially engaging the business sector with the education sector (Lambert, 2003). The level of knowledge venturing and commercialisation undertaken by HEIs may be determined by a number of core factors. These include the entrepreneurial orientation and attitude of particular universities, which may be shaped by the underlying national and regional policy environment relating to the knowledge commercialisation activities of the higher education sector (Etzkowitz, 1998; Etzkowitz et al., 2000; Smilor et al., 1993). For instance, it is argued that the USA has a more vibrant and decentralised system of university knowledge commercialisation than Europe due to the introduction in 1980 of the Bayh-Dole Act, which gave universities, rather than individual researchers, title to innovations established in their confines (Goldfarb and Henrekson, 2003).

Orthodox explanations of the failure of regions to take advantage of universities as a local knowledge economy resource usually point to a lack of regional capacity as the principal barrier to realising such advantage (Lambert, 2003). While such explanations highlight one important aspect of the relationship between universities and regional development, it does not do full justice to understanding the complex set of issues constraining the capacity for such advantages to be constructed, which

encompasses structural, institutional and social factors (Boucher et al., 2003; Lawton Smith, 2007). These include not only demand side factors but the propensities of universities to engage at the regional level, the availability of supply side resources to stimulate engagement, as well as the national environments within which universities are situated. This complexity of influences and explanations can be related to the fact that regional variations in, for example, new firm development per se are related to a range of factors including income levels, industrial density and population growth (Armington and Acs, 2002).

Despite restrictions and limitations, it is generally acknowledged that universities can serve as sources of knowledge for industry, and that policy initiatives designed to build new niches of knowledge and develop more effective mechanisms for transferring university-based knowledge to regional partners can potentially bolster regional innovation and economic development (Benneworth and Charles, 2005). Universities have traditionally provided know-how (skills and capability) and know-why (general principles and laws), but the focus on commercialising knowledge, offering consultancy services and entering into collaborative relationships all demonstrate academic expansion into know-what (facts) and know-who (establishing collaborative relationships) (Charles, 2006). The balance between creating and diffusing knowledge illustrates an emerging 'third mission' of universities where new commitments to service compliment existing teaching and research missions (Etzkowitz and Zhou, 2006). However, there is significant debate surrounding the extent to which universities should focus on knowledge creation or knowledge diffusion. Scholars such as Feller (2003) argue that universities should focus on building research capacity (knowledge creation) if they want to increase knowledge commercialisation, while others argue that developing more effective mechanisms for transferring knowledge to both private and public sectors (knowledge diffusion) is more important (Stoneman and Diederen, 1994).

In the UK, a government sponsored review of the role of universities in stimulating innovation performance argues that although universities do have a crucial part to play, they cannot be expected to contribute equally to this goal, with the onus firmly placed on 'curiosity-driven research' universities as the key sources of innovation (Sainsbury, 2007). Other universities, it is argued, should focus more on economic

missions relating more to 'user-driven research' and professional teaching. The review also highlights the increased prominence of regions as the interface connecting policymakers, universities and the private sector. Another review sponsored by the government further identifies a need for a better understanding of regional variations in innovation performance and the influence of university research commercialisation and knowledge transfer performance (Wellings, 2008). These reviews both indicate a requirement for policymaking to better account for the diversity of universities and the regions in which they are located. Although economic development and innovation policy in the UK has increasingly recognised the need to account for regional diversity, the Further and Higher Education Act of 1992 (HMSO, 1992), which established polytechnics as universities, has implicitly pushed an agenda of homogenisation across the higher education sector. Although in itself this has brought many benefits, it has meant that the breadth of differentiated aims and activities across UK institutions has become somewhat opaque from a policymaking perspective.

Methodology

The methodology consists of an analysis of secondary data sourced from: the annual Higher Education and Business Community Interaction Survey (HEBCIS) which is made freely available by the Higher Education Funding Council for England (although the dataset also covers institutions in Northern Ireland, Scotland, Wales and Northern Ireland); a consolidation of the annual financial accounts of all HEIs in the UK made available by the Higher Education Statistics Agency (HESA), as well as regional level data obtained from the Office for National Statistics. The HEBCIS dataset covers all HEIs in the UK and consists of a number of indicators relating to knowledge transfer and commercialisation indicators, while the HESA publishes overall income, expenditure and employment data, facilitating the calculation of value added generation and labour productivity as outlined below. In all cases, the data refers to 2005/06.

In total, there are 158 HEIs across the UK (based on returns from the HEBCIS survey), with approximately one-quarter of these located in London. South East England has the second highest number of institutions, followed by Scotland and North West England (Table 1). In order, to assess differences across institution types we have categorised each based on whether they are a traditional pre-1992 university

or a newer post-1992 university. In general, pre-1992 institutions account for the leading research-intensive universities (and the majority of research income), with post-1992 institutions often characterised by aims to broaden access to higher education, particularly through professional teaching. Regions differ in the proportion of the institutions they possess that are either pre- or post-1992 universities. In London, Eastern England, the North East, South East, Wales, and Yorkshire and the Humber there is a relatively even split. The East Midlands, North West, South West, and West Midlands are biased toward post-1992 institutions, while in Scotland two-thirds of institutions are classed as pre-1992. As well as the number of institutions, it is also useful to measure their regional importance based on the number of people they employ. Overall, universities in London, the North East, Wales, and Yorkshire and the Humber provide the largest proportion of employment to the total workforce of their respective regions, and universities in Eastern England, the South West, and Northern Ireland the least.

Although it is possible to further refine such a typology - for instance Tight (1988) and Scott (2001) have developed classifications with six and seven categories respectively – for the purposes of our analysis and focus on universities and actors within their regions, a binary approach provides a practical means of analysing key differences. Similarly, although we present data for all twelve regions, in order to test for difference we categorise regions as being either relatively economically 'competitive' or 'uncompetitive'. As discussed above, based on variations from the UK average, London, South East England, and Eastern England are classed as competitive regions, and the remainder as relatively uncompetitive. The statistical analysis utilised Mann–Whitney tests of difference to examine the significance of any observed differences between groupings and correlation analysis to examine relationships between variables.

Table 1 About Here

As a means of seeking to capture differences in the regional economic relevance of HEIs we calculate the value added generated by institutions as a proportion of the total value added generated across regions as a whole. In a corporate context, value added is the wealth created by a firm, which can measured in a number of ways, but

generally reflects sales less costs of bought-in goods and services. Specifically, firm level value added can be calculated from a company's accounts by adding together operating profit, employee costs, depreciation, and amortisation/impairment charges. Applying a similar methodology, HEI value added for 2005/06 is calculated by adding together surplus, employee costs, and depreciation. This allows us to gauge differences in HEIs according to their wealth generating capacities. Furthermore, it is possible to estimate a measure of the labour productivity of HEIs by calculating the value added generated per full time equivalent employee.

University Value Added and Productivity

Table 2 highlights those institutions generating the most and least value added during 2005/06. At the top of the list are many of the UK's most prestigious universities, led by the University of Cambridge, which generates close to £500 million annually, with three of the top ten being universities located in London. At the other end of the list, we see a number of small institutions specialising in particular disciplines, especially the arts. In general, the diversity of institutions in terms of differences in wealth generating capacity is clear. There is a significant difference in value added generated by pre-1992 and post-1992 institutions, with pre-1992 universities generating, on average, more than twice the value added of their post-1992 counterparts. However, it is also important to control for size as a means of assessing more relative differences in value added generation.

Table 2 About Here

When controlling for size, based on numbers of full time equivalent employees, London is dominant amongst those institutions recording the highest levels of labour productivity, accounting for all the top ten institutions, with the exception of the University of Cambridge (Table 3). At the bottom of the list, those HEIs generating the least value added per full time worker are all located outside the Greater South East (London, South East England, and Eastern England), apart from two relatively small institutions in London, with a number located in the UK's least competitive regions. This begins to suggest that the value added generating capacities of HEIs in the UK may be connected to their geographical location, which confirms the findings of other research which has similarly intimated that the performance of universities is

as at least partly an outcome of the environment in which they are located (Braunerhjelm, 2008).

Table 3 About Here

As shown by Table 4, university labour productivity is related to both location and institution type. HEIs located in competitive regions have significantly higher productivity levels than those in uncompetitive regions. This difference is significant where comparing all HEIs as well when comparing pre-1992 and post-1992 HEIs in competitive regions with pre-1992 and post 1992 HEIs in uncompetitive regions. These differences indicate that the most economically competitive regions of the UK tend to be the location of HEIs generating higher levels of value added per worker. Also, pre-1992 HEIs have significantly higher labour productivity rates than post-1992 institutions. As shown by Table 5, when HEI productivity is aggregated at a regional level, Eastern England and London have the highest Value Added per FTE employee, followed by Northern Ireland and the West Midlands. Those regions with the lowest HEI labour productivity are Yorkshire and the Humber, the South West, and the North West.

These differences have a clear bearing on policies, both national and regional, promoting the role of universities as catalysts of economic development. In particular, it suggests that while the more competitive regions may be able to benefit from being the home of the majority of the UK's most prestigious and wealthiest universities, more lagging regions are likely to contain a greater concentration of institutions that are less able to compete in the higher education marketplace with their more prestigious counterparts. Furthermore, it has been suggested that universities in lagging regions may develop 'fault lines' if they seek to overly diversify their portfolio, particularly as they seek to engage further in regional economic development activities (Benneworth and Hospers, 2007).

Tables 4 and 5 About Here

Excluding the rather special case of London, with its abundance of HEIs, there is a strong negative relationship between higher education contributions to GVA at the

regional level and regional GVA per capita (Spearman's r= -0.74, p < 0.01). This inverse relationship may be an indication that universities in peripheral regions act as a substitute for agglomeration economies, although the impact of universities on regional development has been found to be significantly less than agglomeration effects (Goldstein and Drucker, 2006). The fact that universities in less competitive regions generally produce less wealth implies a potential policy problem, i.e. weaker universities have a responsibility for developing weaker regions. In order to relate this issue more specifically to role of universities as regional knowledge and innovation-performing institutions, it is important to further assess differences in regions as measured by HEI innovation and knowledge commercialisation activity.

Innovation and Knowledge Commercialisation

A commonly used (although contested) proxy measure of innovation at the regional level is expenditure on R&D activity. It is possible to analyse such expenditure by broad sector – business, government, and higher education – across the UK's regions. Correlating the proportion of R&D expenditure in each region (excluding London) emanating from the higher education sector with regional GVA per capita indicates a significant inverse relationship between the two variables (Spearman's r= -0.72, p = 0.01), which suggests that HEIs in less competitive regions play a stronger role in regional innovation activities. This role is likely to be higher than in more competitive regions almost by default, with less competitive and less innovative regions possessing a relative dearth of innovation actors outside of the higher education sector. The lack of other innovation actors with which universities are able to engage may have a limiting effect on the capacity of universities to stimulate interactive modes of innovation within their region (Fritsch and Slavtchev, 2007).

A further proxy measure of regional innovation is patent applications registered to firms, institutions, and individuals located in a region. It is also possible to measure patenting activity within HEIs, and therefore regional differences in the contribution HEIs make to overall regional patenting activity. With the exception of London, it is the UK's least competitive regions that are the most dependent on HEIs as generators of patent applications (accounting for five of the six most dependent regions). The devolved regions of Scotland and Northern Ireland are the most dependent on their HEIs, followed by London, Wales, and North East England (Table 6). A growing

feature of HEI knowledge commercialisation processes in recent years has been the establishment of spin-off firms, many of which are located within the region of origin often on a science park or within an incubator located in close proximity to the originating university. Such knowledge-based entrepreneurship, therefore, contributes to overall enterprise and business start-up activity within a region. As shown by Table 6, it is largely the UK's least competitive regions that are most reliant on universities as a source of new business formation, measured by university spin-off firms as proportion of all new VAT registered firms within a region. Wales and North East England are the most reliant, followed by South East England, Yorkshire and the Humber, and Scotland.

Table 6 About Here

Although universities in uncompetitive regions tend to be relatively more important as regional sources of wealth generation and innovation, in order to compete on the national and international stage they will generally need to be more effective at commercialising their knowledge. However, as shown by Table 7, across a number of HEI commercialisation indicators there is little in the way of a pattern to suggest greater knowledge commercialisation activity within lagging regions. More noticeably, traditional universities generally accrue significantly higher levels of commercialisation income through contract research and research projects than post-1992 institutions. Furthermore, at an individual HEI level there is a significant relationship knowledge commercialisation and the overall labour productivity rates of universities ($r= 0.45$, $p <0.0001$) (Figure 1). This makes clear that it is the UK's most productive (and often larger) institutions that are most effective at commercialising and transferring their knowledge. The problem for the most uncompetitive regions is that whilst they may have one or possibly two institutions in this category, they do not possess a critical mass of institutions with such large productive capacities. This capacity may be related to issues of regional demand for university-generated knowledge and sources of finance. Interestingly, Table 7 indicates that Wales and North East England are the most successful regions in obtaining finance through collaborative research funding. While on the face of it this would appear to indicate adeptness in sourcing finance through collaboration and cooperation, a further interrogation of the data indicates that a significant proportion of this finance is

acquired through public sector sources, rather than the type of private sources indicative of knowledge commercialisation activity.

Table 7 and Figure 1 About Here

The right-hand column of Table 7 lists the proportion of commercialisation income HEIs source from within their region. Although at an institutional level, there is little relationship between overall HEI labour productivity and the proportion of knowledge commercialisation activity undertaken within a respective HEI's region, 'newer' institutions are significantly more likely to receive a higher proportion of their commercialisation income from sources within their region. It is noticeable that HEIs in Wales source only 8% of their commercialisation income from within the region, far lower than HEIs in any other region. This potentially indicates the existence of a lack of demand from firms within the region for the type of knowledge Welsh universities are capable of supplying. In other words, the productive capacity of universities in Wales is constrained by the regional business environment within which they are situated. This concurs with recent qualitative evidence of the weakness in demand from the business community in Wales for the knowledge-based services and activities of the regional higher education sector (Huggins et al., 2008b). This reinforces the contention that regional contexts are an important influencing factor on the economic and innovative performance of universities. Although the demand for university knowledge in the majority of regions is predominantly non-regional, such regional contexts are likely to further accentuate performance differences as universities increasingly engage in a market-based environment for the sourcing of knowledge (Bok, 2003).

Conclusions and Policy Implications

The evidence presented in this paper suggests that there are significant differences in the wealth generated by universities according to regional location and the type of institution. First, we find that universities in more competitive regions are generally more productive than those located in less competitive regions. Second, the results suggest that more traditional universities are generally more productive than their 'newer' counterparts, and that the overall economic and innovation performance of regions in the UK is generally inversely related to their dependence on the universities

located within their boundaries. Furthermore, we find that university productivity is positively related to knowledge commercialisation capabilities. Overall, these results point to significant variations in the wealth and knowledge generation capabilities of universities across UK regions. Weaker regions tend to be more dependent on their universities for income and innovation, but often these universities under-perform in comparison to counterpart institutions in more competitive regions. Therefore, it appears that knowledge commercialisation activity is a source of productivity advantages for universities, but markets for knowledge in less competitive regions appear to possess demand-side weaknesses.

In general, these findings tend to substantiate a growing body of literature which contends that the diversity of higher education institution types is not sufficiently recognised by policymakers, and also that such diversity means that the regional role of universities is likely to vary on an institution-by-institution basis (Lawton Smith, 2007; Abreu et al., 2008; Kitson et al., 2009). In particular, the paradox our findings suggest is that although some universities are relatively weak economic and innovation performers on a national scale, at a regional level they play a vital role as the providers of both wealth and innovation capacity. Although the analytical approach outlined in this paper has been rather binary in nature – competitive/uncompetitive region, old/new universities – in reality the picture is far more granulated (Abreu et al., 2008). Furthermore, the competition and hierarchy effects between different types of universities within a region add a further distinguishing layer of complexity (Boucher et al., 2003). The regional environment may also influence the actions of institutions. For instance, a relatively strong knowledge-generating university in a relatively weak region may have a greater propensity to engage with firms in other regions. Weak regions may be characterised by insufficient private sector economic activity and a higher than average density of small firms perceiving little benefit to be gained from engaging with the higher education sector. In the long-term, this may result in a leakage of knowledge from the home region serving only to exacerbate regional competitiveness differentials (Siegel et al. 2007).

From a regional policy perspective, although universities have a role to play in stimulating private sector demand for knowledge, in many cases this is necessarily

limited given their own wide-ranging portfolios of activities. Only a small number of institutions can be expected to be the transformers of the innovation capabilities and knowledge economies of their regions. As others have argued, the expanding role of universities whereby governments continue to 'pile' new functions and activities onto universities is often leaving them with a 'mission impossible' (Jacob et al., 2003; Nedeva and Boden, 2006). The promotion of regional science, technology and innovation policies is often placing universities at the centre of agendas to regionalise policies which at the national level are already overly fragmented and lacking in coherence (Perry and May, 2007; Laranja et al. 2008). If universities are to continue to play a regional role in this area it is vital that their knowledge commercialisation and transfer initiatives are fully supported to ensure sustainability and coherence. However, there is need to look for more broader policy solutions in the quest to transform uncompetitive regions into knowledge-based economies, particularly as future developments will need to be placed within a globalised knowledge environment. As Lester (2005) has argued at a national level, the standard science and technology model of engagement does little to harness the diversity of strengths possessed by the higher education sector.

In many ways universities are the 'multinationals' of this environment, and from a regional perspective the analogy between universities and multinationals is pertinent. For instance, the means by which policymakers have sought to embed multinationals in their region within clusters and supply-chains of economic activity (Huggins, 2001; Phelps et al., 2003), resembles the types of local linkage policymakers are seeking to create for universities through knowledge network and engagement processes. Given the evidence concerning the spatially constrained nature of university knowledge, the role of policymakers as the interlocutor across universities and the regional business community – to enhance the impact of this knowledge - appears logical, particularly as universities do not (yet) possess the same footloose tendencies in choice of location as their multinational counterparts (Kitson et al., 2009; Lehrer et al., 2009). However, there are clearly numerous challenge related to establishing economically meaningful knowledge-based relationships within a specific regional environment. Policymakers need to further understand the extent to which current interventions are alleviating market failure or stimulating new channels of knowledge flow resulting in improved economic performance. A key issue in less competitive regions appears to be the lack

of an appropriate critical mass of nodes in regional knowledge and innovation systems, which our findings suggest is manifested by their relative over-dependency on the higher education sector.

Evidence from leading regions around the world indicates that while universities can play an important role they are often supported by a dense system of institutions, including publicly-funded research institutes and laboratories dedicated to applied research, much of which has commercialisable potential. Most of the UK's least competitive regions have no such established research infrastructure, with many of the UK's public research institutes based in the southern regions, which, by no coincidence, are also the most economically competitive. To some extent, regional policymaking has attempted to imitate these institutions through the funding of elite research centres within the existing higher education framework. Whilst such initiatives may produce some benefits, they are far too diluted and under-resourced to replicate the impact of stand-alone research institutes, which are largely manned by academics who – like universities - continue to have a range of activities competing for their time. Rather than burden universities further, the focus of regional innovation and economic development policy may be better targeted at creating or attracting firms or other institutions with the potential to fill existing knowledge infrastructure gaps and establish agglomeration economies (Goldstein and Drucker, 2006). In other words, there is a necessity for other conditions, alongside high-performing universities to be in place (Christopherson et al., 2008).

Although this paper has necessarily focused on the material interdependencies between universities and regions, in the form of wealth and innovation creation, it is important that other research seeks to further evaluate the immaterial interdependencies generated through, for example, symbolism, reputation and branding (Power and Malmberg, 2008). It is, therefore, important to highlight that the focus on the direct wealth and knowledge-creating abilities of universities does overlook other important functions. Although many institutions may possess limited research bases, significantly reducing their ability and propensity to engage in these knowledge commercialisation activities, they often contribute to regional development in other ways, such as through cultural activities and the promotion of social inclusion, which can lead to wider organic links between business and

universities (Lockett et al., 2003; Chapple et al., 2005; Drucker and Goldstein, 2007; Abreu et al., 2008; Bramwell and Wolfe, 2008). In particular, these include third mission activities delivered by university outreach departments, such as professional education programmes. More fundamentally, the most important role of universities at the regional level will continue to be their human capital creation capacities and ability to produce highly skilled and employable new labour market entrants in the form of their graduates. Finally, there are multiplier effects through employment and student expenditure within host regions that significantly heighten the indirect wealth-generation benefits of universities beyond those we have sought to measure in this paper.

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Table 1: Higher Education Institutions by Region

Region	Number of HEIs per Region	Number of Pre-1992 HEIs per Region	Number of Post-1992 HEIs per Region	HEI Employment as a % of Total Regional Employment
East Midlands	9	3	6	0.96
Eastern England	9	4	5	0.73
London	39	21	18	1.56
North East	5	2	3	1.19
North West	14	4	10	1.04
Northern Ireland	2	1	1	0.86
Scotland	15	10	5	1.02
South East	17	8	9	1.02
South West	13	4	9	0.81
Wales	12	6	6	1.18
West Midlands	12	4	8	0.94
Yorkshire and the Humber	11	6	5	1.16
UK	158	73	85	1.05

Source: Higher Education Funding Council for England; Office for National Statistics

Table 2: Highest and Lowest Value Added Generating HEIs in the UK 2005/06 (£000s)

Rank	HEI	Region	Value Added (£) 2005/06
1	University of Cambridge	East of England	459,690
2	University College London	London	385,115
3	University of Manchester	North West	346,317
4	University of Oxford	South East	335,478
5	Imperial College London	London	321,775
6	King's College London	London	264,358
7	University of Leeds	Yorkshire and the Humber	246,999
8	University of Birmingham	West Midlands	241,101
9	Open University	South East	227,800
10	Cardiff University	Wales	211,881
149	Cumbria Institute of the Arts	North West	5,835
150	Royal Agricultural College	South West	5,740
151	Norwich School of Art & Design	East of England	5,733
152	Royal Welsh College of Music and Drama	Wales	5,626
153	RCN Institute	London	5,288
154	Leeds College of Music	Yorkshire and the Humber	4,381
155	Courtauld Institute of Art	London	4,091
156	Dartington College of Arts	South West	3,703
157	Rose Bruford College	London	3,363
158	Conservatoire for Dance and Drama	London	220
	Mean Average Pre-1992 HEIs		108,368**
	Mean Average Post-1992 HEIs		47,225**

Source: Based on data from the Higher Education Statistics Agency (** $p \leq 0.01$ – non-parametric Mann-Whitney test of difference)

Table 3: Highest and Lowest Value Added Generating HEIs per Full Time Equivalent Employee in the UK 2005/06 (£s)

Rank	HEI	Region	Value Added per Full Time Equivalent Employee (£)
1	London Business School	London	70,332
2	St George's Hospital Medical School	London	60,352
3	University of Cambridge	East of England	60,125
4	King's College London	London	57,312
5	University College London	London	54,443
6	Imperial College London	London	54,230
7	Royal College of Music	London	54,057
8	City University, London	London	51,587
9	London School of Economics and Political Science	London	51,512
10	Royal Veterinary College	London	50,399
149	University of Plymouth	South West	32,036
150	University of Sunderland	North East	31,723
151	Cumbria Institute of the Arts	North West	30,693
152	Leeds College of Music	Yorkshire and the Humber	30,092
153	University of Wales, Aberystwyth	Wales	29,849
154	Royal Agricultural College	South West	29,591
155	Trinity College Carmarthen	Wales	29,376
156	Central School of Speech and Drama	London	28,166
157	University of Chester	North West	28,034
158	Conservatoire for Dance and Drama	London	770

Source: Based on data from the Higher Education Statistics Agency

Table 4: HEI Value Added per Full Time Equivalent Employee in the UK 2005/06 (£s) by Region and Institution Type

Institution/Region Type	Value Added per Full Time Equivalent Employee (£)
Mean Average HEIs in Competitive Regions	42,429**
Mean Average HEIs in Uncompetitive Regions	37,501**
Mean Average Pre-1992 HEIs in Competitive Regions	46,088**
Mean Average Pre-1992 HEIs in Uncompetitive Regions	38,319**
Mean Average Post-1992 HEIs in Competitive Regions	38,655**
Mean Average Post-1992 HEIs in Uncompetitive Regions	36,884**
Mean Average Pre-1992 HEIs	41,831**
Mean Average Post-1992 HEIs	37,551**

Source: Based on data from the Higher Education Statistics Agency (** $p \leq 0.01$ – non-parametric Mann-Whitney test of difference)

Table 5: Regional HEI Value Added 2005/06

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

Source: Higher Education Statistics Agency; Office for National Statistics

Table 6: Higher Education Contributions to Regional Patenting and New Firm Formation Activities (2005/06)

Region	Cumulative portfolio of active patents as a proportion of regional patent applications	HE Spin-offs per New VAT registered company (000s)
Wales	0.95	62.6
North East	0.48	43.0
South East	0.31	34.7
Yorkshire and the Humber	0.43	29.6
Scotland	1.28	25.6
North West	0.20	23.9
East Midlands	0.39	21.1
London	1.07	20.7
West Midlands	0.31	13.2
Northern Ireland	1.18	10.5
Eastern England	0.22	8.2
South West	0.17	8.0
UK Average	0.52	23.1

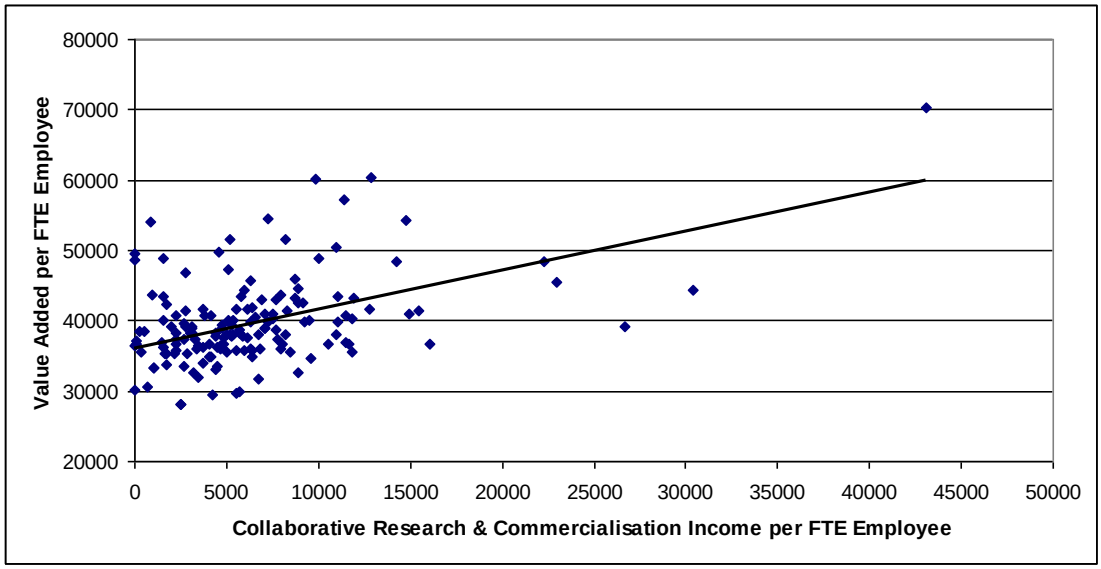
Source: Higher Education Funding Council for England; Office for National Statistics

Table 7: Regional Higher Education Knowledge Commercialisation Activity 2005/06 (£)

Region	Contract Research Income per FTE Employee (£)	Consultancy Contracts per FTE Employee	IP Income per FTE Employee (£)	Collaborative research involving both public funding and funding from business per FTE (£)	% of Commercialisation Income Generated from each HEI's Region
East Midlands	1,152	339	87	2,358	25.5
Eastern England	2,331	757	209	2,605	23.3
London	3,549	930	129	1,348	23.6
North East	2,080	1,636	37	3,844	21.9
North West	1,226	577	287	2,352	35.1
Northern Ireland	1,351	242	18	1,737	59.9
Scotland	2,617	1,054	444	3,196	22.6
South East	1,865	977	207	1,880	23.0
South West	1,801	1,145	290	902	18.2
Wales	1,572	845	99	4,348	8.4
West Midlands	2,634	586	378	1,148	24.4
Yorkshire and the Humber	2,271	381	33	1,040	29.8
Mean Pre-1992 HEIs	2,683**	1,315	283	3,343**	21.5**
Mean Post-1992 HEIs	544**	542	506	555**	38.3**

Source: Higher Education Funding Council for England (** $p \leq 0.01$ – non-parametric Mann-Whitney test of difference)

Figure 1: Relationship Between HEI Value Added per FTE employee and Income from Collaborative Research and Commercialisation per FTE Employee



Source: Higher Education Statistics Agency; Higher Education Funding Council for England