Entrepreneurial Universities and the Region: a Longitudinal Study of the UK Higher Education Sector

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ABSTRACT

Objectives.
Whilst the roles of institutional and locational characteristics of a university in determining its entrepreneurial performance level has been examined in prior research studies, they are not fully acknowledged in current UK policies facilitating linkages between academics and businesses. This paper investigates the extent to which universities of different types and across different regions compare with each other with regard to their performance in entrepreneurial activities.
Prior Work.
The entrepreneurial performance of universities may be affected by the competitiveness of their location. Less competitive regions tend to lack research infrastructures, leaving universities as the singular source of advanced knowledge. Governments have recently heightened expectations on universities by giving them new functions, including tasking them with becoming more entrepreneurial.
Approach.
The paper draws on the Higher Education-Business and Community Interaction Surveys (HE-BCIs) from 2003-2012 that examines the entrepreneurial activities of universities. It also uses the classification of UK HEIs and the UK Competitiveness Index (UKCI) to compare the performance of established (pre-1992) and new (post-1992) universities and to assess the relationship between entrepreneurial activities of universities, their age and geographical location.
Results.
More established universities performed best in generating income from entrepreneurial activities. Performance was affected more by institutional than locational characteristics. No significant difference was found between established universities in competitive and uncompetitive regions in their entrepreneurial activity income, but new universities were negatively impacted when located within weaker regions.
Implications.
Both established and newer universities are of importance to regional economic development, albeit in different ways. Specially tailored policies are therefore required to maximise universities' potential to contribute to economic development in various locations. These must recognise the differences within the range of institutions that comprise the sector that enables them to contribute more effectively in entrepreneurial activities.
Value.
Until recently, the complexity of the UK higher education sector has been largely absent in innovation policy agenda. This study offers both practical insights as well as a more nuanced understanding of the ability of universities to act more entrepreneurially. It tests the notion of the entrepreneurial university and sets it within the UK context.

1. INTRODUCTION

Universities are now increasingly portrayed as important entrepreneurial actors within systems of regional innovation (Cooke *et al.,* 2004; Foray and Lundvall, 1996; Huggins *et al.,* 2008; Jones-Evans *et al*., 1999; Kitagawa, 2004; MacKenzie and Zhang, 2014) due to their ability to engage in third mission activities which return an economic benefit over and above their core first (teaching) and second (research) missions. As a result, policymakers are not only looking to higher education institutions as sources of scientific and technological knowledge but as major contributors to the transfer of this knowledge into regional and national economies (Audretsch *et al.,* 2005; Wright *et al.,* 2007).

The main aim of this paper is to evaluate the recent progress of knowledge exchange activities in the UK higher education sector with a view to understanding the potential for universities to act as drivers of economic growth in other developed economies. To date, there has been little systematic analysis of the performance of knowledge exchange activities in higher education institutions (HEIs) across UK regions or their development during a longer period. This is surprising, given that the importance of university-business interactions has not only been addressed in various UK Government policy documents but also given priority through the introduction and implementation of a large number of funding schemes, initiatives, and programmes that are all designed to foster knowledge exchange between universities and other innovation actors.

Whilst the roles of institutional, departmental and locational characteristics of a university in determining its entrepreneurial performance level have been addressed by the extant literature (Clarysse et al, 2011; Kenney and Goe, 2004; Rasmussen et al, 2013), they have yet to be fully acknowledged in those UK policies facilitating linkages between academics and businesses (Abreu *et al.,* 2008; Kitson *et al.,* 2009; Lawton Smith, 2007). This is despite the consideration that these two factors should be of particular interest to policy makers given that there is not only diversity in the type of institution within UK higher education (Hewitt-Dundas, 2012) but that universities are located in areas with varying degrees of prosperity (Benneworth and Charles, 2005; Huggins and Thompson, 2010). Therefore, this paper will investigate the extent to which different types of universities based in different regions compare with each other with regard to their performance in entrepreneurial activities. The UK has been chosen as the focus of the study for three reasons: 1) it is has a well-developed and mature higher education system with well-established links to industry; 2) it collects statistics on higher education-business community interactions that provide economic returns to universities; and 3) the *UK Competitiveness Index* allows for regional comparisons across different territories to better understand the role of context in such interactions.

2. ENTREPRENEURIAL UNIVERSITIES

Various studies have shown that the activities of universities are increasingly being recognised as a key stimulant for knowledge-based economic development and determinant of regional competitiveness (Bok, 2003; Boschma, 2004; Etzkowitz, 1998; Goldstein and Renault, 2004; Klofsten and Jones-Evans, 2000). In particular, they can play a developmental role within the local business community as they establish programmes and facilitate networks that directly and indirectly support the regional economy (Klofsten et et al., 1999; Keane and Allison, 1999). In fact, higher education policies continue to encourage universities to become more engaged with regional business and innovation, which have brought knowledge exchange practices to the fore of policy landscape (Jones-Evans, 1998; Lambert, 2003; National Committee of Inquiry into Higher Education, 1997; Sainsbury, 2007; Wellings, 2008; Whitty, 2013; Wilson, 2012). However, one theme that has received less attention in the literature is the relationship between the performance and intensity of the entrepreneurial activities of universities that result in knowledge exchange with the business community. Although it could be assumed that universities with high performance are also more actively involved in entrepreneurial knowledge-based activities, the opposite could also be true. In other words, some universities are able to generate a high volume of income from a small number of large collaborative partnerships. For example, one may face a dilemma when attempts to compare a university of this type with another university which is intensively engaged with a large number of small-scale collaborations as would be likely in more peripheral regions dominated by small firms. As Jones-Evans (1998) notes, it may therefore be more relevant from a policy perspective to match what

universities can provide with what firms actually need rather focusing on generating the largest amount of financial outcome.

This research will also examine the contextualised and embedded factors that could explain the regional differences in the dominance of knowledge produced by academics. Adding a regional dimension to our analysis of how policy makers should heighten the impacts of universities is important as regions, especially those less successful ones, are challenged by the regional innovation paradox (Oughton et al., 2002). Indeed, universities are more likely to be amongst the most important research and innovation assets in weaker regions and are therefore a key part of policy efforts in those regions to support knowledge-based economic development (Jones-Evans, 1998; Boucher et al., 2003).

2.1 Institutional factors

Whilst universities have tended to integrate economic development activities that are directly relevant to their normal missions, i.e. teaching and research (Etzkowitz, 1998), they are becoming increasingly engaged with various types of partners in different modes of networks at local, regional, national, and international levels. Knowledge flows between universities and private sector firms have been the focus of a large body of literature, which has tended to further distinguish between different types of firms in terms of size, research intensity, and geographical location. As Huggins et al. (2008) argued, small to medium-sized enterprises (SMEs) could be regarded by universities as inferior and less lucrative collaborators in comparison to their larger counterparts that are also often internationally based and R&D intensive, This is in contrast with the fact that SMEs, with limited resources devoted to in-house research, are in greater need of university-produced knowledge than large companies. Although high-technology industries are considered to be the main partners of universities due to closer research focus between the two, it has been suggested that universities are also increasingly involved with less technologically intensive industries (Meyer-Krahmer and Schmoch, 1998; Pavitt, 1984). However, it might be expected that links between academics and firms in older industries may take different forms from those for high-technology companies. While high technology firms tend to build research-based partnerships with universities, other SMEs may rely on non research-intensive universities to provide consultancy, student placements, and facilities and equipment related services.

The focus of early research on university-industry linkages has largely been on knowledge transfer through activities such as patent licensing which deploys academic know-how to specific users. This approach has tended to benefit more research-intensive universities where the generation of scientific knowledge is the main focus for such institutions. More recent research has argued that the importance of intellectual property (IP) activities has been overestimated and that focusing narrowly on IP channels underestimates the comprehensive roles of universities (Abreu et al., 2008; Hewitt-Dundas, 2012; Huggins et al., 2012). For instance, some previous studies have found that a focus by universities on academic quality appears to be negatively associated with participation in collaboration activities (D'Este and Patel, 2007; Ponomariov, 2008). This seems to suggest that academics in lower quality research institutions may be more motivated to embrace industry collaboration and it can be argued that such universities have a lower degree of resource munificence for academics, which motivates, or forces, their employees to acquire external research funds by working with business.

However, other studies have made the case that the most research-intensive universities possess strong networks with external organisations (Huggins et al., 2010b; Lockett et al., 2003). This is because world excellent research in these institutions serves as a magnet for large, global industrial partners that often pursue best knowledge regardless of its location. For example, Lawton Smith (2003) found that the four UK universities with the highest research income and quality – University of Oxford, University of Cambridge, University College London and Imperial – were also the leading performers in areas of spin-offs, patents, and licences. This echoes the positive correlation between the institutional research performance and the individual participation in knowledge commercialisation identified in many other studies (Di Gregorio and Shane, 2003; O'Shea et al., 2005). The presence of technology or knowledge transfer offices, as well as their capabilities, are also thought to be a factor influencing the capability of academics to engage in knowledge exchange (Carlsson and Fridh, 2002; Jones-Evans et al., 1999; Markman et al., 2005; Phan and Siegel, 2006).

There is currently a lack of empirical studies examining the entrepreneurial activities of universities from a wider perspective to carefully compare how they are involved in activities beyond simple

knowledge commercialisation. Whilst research-intensive universities might outperform their counterparts in IP related activity, they may not necessarily do so in other categories of engagement. Indeed, it has been suggested that the participation and promotion of knowledge exchange activities are largely conditioned by the missions, strategies, values, and cultures of individual universities (Kitagawa and Lightowler, 2013; Vorley and Nelles, 2009). Unfortunately, comparative empirical evidence of the role of institutional contexts in academic engagement is rather scarce although a relatively large body of literature has examined institutional-level factors in encouraging commercialisation activity, especially since the introduction of policies like the Bayh-Dole Act (Mowery and Sampat, 2005; Powers and McDougall, 2005). These studies suggest that participation in knowledge commercialisation is positively related to the level of competition that academics face (Goldfarb and Henrekson, 2003). This is not surprising as intense competition for resources would understandably motivate academics to become more actively involved in searching for partners and securing extra research funds which would otherwise be unavailable. In a sense, the way in which competition drives academic engagement is similar to how being in lower quality university motivates researchers to work with business i.e. academics are likely to respond to unfavourable conditions by devoting themselves more to build partnerships.

2.2. Regional factors

Whilst universities have been viewed as an important source of competitiveness by regional policy makers, it is necessary to point out that university knowledge networks are not always spatially bounded and can be both local and global (Andersson and Karlsson, 2007). For example, the study by Cooke et al. (2002) of Tel Aviv, Belfast, and Cardiff found evidence that universities have much stronger interactions with businesses at national and international levels than at regional level. It has also been claimed that knowledge sourced globally by firms may be superior to that from local sources (Davenport, 2005; Johnson et al., 2006), which might help explain the rising levels of national or international partnerships involving academics and businesses, especially involving research-intensive institutions. In weaker regions where the industrial base is dominated with a large number of small firms, universities and academics may be forced to find their partners elsewhere as proximate firms are lacking the absorptive capacity to commercialise the knowledge they can provide. However, there is still no simple answer to the question of how does the geographical feature of knowledge networks impact on the effectiveness of academic-industry linkages and foster the innovativeness of the business partners.

In general, there has been an increase in the level of policy expectations for universities to impact on economic development through supporting the embedding of innovation activity at a regional level (Etzkowitz and Klofsten, 2005; Rasmussen et al, 2006). However, less is known about the actual processes of knowledge flows between academics and businesses and how these processes vary across regions (Huggins and Kitagawa, 2012; Porter and Ketels, 2003; Power and Malmberg, 2008). This lack of understanding complicates the design and implementation of policies aiming to fully realise the direct and indirect contribution of universities make to economies (Kelly et al., 2002). As discussed earlier, the bulk of current literature has tended to focus on IP-related activity and therefore empirical studies examining a wider spectrum of academic engagement are needed to understand how university knowledge flows, in what ways, between whom, and to where. In addition, research has suggested that the impact of universities varies not only over space but also over time (Cohen and Levinthal, 1990; Nelson, 1988; Pavitt, 1984). As a result, directions which future research could possibly follow include examining regional differences in the structure of university knowledge networks and tracking the evolution of knowledge networks within the same region throughout a longer period to identify factors underlying those changes.

Policy interventions to increase territorially focused university-industry interactions are often justified by the claim that university knowledge tends to spill over within a certain geographical distance, showing the phenomenon of the so-called localised knowledge spillovers (Giuri and Mariani, 2013; Munari et al., 2012; Raspe and van Oort, 2011). A growing body of literature has emerged on the subject, represented by case studies on U.S. high-tech clusters (Saxenian, 2006), Italian industrial districts (Piore and Sabel, 1984), and innovative milieus (Breschi and Lissoni, 2001a). Localised knowledge spillovers could, according to Breschi and Lissoni (2001b), be first and foremost defined as knowledge externalities bounded in space that allows companies operating nearby important sources of knowledge such as universities, to introduce innovation at a faster rate than rival firms located elsewhere. This stream of studies has attributed these local knowledge spillovers to the fact

that knowledge is often tacit and sensitive to the distance between the organisations which attempt to exchange knowledge effectively.

Not surprisingly, an early focus of studies on the regional impact of universities has been on examining linkages associated with codified forms of knowledge such as "patent activity … and innovation rates" (Howells, 2002). For example, Jaffe's (1989) study assessed the effects of academic research and showed that corporate patent activity at the U.S. state level was influenced by the R&D spending performed by local universities, after controlling for corporate R&D and state size (measured by population). Using patent citations, Jaffe et al. (1993) studied the geography of knowledge spillovers from academic research into corporate R&D. In order to control for the pre-existing geographic concentration of production, the paper matched each citing patent to a non-citing patent. One finding was that firms were more likely to cite research from a co-localised university with relevant research strengths than from universities from elsewhere. Similar findings on the influence of universities on regional innovative output have been observed in Europe. For example, an innovation survey covering regions across a number of European countries showed that most of the private sector cooperation partners of universities are located at relatively close distance (Fritsch, 2003, 2005). On a national level, the work of Fischer and Varga (2003) provided evidence on the importance of knowledge spillovers from university research activities to regional knowledge production in Austrian high-technology industries. In France, Ronde and Hussler (2005) confirmed that the interrelationships developed between the actors within the territory determine regional innovativeness whilst similar evidence has been found from empirical analysis of Italy (Piergiovanni et al., 1997) and Sweden (Andersson and Ejermo, 2004). As empirical studies have tended to be narrowly focused on patentable knowledge, more theoretical supports are required to clarify the concept of knowledge spillovers. In fact, Jaffe et al. (1993) acknowledged the reliance of their study on patent and citation data and proposed further research to include a wider range of mechanisms of knowledge transfer. Therefore, whilst it is a sound idea to quantitatively analyse the spillover effect of both codified and tacit knowledge but the challenge is about how to measure tacit knowledge and track its spillovers in practice.

However, it is not a simple case of causality between university R&D and regional innovation, as the mere presence of a university does not guarantee that it would contribute significantly to the performance of an innovation system (Fritsch and Slactchev, 2007). In this view, arguments such as that of Jaffe (1989) where "a state that improves its university research system will increase local innovation by attracting industrial R&D and augmenting its productivity" may be arbitrary without considering it is also possible the case that increases in university outputs are caused by increases in industrial R&D. One may find it is more likely that universities' knowledge production and industrial innovation facilities are in a circle, with increases in one facilitating and stimulating further growth of the other. Thus it is not hard to see an increasing number of studies such as Feldman (1994) questioning the generality of the role of university in fostering regional industrial innovation. Indeed, Greunz (2005) has argued that the level of patenting within a region is not just related to the knowledge created by universities, implying the contribution of other sources such as public research institutes (Beise and Stahl, 1999). In this respect, evidence from global leading regions seems to suggest that, in those areas, "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" (Huggins and Johnston, 2009a). In contrast, less competitive regions tend to show a lack of this type of established research infrastructure, leaving universities as the most important, but alone, source of advanced knowledge. Governments in such regions therefore further reinforce their expectations on universities by piling new functions and activities onto them that then often leaves universities with a 'mission impossible' (Jacob et al., 2003; Nedeva and Boden, 2006). In other words, the overdependency on the higher education sector in some regions may turn out to be harmful to those universities.

3. THE UK HIGHER EDUCATION SECTOR.

Various rankings, including the Times Higher Education and the QS World University Rankings, have suggested that the UK possesses the second-strongest university system in the world after the U.S. For example, the most recent QS 2013 results shows that the UK now has six of the world's top 20 universities, with Cambridge, UCL, Imperial and Oxford making into the top 10. Besides its global research excellence, an even more notable feature of the UK higher education sector is the

remarkable longevity it demonstrates. In the UK, ancient universities (i.e those medieval and renaissance universities founded before the 17th century) continue to exist and thrive. Oxford is the oldest university in the English-speaking world and it can lay claim to 900 years of continuous existence. Other well-known examples of ancient universities include the universities of Cambridge (founded in 1209), St Andrews (1413), Glasgow (1451), Aberdeen (1492) and Edinburgh (1583).

In the Victorian era, six 'civic' universities were founded in the industrial cities of England and achieved university status before the Second World War. They became known as 'Redbrick' universities, a term inspired by the fact that the Victoria Building at the University of Liverpool was built from a distinctive red pressed brick with terracotta decorative dressings. The original six civic red brick universities were Birmingham, Bristol, Leeds, Liverpool, Manchester and Sheffield, all of which concentrated on educating their students in 'real-world' skills often linked to engineering. It was this deliberate emphasis on a practical higher education that distinguished the redbrick universities from their ancient counterparts such as Oxford and Cambridge.

The size of the UK higher education sector continued to grow in the 20th century, especially in the 1960s when several more universities were founded following the release of the Robbins Report (the report of the Committee on Higher Education), which recommended immediate expansion of universities through granting all Colleges of Advanced Technology the status of universities. In some cases, these so-called 'Plate Glass' universities were older schools than the redbricks although the new Royal Charters granted made them formally universities. At the same time, the UK witnessed the establishment of many polytechnics that centred on professional and vocational programmes of study and complemented those older and more academically orientated universities. By granting university status to 58 higher education institutions that had previously been known as polytechnics, the Further and Higher Education Act 1992 ended the 'binary divide' and further accelerated the expansion of the sector. These institutions are in general called 'post-1992 universities' or 'new universities' although many of them may have an earlier origin.

As the UK higher education sector has become more diverse than ever, its mission has also been redefined as a response to the major shifts in expectations that universities should make an active contribution to the development of their regions (Chatterton and Goddard, 2000). The ineffectiveness of translating scientific work into business innovation in the UK was famously espoused back to the early 20th century by Marshall, who stated that "the small band of British scientific men have made revolutionary discoveries in science; but yet the chief fruits of their work have been reaped by businesses" (Marshall, 1919). Whilst the introduction of the 1993 *Realising Our Potential Awards*, the UK government showed an increased focus on the impact of university-business interactions (Abreu *et al.,* 2008), the first major study into the impact of universities at a regional level did not appear until the Dearing report (National Committee of Inquiry into Higher Education, 1997) which noted that "Universities should no longer be seen as isolated islands of knowledge. Instead, higher education was to be seen as a significant force in regional economies, as a source of income and employment, as contributing to cultural life, and supporting regional and local economic development". This set off a series of reports over the next fifteen years that began emphasising the inter-relatedness of research and economic benefit. In a 2000 White Paper titled "Excellence and Opportunity", the government proposed a number of initiatives and programmes to create clusters of innovation that drew universities and businesses together and to ensure that excellence in science was turned into products and services (DTI, 2000). The UK Science and Innovation Investment Framework for the period 2004-2014 further embedded the notion of translating the knowledge base more effectively into business and public service innovation (HM Treasury, 2004). Other reports were generated which specifically examined how to maximise the impact of universities on knowledge exploitation and economic development. The Lambert (2003) review concluded that government would have to do more to support business-university collaboration and that business will need to learn how to exploit the innovative ideas that are being developed in the university sector. A review of the current and future role of technology and innovation centres in the UK (Hauser, 2010) concluded that If the UK is serious about creating a 'knowledge-economy', the gap between universities and industry must be closed through a 'translational infrastructure' to provide a business-focused capacity and capability that bridges research and technology commercialisation". Two more recent reports (Wilson, 2012, Whitty, 2013) have continued this thinking, suggesting that universities should make facilitating economic growth a core strategic goal.

The significance of converting scientific progress into economic success was highlighted when, drawing on the conclusions of these reports, the UK government began a series of funding schemes to boost knowledge exchange activities in the university marketplace. In 1999, the Higher Education Funding Council for England (HEFCE) established the Higher Education Reach-out to Business and the Community Fund (HEROBC) for the purpose of enhancing the contribution that universities make to the economy and society (HEFCE, 2000). The Higher Education Innovation Fund (HEIF) succeeded this in 2001, with the current incarnation of the fund running from 2011 to 2015 (HEFCE, 2011; PACEC, 2012). In 2004, the Higher Education Funding Council for Wales (HEFCW) founded its Third Mission (3M) Fund which then evolved into the Innovation and Engagement (I&E) Fund (HEFCW, 2009, 2011). Northern Ireland also runs an adaption of HEIF in England while Scotland offers its own Knowledge Transfer Grant (DELNI, 2010; SQW, 2009).

4. METHODOLOGY

4.1. The HE-BCI survey

This paper utilises data gathered by the HE-BCI survey to examine the performance of entrepreneurial universities in the UK. Published by the Higher Education Funding Council (HEFCE) on behalf of all UK HEIs and the national funding bodies, the HE-BCI survey has been collecting data for over a decade. It views interactions from a broad perspective, and measures wider elements such as collaborative research, contract research, consultancy, facilities and equipment related services, as well as intellectual property (IP) channels.

Whilst the HE-BCI survey was originally published in 1999/2000, there was a major revision of the framework underlying the data collection process in 2002/03. As a result, the HE-BCI survey collected data through two pathways: one for strategy and infrastructure, and the other for financial, numeric (time-bound) data. Given the main concern about the actual performance of universities, our analysis focuses on the latter type of data. The results for 2002/03 had to be eliminated as in that year universities did not report their income from courses for business and the community. In contract research, the HE-BCI survey of 2002/03 only collected income contributed by the private sector, rather than that from the public sector or third sector. The absence of these income sources is likely to have a significant impact on the total income generated by universities as courses for business are the most important source of income for UK universities.

Therefore, this paper analyses the results of the HE-BCI surveys from 2003/04 to 2011/12, spanning an eight-year period. The number of HEIs reporting to the survey varies from year to year as some universities choose to submit an optional nil return. For the purpose of consistent comparison, we compare the 133 members of Universities UK (UUK), an organisation that includes virtually all the universities in the UK and some colleges of higher education. Most of these universities have been able to submit effective results to the survey during the whole period. The number of universities finally included in our analysis ranges from 128 in 2008/09 to 131 in 2010/11 and 2011/12, yielding a reliable sample pool. In order to control for the size difference of UK universities, the number of academics full-time equivalents (FTEs) employed in the corresponding year has been drawn from the Higher Education Statistics Agency (HESA).

As viewed by the HE-BCI survey, universities interact with business and the community in a wide spectrum of activities, including not only intellectual property (IP) channels but also various types of research partnerships. Knowledge exchange activities of universities are set out by the survey that assesses the performance of universities in measure of collaborative research income, contract research income, consultancy income, facilities and equipment (F&E) related services income, as well as income from courses for business and IP activity. These elements of knowledge transfer activities will be examined in this paper. However, it is worth noting that although the UK has well-established and high rates of university spin-out activity in terms of numbers of spin-offs created (Wright et al, 2007), which is captured by the HE-BCI survey, the survey does not capture the financial return on spin-out companies thus making it difficult to assess the performance of universities regarding this measure. This measure is therefore excluded from our analysis on the basis of a lack of recording and consistency of what data is available which tends to be collated from news reports and is therefore inconsistent and piecemeal.

In the aim of capturing regional divergence, we used the classification of regions defined by the *UK Competitiveness Index* (UKCI), which comprehensively assesses the relative economic competitiveness of the 12 UK NUTS1 (Nomenclature of Territorial Units for Statistics) regions (Huggins, 2002). The Index was published firstly in 2002, then in 2005, 2006, 2008, and most recently in 2010. Although the exact rankings of each region may change over the period, the regions performing above the UK average and were therefore recognised as being competitive remained the same, namely East of England, London and the South East of England. Therefore, for the purposes of this paper, these three regions could be categorised as competitive regions, with the remaining nine regions being labelled as uncompetitive (Huggins and Thompson, 2010). It is on this basis that this study moves on to examine whether universities in the two types of regions perform differently in generating entrepreneurial activity income, i.e. how the regional context impacts on the scale and scope of knowledge exchange between universities and their stakeholders.

In terms of the categorisation of UK universities, prior studies have usually grouped them according to factors such as research intensity and mission statements (Abreu *et al.,* 2009; Hewitt-Dundas, 2012; Huggins *et al.,* 2012). Abreu *et al.* (2009) compared the entrepreneurial performance of the Russell Group (research-intensive UK invite only group of universities akin to the U.S. Ivy League), other established universities (formed before 1992 but not Russell Group), post-1992 universities (mainly ex-polytechnics), and others (mainly art schools and agricultural colleges). Huggins *et al.* (2012) acknowledged the diversity of UK HEIs, and in particular found that "established universities tend to be more research focused and may have a greater attraction for external organisations". With this in mind, we adopt Huggins *et al*'s classification of UK HEIs and compare the performance of established (pre-1992) and new (post-1992) universities. Consequently our findings are based on the analysis of activities of two different types of university – established and new – within two different types of region – competitive and uncompetitive.

5. RESULTS

5.1 Entrepreneurial activity income of UK universities by type of university

Table 1 shows the total income generated by UK universities per academic FTE as well as performance in the six key types of entrepreneurial activities identified within the HE-BCI survey namely collaborative research, contract research, consultancy research, F&E related services, courses for business and the community and IP activity. It shows that established universities tended to generate much higher income from knowledge exchange activities than their new counterparts did per full time employee, suggesting that old universities were more capable of turning research into tangible economic outcomes. Given that established universities, particularly in the UK context, are more research-intensive and carry out more research as well as committing more funds to it, their stronger performance in knowledge exchange is perhaps unsurprising. Our results also show that the two groups of universities were always significantly different (at the $p < 0.01$ level) throughout the period in income from collaborative research, contract research, IP activity and in total income. In all of these measures, we found that established HEIs outperformed their new counterparts. Therefore not only did old universities lead their newer counterparts in absolute amounts of average income of collaborative research and contract research, but they also showed a higher level of compound annual growth rate, implying the gap between the two groups widened further across the years. For example, every academic FTE in established universities had collaborative incomes 3.66 times greater than in new universities in 2011/12, up from 3.19 times in 2003/04.

In traditional categories such as IP activity and total income, new universities seemed to be catching up although the two groups were still significantly different in the income levels in 2011/12. During the period measured, academics in new universities showed a CAGR of 16.95 per cent in IP activity more than double that of academics based at older institutions although one has to bear in mind that new universities started at a much lower level than the old ones. In general, the gap between the two groups of universities in total income had slightly narrowed. The ratio of average total income per academic FTE of established universities to new universities shrank from 2.26 in 2003/04 to 2.13 in 2011/12. However, it is worth noting that although new universities in the UK are still lagging behind their old counterparts in making economic returns from community engagements, they should be highly recognised for their efforts in, and achievements of, catching up with those more research intensive and resource-endowed institutions during the past decade.

Consultancy research showed a very different pattern than the other two types of research linkages – collaborative research and contract research – as the two groups did not show significantly different performance in this activity until the most recent year. In F&E related services, established universities always performed significantly better than new institutions even though the level of significance might vary by year. Whilst established universities have always shown better performance than new universities in delivering courses to external organisations, there was no significant difference in the first couple of years between the two groups. The difference became significant (at the $p < 0.10$ level) in 2005/06 and remained so in the years to come (at the $p < 0.01$ level). Even so, new universities have developed their performance at a much higher growth rate than old institutions, which has actually helped to narrow down the real gap between the two groups in business courses.

Table 1. Established universities vs. new universities in six types of activities, £000s per academic FTE

	Mean 2003/04	Mean 2011/12	Δ 2003/04-2011/12	Trend 2003/04-2011/12	CAGR %
Collaborative research					
Established	6.64	8.75	2.11		3.51
New	2.08	2.39	0.31		1.75
Contract research					
Established	5.73	9.67	3.94		6.76
New	1.98	2.20	0.22		1.33
Consultancy research					
Established	2.22	3.65	1.43		6.41
New	1.76	2.66	0.90		5.30
F&E related services					
Established	1.05	2.32	1.27		10.42
New	0.34	0.66	0.32		8.64
Courses for business and the community					
Established	5.89	9.77	3.88		6.53
New	3.50	8.26	4.76		11.33
IP activity					
Established	0.36	0.62	0.26		7.03
New	0.04	0.14	0.10		16.95
Total income					
Established	21.89	34.78	12.89		5.96
New	9.70	16.31	6.61		6.71

Notes:

1. All column figures in this table used the same axis format (minimum value and maximum value) to reveal regional differences.
2. CAGR (Compound Annual Growth) was used to determine an 'average' annual growth rate over the whole period.
3. Mann-Whitney test was used to test whether the two samples were independent for each variable. † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

Source: Based on data from the Higher Education Statistics Agency.

5.2 Entrepreneurial activity income of UK universities by type of region

A further question we sought to answer was how the competitiveness of the region in which a university is located impacts on its entrepreneurial activity income. To determine this, we compared the entrepreneurial performance of universities in competitive locations (South East England, London, and East of England) with universities in less competitive regions (Table 2). We found significant difference between the two groups in total income in the years of 2004/05, 2005/06, and 2011/12 (all at the $p < 0.10$ level). In the remaining years, the two groups did not show significantly different performance, although the absolute performance of universities in competitive regions was always higher than that of universities elsewhere. When relating this finding to what is revealed by table 1, it is reasonable to propose that, in the UK, institutional characteristics of universities are more closely associated with their entrepreneurial performance than locational characteristics.

During the whole period, we found no significant difference between the two groups in contract research income and IP income, suggesting that academics in each type of region generated similar income from engaging in these two types of activities. With regard to contract research, universities in uncompetitive regions have been catching up by showing a CAGR of 6.52 per cent, higher than those in leading areas. IP activity told a very different and interesting story than the other types of activities. In the beginning of the period, universities in lagging regions actually showed a higher level of IP income than their counterparts situated within the 'Golden Triangle' area. It was not long after when they lost this advantage as a result of fast growth of universities based in South East England, London, and East of England in licensing IP. With a CAGR of 15 per cent, universities in competitive regions soon took the leading position and strengthened their advantage recently.

In sub-groups of collaborative research, consultancy research, F&E related services and courses for businesses, we could not find significant difference across most years. The two groups did not show significantly different income from collaborative research until 2011/12, when universities in uncompetitive regions reported higher income than those in competitive areas (statistically significant at the $p < 0.10$ level). More importantly, they started at a lower level than those in competitive regions but showed a much higher rate of growth over the period. The difference between the two groups in consultancy research was only significant in 2003/04 while in F&E related services the difference became significant only in 2007/08. In these two types of engagements, universities in competitive regions not only always showed higher levels of income but gained higher growth rates than institutions situated in lagging areas, suggesting widening gaps between the two groups in these measures.

Universities in competitive regions secured more income by delivering courses for business and the community than those in less competitive areas throughout period examined. Their difference became significant for the first time in 2010/11 (at the $p < 0.05$ level) and remained so in 2011/12 (at the $p < 0.01$ level). Whilst it is only in recent years that there have been significant differences between the two groups, universities in less competitive regions actually showed a higher growth rate over the whole period. Income from business courses generated by every academic FTE at universities in competitive regions increased to £14,650 in 2011/12, much higher than that generated by academics in uncompetitive areas (£5,220). Therefore, although the ratio of the two numbers has narrowed between 2003/04 and 2011/12, the gap between the two groups in the absolute income from business courses has actually broadened.

5.3 Entrepreneurial activity income of established universities by type of region

Analysing the entrepreneurial performance of established universities by type of region yielded a set of results, which suggests that regional competitiveness does not significantly impact on established universities' income level of knowledge exchange activities (Table 3). In any given year, we found no significant difference between established universities in the two types of regions in their total entrepreneurial activity income. Again, this is perhaps unsurprising as established universities have, by their nature and by virtue of their age and longevity, a developed (and probably mature) set of business and community networks and relationships both within and outside their respective regional locales, including worldwide partnerships, to facilitate knowledge exchange. Consequently, these types of relationships probably insure them against the negative impacts their regional situations could otherwise have.

Table 2. Universities in competitive regions vs. universities in uncompetitive regions in six types of activities, £000s per academic FTE.

	Mean 2003/04	Mean 2011/12	△ 2003/04-2011/12	Trend 2003/04-2011/12	CAGR %
Collaborative research					
Competitive	4.64	4.75	0.11		0.29
Uncompetitive	4.23	6.25	2.02	†	5.00
Contract research					
Competitive	4.50	6.42	1.92		4.54
Uncompetitive	3.47	5.75	2.28		6.52
Consultancy research					
Competitive	2.04	3.67	1.63		7.62
Uncompetitive	1.96	2.82	0.86	*	4.65
F&E related services					
Competitive	0.95	2.45	1.50		12.57
Uncompetitive	0.54	0.87	0.33	†	6.14
Courses for business and the community					
Competitive	8.05	14.65	6.60		7.77
Uncompetitive	2.49	5.22	2.73	* * *	9.69
IP activity					
Competitive	0.17	0.52	0.35		15.00
Uncompetitive	0.22	0.29	0.07		3.51
Total income					
Competitive	20.35	32.45	12.10		6.01
Uncompetitive	12.92	21.21	8.29	† † †	6.39

Notes:

1. All column figures in this table used the same axis format (minimum value and maximum value) to reveal regional differences.
2. CAGR (Compound Annual Growth) was used to determine an 'average' annual growth rate over the whole period.
3. Mann-Whitney test was used to test whether the two samples were independent for each variable. † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

Source: Based on data from the Higher Education Statistics Agency.

Table 3. Established universities in competitive regions vs. established universities in uncompetitive regions in six types of activities, £000s per academic FTE

	Mean 2003/04	Mean 2011/12	Δ 2003/04-2011/12	Trend 2003/04-2011/12	CAGR %
Collaborative research					
Est in Com	6.74	6.30	-0.44		-0.84
Est in Uncom	6.56	10.75	4.19	* * * * *	6.37
Contract research					
Est in Com	6.11	9.18	3.07		5.22
Est in Uncom	5.44	10.07	4.63	†	8.00
Consultancy research					
Est in Com	2.50	3.90	1.40		5.72
Est in Uncom	2.00	3.45	1.45	†	7.05
F&E related services					
Est in Com	1.30	3.67	2.37		13.85
Est in Uncom	0.86	1.22	0.36		4.47
Courses for business and the community					
Est in Com	10.60	17.15	6.55		6.20
Est in Uncom	2.20	3.78	1.58		7.00
IP activity					
Est in Com	0.26	0.72	0.46		13.58
Est in Uncom	0.43	0.54	0.11		2.89
Total income					
Est in Com	27.50	40.92	13.42		5.09
Est in Uncom	17.49	29.80	12.31		6.89

Notes:

1. All column figures in this table used the same axis format (minimum value and maximum value) to reveal regional differences.
2. CAGR (Compound Annual Growth) was used to determine an 'average' annual growth rate over the whole period.
3. Mann-Whitney test was used to test whether the two samples were independent for each variable. † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

Source: Based on data from the Higher Education Statistics Agency.

In a few indicators such as F&E related services income, income from courses for business and IP income, established universities in competitive regions and in uncompetitive regions also reported similar performance during the whole period. Among these three types of activities, courses designed for business was the area where established universities in less competitive regions grew faster than their counterparts in competitive regions, while in F&E related services and IP activity, regional competitiveness seemed to be positively associated with the annual growth rate shown by established universities.

Significant differences were found in three entrepreneurial activities. The average income from collaborative research generated by established universities in competitive regions declined over the period from £6,740 per academic FTE in 2003/04 to £6,300 in 2011/12. By contrast, with a CAGR of 6.37 per cent, older institutions in less competitive areas not only caught up with their counterparts in competitive regions but also showed significantly higher performance in the most recent years. In 2009/10, the difference between the two groups in collaborative research income became significant (at the $p < 0.05$ level) for the first time and remained significant at the 0.01 level in the next two years.

What this suggests is that established universities are not constrained by the economic competitiveness of their locale in engaging in collaborative projects. Instead, being situated within a weaker region seems to drive old institutions to seek collaborative research projects more proactively, which could be partly due to a lack of proximate firms that require the knowledge provided by those universities. Academics based at those institutions would put more efforts in building external, either national or international, partnerships with the business world. Furthermore, it could be the willingness to making the efforts, in addition to the research capability, that helps established universities in lagging regions outperform their counterparts in more advanced areas.

For both contract research and consultancy research, significant differences were found in a singular year: 2008/09 for the former type and 2011/12 for the latter. Before 2008/09, established universities in competitive regions showed better performance of contract research than those in weaker regions but the difference was not significant. When the difference became significant for the first time (at the $p < 0.10$ level), it was those older institutions in weaker regions that reported higher income than their counterparts in the leading areas. In consultancy research, the income generated by universities was found to be positively associated with the competitiveness of the location where institutions were based, but the difference did not become significant until the very recent year (at the $p < 0.10$ level).

5.4 Entrepreneurial activity income of new universities by type of region

In this analysis, we found that new universities are affected by regional competitiveness (Table 4). The most significant differences between the two groups were found in the level of total income and income from courses for business. More specifically, we found that in these two measures, new universities in competitive regions perform better than their counterparts in uncompetitive regions.

From 2004/05 onwards, the total income per academic FTE of new universities in competitive regions has not only always been significantly higher than that of post-1992 institutions in places beyond the 'Golden Triangle' but has been developing at a higher annual growth rate. Given that we asserted earlier that established universities often have connections which go beyond their regional locales, this finding could imply that the regional profile has a stronger influence on new universities who, in the absence of an established reputation and mature relationships, may be more dependent on regional collaborations. Indeed, the strong vocational origins of many new universities in the UK tend to indicate their focus on meeting the skill needs of regional workforce.

Table 4 also compares the performance of the two groups in the six categories of knowledge exchange activities and shows that the difference between the two groups in total income is largely due to their varying capabilities of generating income from courses for business and the community. In activities such as collaborative research, contract research and IP, there was no significant difference between the two groups in any given year. Although significant differences were found in the cases of consultancy research and F&E related services, they only appeared in a singular year (2003/04 for consultancy research and 2007/08 for F&E services), which suggests that in the most recent four years, the two groups showed comparable levels of performance in both activities.

Table 4. New universities in competitive regions vs. new universities in uncompetitive regions in six types of activities, £000s per academic FTE.

	Mean 2003/04	Mean 2011/12	△ 2003/04-2011/12	Trend 2003/04-2011/12	CAGR %
Collaborative research					
New in Com	2.00	2.73	0.73		3.97
New in Uncom	2.13	2.20	0.07		0.41
Contract research					
New in Com	2.47	2.81	0.34		1.63
New in Uncom	1.70	1.86	0.16		1.13
Consultancy research					
New in Com	1.46	3.37	1.91		11.02
New in Uncom	1.94	2.26	0.32	†	1.93
F&E related services					
New in Com	0.52	0.85	0.33		6.34
New in Uncom	0.24	0.56	0.32	†	11.17
Courses for business and the community					
New in Com	4.82	11.39	6.57		11.35
New in Uncom	2.76	6.51	3.75	* * * * † * * * *	11.32
IP activity					
New in Com	0.06	0.26	0.20		20.12
New in Uncom	0.03	0.07	0.04		11.17
Total income					
New in Com	11.33	21.41	10.08		8.28
New in Uncom	8.79	13.45	4.66	* * * * † * * * *	5.46

Notes:

1. All column figures in this table used the same axis format (minimum value and maximum value) to reveal regional differences.
2. CAGR (Compound Annual Growth) was used to determine an 'average' annual growth rate over the whole period.
3. Mann-Whitney test was used to test whether the two samples were independent for each variable. † $p < 0.10$, * $p < 0.05$, ** $p < 0.01$.

Source: Based on data from the Higher Education Statistics Agency.

These patterns can be contrasted to that of courses for business in which the activity of new universities in competitive regions and uncompetitive regions have reported significantly different income in all but one year. Interestingly, the years when the two groups showed significant difference in courses are the same as the years when the total income of the two groups were found to be significantly different. During the period examined, the income from courses generated by new universities in competitive regions increased from £4,820 to £11,390 per academic FTE. This increase is much larger than what has been achieved by those academics in weaker regions that were able to improve their average income level of courses by only £3,750.

What seems more interesting is that the regional competitiveness of the location of new universities is positively associated with the annual growth rate shown by the institutions. As table 4 clearly reveals, new universities in competitive regions showed higher CAGRs in five out of six types of activities as well as in total income than those post-1992 institutions based in lagging regions. The only exception is F&E services where new universities in uncompetitive areas led their counterparts in competitive regions. However, this is also an activity from which the absolute amount of income only accounts for a very small share of the total income generated by new universities in both types of regions. The higher growth rate of F&E services shown by new universities in uncompetitive regions could not overturn the fact that the gap between the levels of total income of the two groups has further widened across the period.

6. CONCLUDING REMARKS

The drive for knowledge as a competitive asset is one that can only be undertaken with cognisance of the context in which is it created and commercialised. This paper has therefore attempted to address and better inform our understanding of the interrelationships between research intensity, regional profile and entrepreneurial performance of universities with a view towards establishing a methodology to open up future research avenues. Drawing upon the *UK HE-BCI* survey data between the academic years of 2003/04 and 2011/12, and the *UK Competitiveness Index* for the same period, this study examined the performance of 133 UK universities in entrepreneurial activities with a special focus on the impacts of research intensity and regional competitiveness on the performance of universities by contrasting two university groups (established and new universities) and two regional groups (competitive and uncompetitive regions). Whilst acknowledging efforts made by previous studies either to explore spatial differences in certain types of knowledge transfer activity or to compare institutional difference across a range of university-business engagements, there is still a gap in the literature which marries these aspects together, i.e. examining a full spectrum of knowledge exchange activities, and in the meantime, to compare the performance across regions and institutions during a longer period. Although focused on the UK, the study has wider implications for policymakers and theorists considering the role of universities in driving economic development and the movement towards the creation and development of the knowledge economy, particularly within developed economies with mature higher education systems such as much of Europe, the US and parts of Asia.

The findings suggest that more established universities in the UK have outperformed their younger counterparts in generating income from their knowledge transfer activities, thus demonstrating more active involvement in their entrepreneurial missions. Therefore, the entrepreneurial performance of universities was found to be influenced more by their institutional than locational characteristics. While we found no significant difference in the entrepreneurial activity income generated by established universities in competitive and uncompetitive regions, new universities seemed to be negatively impacted when located within weaker regions in their entrepreneurial activities. This suggests a possible policy intervention may be needed in order to address this issue, especially given that, to date, there has been much debate over the importance of regional policy in recent years (Cooke, 2013). The fact that the gap between the levels of total income of new universities in the two types of region has actually widened over the years indicates there might exist the so-called ‘Matthew Effect’ (or accumulated advantage), a sociological phenomenon where the rich get richer and the poor get poorer. Unlike their established counterparts, new universities may be less capable to overcome the disadvantages of being situated within a weaker region where lacks proximate firms in need of university-generated knowledge. It may be that established universities are better able to take advantage of their superior heritage, dominant research position and reputational capital than newer universities in maximising returns from entrepreneurial activities (i.e. those beyond the more traditional first and second missions).

The complexity of the UK higher education sector has been largely absent in innovation policy agenda (just as it arguably has from the European and American agendas also). Results from our analysis show that both established and new universities are of importance to regional economic development, albeit in different areas and in different ways. Given that most knowledge transfer policies and programmes ignore the specific individual characteristics of universities, despite the earlier conclusions of studies such as Jones-Evans (1998), it may be hard to expect all of them to make the same progress. Nonetheless, that does not mean that policy should remain broadly based as a more nuanced approach which takes into account regional and institutional differences may be required. For example, new universities often come from a vocational and training-focused background and are, to an extent, playing catch-up with their more established peers in research terms and the higher-value aspects of third mission activities (MacKenzie and Zhang, 2014). Consequently, recognition of the different roles they play within their regional situation and the third mission activities they are most concentrated in would help them improve their engagement levels and improve efficiencies. Specially tailored policies are thus required to maximise the potential of universities to contribute to economic development in their various locations that recognise the differences within the broad range of institutions that comprise the sector and thus enable them, irrespective of their age, to contribute more effectively in third mission activities.

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