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## **Dynamics of Knowledge Exchange: Why and how do universities diversify or specialize?**

**Research report**

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## Executive Summary

As universities' funding, visibility and reputation increasingly depend on their engagement in knowledge exchange (henceforth: KE) with non-academic stakeholders, institutions are increasingly likely to treat KE as a core strategic activity rather than a simple byproduct of their research and teaching engagement. Searching for greater efficiency and effectiveness in KE, in fact, universities will try to maximise the strategic fit between their resources and the opportunities in their socioeconomic contexts, over time developing their own KE profiles. Current research has identified some empirical regularities in the nature and evolution of universities' KE channels and stakeholders: universities that are research intensive and specialize in science, engineering and medicine tend to engage in IP exploitation (patent licensing, spinouts) and research contracts with industry, while universities that are teaching intensive and specialize in the humanities, arts and social sciences, tend to engage in consultancies, executive education and regeneration programmes, often in partnership with public bodies, non-profit organizations, community groups. Little evidence however exists so far about:

1. How do universities' KE profiles change over time, particularly in terms of changes in the *variety* of KE channels used and stakeholders involved?
2. Which management interventions enable these changes?
3. What are the drivers of such changes, particularly in terms of the impact of universities' changing sources of funding on their KE profiles?

We investigate these three questions using a mixed method approach that relies on the combined analysis of a eight year panel dataset containing information on 150 UK universities' KE engagement, and of a set of twelve semi-structured interviews with university managers at institutions that have exhibited changing KE profiles.

In relation to the first question, we empirically identify three different patterns of change in universities' KE profiles: (1) diversification in the range of KE channels and/or in the range of KE stakeholders, leading to a more balanced KE portfolio; (2) specialization in certain KE channels, and/or in engaging with certain KE stakeholders; (3) changing the mix of KE channels or the mix of KE stakeholders without changing overall specialization

In relation to the second question, we demonstrate that each pattern of change in KE profile is enabled by different types of managerial interventions. KE profile specialization requires the university to focus on its competitive strengths, to enable researchers to do more of what they are already doing well. Hence, university managers need to: create awareness among academics of knowledge exchange and of its strategic importance; support and mentor academics that are already doing some KE; identify and share best practices; support interdisciplinarity, in line with research funders' preferences – aligned with

supporting successful researchers. KE profile mixing requires the university to refocus efforts from certain KE activities to others. University managers therefore need to communicate mission focus and key stakeholders to academics; develop departmental and/or faculty-level strategies; promote interactions between departments and faculties; meetings, as well as workshops and events to promote collaborations. KE profile diversification requires the university to exploit the variety of competences within the institution, to allow new KE activities and stakeholders to emerge. University managers therefore need to develop a central KE strategy, to involve all parts of the institution; to promote interactions within the university at all levels (institution, faculties, departments) and collaborations between academics to allow new areas of engagement to emerge freely.

In relation to the third question, we investigate the effects of universities' changing sources of funding on the breadth of their engagement in KE, considering both the variety of activities they perform and the variety of stakeholders they engage with. We find that, when universities increase their dependency on KE income (e.g. the exploitation function becomes more important), they tend to specialize in the KE activities they are already successful in. The opposite occurs when universities increase their share of research income (e.g. the exploration function becomes more important): in this case they are able to diversify their KE activities and the stakeholders they engage with. These effects are moderated by the breadth of the knowledge base of the institution and by the institution's resources, proxied by its size.

Hence we find that changes in universities' sources of funding have the potential to impact the universities' behaviour in KE, with growing dependence on KE income leading to specialization and, potentially, a loss of variety in the system, while the opposite effect occurs when universities can rely on a larger share of research income.

# 1 Introduction

Knowledge Exchange (henceforth: KE) related activities between universities and non-academic stakeholders, have become increasingly important for policy makers, university managers and researchers alike (Etzkowitz et.al., 2000; Guerrero and Urbano, 2014). These include a wide variety of pathways that are used by universities to engage with, and transfer knowledge born through research for use by, the wider society. These activities, often collectively referred to as the “third mission” of universities, are seen as an important component of universities’ overall purpose and strategy, alongside their traditional missions of education and research. Examples of such activities range from very formalized contractual interactions such as patent licensing, spin out creation, contract research and consultancies, to more informal engagement routes such as ad-hoc advice, membership of company boards, public performances related to art and culture, participation in local, regional and national regeneration programmes, and many others.

A significant factor behind the growing importance of this “third mission” is the worldwide shift in the public funding model of higher education, wherein public funds are increasingly in short supply and universities are being asked to substitute them with private funds (such as endowments, research income from industry, sale of knowledge intensive services such as quality testing, executive education courses, and other sources). At the same time universities are under pressure to demonstrate that their public funded research and other activities generate impact. For instance, the Knowledge Exchange Framework (KEF)<sup>1</sup> is a recent policy initiative to quantify the volume and quality of KE carried out by universities in the UK, sitting alongside the Research Evaluation Framework (REF) and the Teaching Evaluation Framework (TEF). This increased attention to measuring KE at the university level has led to systematic data monitoring and collection exercises in a number of countries around the world. Influential examples are the HE-BCI survey in the UK, AUTM survey in the US and Canada and the ASTP-ProTon surveys in the EU. The data sets created through these surveys can be used to produce a ready set of indicators that allow universities to benchmark their KE performance, while also providing policy makers with instruments for designing and testing policy interventions within the sector (Sengupta and Ray, 2017a).

Established indicators, such as returns from collaborations, contracts, consultancies and commercialisation, are widely used by universities to judge their own performance and strategy, and by policy makers to create allocation rules and incentives to generate greater impact from publicly funded research. However, there is growing awareness that these indicators often underrepresent the true extent of universities’ KE activities and interactions, and in particular they are not representative of how KE is organized within a

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<sup>1</sup> <https://re.ukri.org/knowledge-exchange/knowledge-exchange-framework/>

university, why it changes over time and how such changes are implemented (Rossi and Rosli, 2015). This project aims to provide a more holistic understanding of the full range of activities underpinning universities' KE performance and their combined impact on the dynamics of KE within universities. We explore universities' strategies and activities at multiple levels, and how these impact their overall KE profiles, in particular, how the profiles have diversified or specialized over time.

This project has multiple aims. First, we identify and classify universities based on the diversification, and changes to the diversification, of their KE profiles. Second, we study how universities can adopt and implemented such changes, given their underlying contexts. Third, we attempt to explore what drives such changes – in particular, the impact of the relative importance of KE versus basic research on downstream KE portfolio. Taking a dynamic multilevel view, this project attempts to explore a wider range of (micro-level) activities carried out by various individuals and units in the university, their interactions with each other, and how these may be mapped to the *dynamic* patterns seen in the organization-level (macro) data. In essence our work examines university led KE strategically, that is, explores the phenomena at both micro and macro levels which lead to *changes* in overall KE profiles of universities, and how such changes are actually brought about within these organizations.

We organize this report into the following sections. In Section 2, we describe our initial analysis of the macro (organization) level data, the overall categorisation strategy for all universities in the secondary sample and the sampling strategy for micro-level analysis. A large scale panel dataset of 150 UK universities over a period of eight years (2008/09 to 2015/16), assembled from several publicly available data sources, was used both for the sampling of the participants in the qualitative interviews that supported the micro-level analysis, and for the macro-level analysis of the determinants of changes in KE profiles. In Section 3, we present the results of our micro-level analysis of the qualitative data we collected through interviews (we interviewed key KE management personnel from twelve universities that had exhibited remarkable changes in their KE profiles over the 8-year period), and which is presented in the form of an analytical case study illustrating what management practices underpinned the implementation of different types of changes in KE profiles. In section 4, we present the results of our examination of the broad drivers of KE profile changes, particularly in terms of KE diversification. This is based on the econometric modelling of the university-level factors driving the extent of KE diversification, building on the entire above-mentioned panel dataset (150 universities over 8 years). The findings are discussed and recommendations made in Section 5. All Tables referred to in the text can be found in the Appendix.

## 2 Diversification in University KE

We built a panel dataset of 150 universities in the UK for eight consecutive academic years (2008-09 to 2015-16), using publicly-available university information from several sources. In particular, we used the data from the Higher Education Statistics Agency (HESA), which include both general financial data on universities' different income sources, and specific data from the Higher Education Business and Community Interaction (HE-BCI) survey on KE engagement, containing information about the income the university received from different types of KE activities and from different types of stakeholders.<sup>2</sup> We computed two indices to identify patterns of change in KE engagement: a diversification index and a differentiation index. These indices were computed on types of KE activities or channels from which the universities received KE income (six categories were considered: collaborative research income, contract income, consultancy income, IP income, CPD and local regeneration), as well as on the types of stakeholders with which the universities engaged and received KE income from (three categories were considered: income from SMEs, income from non-SMEs commercial companies, income from non-commercial organizations).

In our case, for a given university in time  $t$ , the diversification index for KE channels  $v(t)$  is given by:

$$v(t) = 1 - \sum_{j=1}^M \left( \frac{x_{jt}}{X(M, t)} \right)^2$$
$$X(M, t) = \sum_{j=1}^M x_{jt}$$

Here,  $M$  is the number of KE channels available to the university,  $x_{jt}$  is the income from a given source in time  $t$ , and  $X(M, t)$  is the total income from all sources in time  $t$ . This index is computed for every university for every time period in our data. Note that  $0 \leq v(t) \leq 1$ , where lower values imply higher concentration in one of the six available channels and higher values imply more diversification within the channels. Based on the data available,  $M = 6$ , incorporating the channels mentioned above. Similarly, the diversification index for KE stakeholders  $w(t)$  is given by:

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<sup>2</sup> The data used for the quantitative part of the project is closely aligned with the underlying data used in the first round of the KEF in the UK. A KEF consultation process was currently underway alongside a review of the HE-BCI surveys while this report was being prepared. We discuss the implications of our findings with reference to the KEF and UK policy in Section 5.



$$w(t) = 1 - \sum_{k=1}^N \left( \frac{y_{kt}}{Y(N, t)} \right)^2$$

$$Y(N, t) = \sum_{k=1}^N y_{kt}$$

Here,  $N$  refers to the number of stakeholder types available to the university,  $y_{kt}$  refers to the income from a given stakeholder type in time  $t$  and  $Y(N, t)$  refers to the total income from all stakeholder types for the university in time  $t$ . Based on the data available,  $N = 3$ , incorporating the three classifications of stakeholders mentioned above.

This diversification index, a form of the well-known Herfindahl index (Herfindahl, 1982) has found wide application in the higher education literature, where it has been used to measure, among others, diversification of teaching curricula (Rossi, 2009), and of product offerings and portfolio (Acar and Sankaran, 1999). The standard deviation of this index captures the extent of change *within the university* of its profile of KE incomes from various channels/stakeholders over the 8 years in our data.

The differentiation index (Zwanziger et al., 1996), computed for each university  $j$  in each period  $t$ ,  $D_j(t)$ , is:

$$D_j(t) = \sum_{i=1}^M \left( \frac{x_{jit}}{X_{jt}} - \frac{x_{it}}{X_t} \right)^2$$

where:

$x_{jit}$  is the income from KE channel/stakeholder type  $i$  received by university  $j$ ,  $X_{jt}$  is the total KE income of university  $j$ ,  $x_{it}$  is the income from KE activity  $i$  received by all universities, and  $X_t$  is the total KE income of all universities. This index tells us whether the mix of income from KE activities received by a university is more or less similar to the mix received by an “average university”: the index varies from 0 to 1, with zero indicating minimum differentiation from the “average university” and 1 indicating maximum differentiation. The standard deviation of this index, moreover, captures the extent of change *within the university* in terms of its relative position to the rest of the sector.

Within the context of this UK based panel data, the diversification and differentiation index are inversely related: a university that is very diversified is more similar to the “national average” and hence less differentiated, while a university that is more specialized is more differentiated from the rest.

These two indices and their standard deviations, computed for each university for each of the eight years, were then used to identify universities that “stood out” from the rest.

Specifically, in a longitudinal perspective, we identified universities that exhibited high standard deviation in the diversification and/or differentiation indices over the eight year period, computed over the different types of KE channels and over the different types of KE stakeholders. This allowed us to select universities that had changed their KE profiles over time, either in terms of the types of KE activities from which they received income, or in terms of the types of stakeholders they engaged with, or both. We grouped universities into three groups on the basis of their overall size (proxied by their overall income): large universities (top third of the income distribution), middle-sized universities (second third of the income distribution) and small universities (lower third of the income distribution).

In particular, we selected those universities whose standard deviation in the differentiation index and/or the differentiation index (computed over the different types of KE channels and/or over the different types of KE stakeholders) was higher than 90-95% of their income group. This way we identified a set of 34 universities that exhibited remarkably changing KE profiles, of which 12 were in the large universities group, 12 were in the middle-sized universities group, and 10 were in the small universities group.

We analysed the patterns of diversification and differentiation of income from different KE activities and income from different stakeholders for these 34 universities, which allowed us to classify them into three patterns regarding changes in KE profiles. These were: (1) **KE profile diversification**, (2) **KE profile specialization**, (3) **KE profile mixing**.

KE profile diversifiers (14 universities) are universities that initially were specialized in either the KE activities they performed or the types of stakeholders they engaged with, but which later became more diversified. So these universities moved from being outliers, to being close to where most other universities were placed in the terms of activities and stakeholder mix (their differentiation from the overall system of universities decreased).

KE profile specialists (14 universities) include those universities that are at the other spectrum, that is, they were initially more diversified but later became specialists in terms of KE activities or stakeholders, thus differentiating themselves from the rest of the system.

Finally, KE profile mixers (6 universities) changed their KE mix significantly, but without moving towards being specialists or diversifiers to any greater extent than what they were originally. Thus, these universities increased the reliance on certain KE activities or stakeholders at the expense of others.

Table 2.1 summarizes the distribution by income range and by KE change pattern of the 34 universities that exhibited significant changes in their KE profiles.

This group of 34 universities formed the sample from which we shortlisted 12 case studies to be investigated in greater depth, distributed across the three size groups (5 in the large universities group, 5 in the middle-sized universities group, and 2 in the small universities group) and across the three change patterns (3 KE profile diversifiers, 6 KE profile

specializers, 3 KE profile mixers). Table 2.2 provides the distribution of these 12 universities which were interviewed. The details of these case studies and their findings are discussed in the next section.<sup>3</sup>

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<sup>3</sup> We had attempted to recruit around 25 universities to participate in the project, as was indicated in the grant application to SRHE. Although we contacted all 34 of the identified universities, in the end we received positive responses from the 12 only. This is more than 30% of the interviews we contacted, which is in line with (or even slightly higher than) response rates typically obtained in qualitative studies. However the pool of universities that exhibited remarkable changes in KE profiles (whose size was unknown before undertaking the study) was rather small compared to the overall population. The decision to restrict our sample to those universities that exhibited a high (above the 90-95 percentile) standard deviation in the differentiation and/on diversification index restricted our pool of potential interviewees but ensured that we only focused on universities that had seen significant changes in their KE profiles.

### 3 Implementing Diversification and Specialization in KE

This part of our investigation based on the case studies revolve around the managerial interventions that underpin changes in universities' KE profiles. Building on control systems theory (Simons, 1994, 1995; McCarthy and Gordon, 2011), we discuss four possible types of managerial interventions – relating to belief systems, boundary systems, diagnostic control systems and interactive control systems – and their relevance for each of the three possible patterns. We argue that managerial interventions relating to belief systems, in order to align the behaviour of university staff to the desired KE profile, are important in order to achieve all kinds of changes in KE profiles; interventions relating to interaction systems are particularly important for KE profile diversification, in order to enable staff to identify and grasp a wide range of KE opportunities; while interventions relating to boundary systems and diagnostic systems are particularly important for KE profile specialization and KE profile mixing, in order to support staff acting in accordance with specific KE activities and achieving targets aligned with those activities. Table 3.1. summarizes the main tenets of the four types of control systems, and aligns each type of change in KE profiles with their expected supporting managerial interventions.

In order to analyse the types of managerial interventions that underpinned different patterns of change in KE profiles, we relied on the qualitative information provided by our 12 interviewees. First, a semi-structured questionnaire was developed, which was designed to capture a detailed picture of the KE, teaching and research activities within the university, the nature and history of these activities, and the strategies and organizational and management practices underpinning KE at the institution. Several items in the questionnaire could be aligned with the four main areas of management intervention identified by control systems theory: belief systems (university's KE strategy and focus/mission and how they are communicated), boundary systems (incentives and support systems for KE), diagnostic systems (benchmarking and assessment of KE performance, best practices) and interaction systems (interactions within the university and how they are encouraged).

Second, this questionnaire was then used to interview key KE personnel in the 12 universities mentioned in Table 2.2; we interviewed relatively senior managers involved with the KE processes, who could provide us with a detailed picture of the complexity of interactions among various players within the university. The interviews were carried out (either individually or in pairs) by two investigators and a research assistant. The interviews were recorded and then transcribed professionally.

Finally, the interview transcripts were analysed through a detailed thematic analysis using NVivo. We followed an inductive approach to generate first and second order themes from the coded data. This was an iterative process, requiring multiple independent readings of the interview transcripts by the investigators. We aligned the emerging first and second order themes with the four key areas of management interventions identified by control

systems theory – belief, boundary, interaction and diagnostic systems – to examine whether there were any differences in coding patterns between universities exhibiting three different change patterns – KE profile diversifiers, KE profile specializers and KE profile mixers. Table 3.2 (first three columns) reports first and second-order themes relating to the KE activities emerging from the analysis, and how these relate to the typology of managerial interventions discussed above.

Our analysis of the interview data suggests that, in line with our expectations based on control systems theory, different change patterns are supported by different management interventions. We identified the themes that were particularly pertinent to each type of KE profile change by looking at the relative frequencies with which each theme was mentioned in the interviews. In table 3.2, the three columns on the right report a tick for any theme that is mentioned particularly frequently by universities adopting the type of change in KE profile reported in the corresponding column. The overall findings are presented below.

- KE profile diversification requires universities to exploit the full variety of competences within the institution in order to enable new KE activities to emerge. This requires *belief system interventions* in the form of a centralized approach to KE strategizing, and *interaction system interventions* to promote interactions within the university at all levels (institution, faculties, departments) as well as collaborations between academics to facilitate the exploration of new areas of engagement.
- KE profile specialization requires universities to focus on internal competitive strengths in order to enable researchers to do more of what they are already doing well. This requires *belief system interventions* in the form of creating awareness among academics of knowledge exchange and of its strategic importance, and *boundary systems interventions* to support and mentor academics in KE. This strategy is also associated with support for interdisciplinarity.
- Finally, KE profile mixing requires universities to refocus their efforts from certain KE activities to others – probably in response to events that have made certain KE activities less feasible than they were in the past, encouraging the university to put effort in new areas. This strategy requires *belief system interventions* in the form of renewing the focus of its mission and its KE stakeholders, and developing departmental / faculty-level strategies; *interaction system interventions* to promote interactions between departments and faculties, organize meetings, workshops and events to promote collaborations; and *boundary system interventions* in the form of career incentives for academics and incentives for managers.

## 4 What Drives KE Diversification and Specialization

Here we examine the primary drivers of diversification or specialization strategies in universities, in relation to their research and KE missions. Universities are increasingly being looked upon as ambidextrous organizations, where they are simultaneously expected to explore the frontiers of knowledge through basic research, and at the same time, exploit this knowledge to create impact, both for the benefit of the wider society and for non-academic stakeholders for whom this knowledge has commercial value (Ambos et al., 2008; Sengupta and Ray, 2017b). While the exploration function has traditionally been a part of universities' core mission of research and teaching, it is only recently that the exploitation function - collectively referred to as KE in the literature - has become a central feature in many universities (Ambos et al., 2008; Chang et al., 2009; Chang et al., 2016).

A key factor that encourages universities to evaluate KE much more strategically than in the past, is the gamut of significant changes in the public funding model of basic research (Bhattacharjee, 2006). In many countries, public support for basic research (and education) is gradually being reduced, and universities are being encouraged to reduce their dependence on these in favour of private sources (Muscio et al., 2013; Rosli and Rossi, 2016; Strehl et al., 2007). The latter includes income from private donations in some cases, but a more widespread source is KE, in the form of licensing of intellectual property, research contracting, provision of consultancy services, provision of executive education courses, and so on. Furthermore, the allocation mechanisms for public funding have changed, with an increased role of performance-based funding allocations, which concentrate funding at the top of the rankings, leaving middle and low-ranking institutions particularly vulnerable to uncertainty (Rosli and Rossi, 2016).

There is also growing evidence that universities are increasingly treating the exploitation function strategically, thus allocating resources, designing incentives, setting up internal mechanisms and processes to enhance KE, and generally taking a longer-term view of KE as an organization (Sengupta and Ray, 2017a). But not much is known about the dynamic impact of external and internal changes on the way a university's exploitation function has *evolved*, particularly around how KE is structured, strategized and executed (Uyarra et al., 2019). While it has been shown that increasing reliance on private funding changes the nature of universities' research activities and may encourage short termism (Archibugi and Filippetti, 2016), much less is known about how the exploitation arm reshapes itself in response to its own increasing relevance from a strategic point of view. The present study is one of the first to address this research gap, by analysing how universities' increasing dependency on its own exploitative function impacts its KE strategy.

While previous research has examined the dynamic interlinkages between KE and research in terms of overall output, there is little understanding of how KE evolves strategically over time. This is crucial, both from a theoretical and practical perspective, as

ambidexterity as a concept is closely aligned with the *dynamic capabilities* of organizations, and the latter has been shown to be critical for long term survivability and prosperity of organizations (O'Reilly and Tushman, 2008; 2013; Teece et al., 1997). From a university's perspective, this implies that, as its KE and research capabilities develop and mature, it may wish to reconfigure its future KE strategies and develop new competencies in response to changing realities around both these functions underpinning ambidexterity.

Using this data, we examine how changes in the *relative importance* of exploration versus exploitation functions triggers moves towards diversification versus specialisation in KE strategies. In effect, we test several hypotheses.

The increasing importance of exploitation means that the stakes are higher for universities who get their KE strategy wrong. On the one hand, higher stakes attached to KE strategy might make it more attractive for universities to hedge against risk by means of diversification, but this is a costly strategy and requires a re-orientation in the university's dynamic capabilities. On the other hand, stabilising current sources of income by building on existing dynamic capabilities might appear more promising and entails lower upfront costs. Hence, we expect that as the exploitation function becomes more important universities will tend to specialize in the KE activities they are already successful in:

*H1: As a university's share of income from KE increases, the diversification in the KE channels and stakeholders used decreases.*

We would expect the opposite to happen if on the other hand a university's exploration function becomes relatively more important in terms of its portfolio. Greater research income potentially leads to better and more diversified research outputs, both basic and applied. This would allow, and sometimes make it necessary, to be more flexible when engaging with external partners. An increase in the proportion of research income also can have positive reputational consequences for a university, for specific departments or academic researchers. It can help to increase its visibility among new stakeholders, who may wish to engage through channels which have not been used to much extent previously by the university. Moreover, from a cost point of view, a larger source of complementary income from research would mean that some of it can be diverted towards the university's exploitation function, to add to the resources available to the KTO as well as the researchers. Hence, we expect that:

*H2: As a university's share of income from basic research increases, the diversification in the KE channels and stakeholders used increases.*

A key research resource that acts as an enabler of KE is the breadth of the knowledge base of the university. Universities with a broader knowledge base will be more likely to use their existing potential to explore more channels and partners than universities with a narrower knowledge base (Hewitt-Dundas, 2012). For the latter universities, KE

diversification might not be feasible at a reasonable cost, and it might even be preferable to increase the specialisation of their KE activities, in order to exploit their competitive advantage in particular forms of KE (such as CPD or consultancies). Hence we expect that:

*H3: Narrower knowledge base “strengthens” the links between KE/research income shares and diversification in its KE channels and stakeholders, i.e. knowledge base narrowness leads to an increase in the “magnitude” of the links.*

The overall size, scale of an organization is closely linked with its ability to be ambidextrous and the latter’s impact on performance (Cao et al., 2009; Lin et al., 2007), contingent on the availability of key resources (O’Reilly and Tushman, 2013). Universities with more resources available to them are able to carry out their exploration and exploitation functions simultaneously more efficiently than those which are resource constrained (Ambos et al., 2008; Perkmann et al., 2013; Wright et al., 2008). With increased overall amount of resources, universities’ dependence on individual lines of income diminishes. Thus, any additional increase in KE or research incomes may be used to cross-subsidize or re-invested in longer term projects, which otherwise would have been used to strengthen existing links. As a consequence, the decision to diversify KE channels and stakeholders would be less dependent on the income being generated by KE or research, but more dependent on the nature of research outputs, strategic focus of the university, historical contexts etc., all of which are important antecedents for the structure and business model of a university’s KE function (Sengupta and Ray, 2017a). Hence, we expect that:

*H4: Greater availability of resources weakens the link between KE/research income shares and diversification of its KE channels and stakeholders, i.e. increased resource availability leads to a decrease in the “magnitude” of the links.*

These hypotheses collectively represents the conceptual model presented below in Figure 1.

We use the same panel of 150 UK based universities described above, based on the HE-BCI and HESA datasets, for testing the conceptual model presented in Figure 1. UK is a particularly good context for study as policy changes in recent years have increased the potential volatility of universities’ sources of income.

The statistical results of the analysis are presented in Tables 4.1 and 4.2. The results of our analysis can be summarised as follows:

- We find that as a university’s exploitative function matures and becomes increasingly important relative to others, it becomes more specialized in its KE profile (H1).



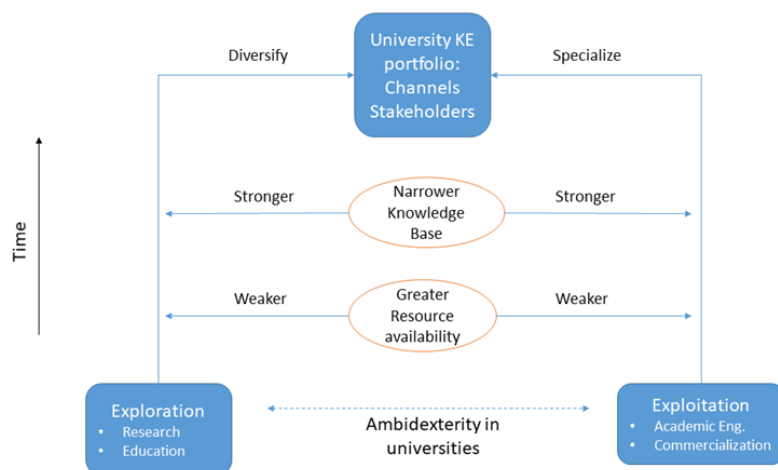
- On the other hand, as the exploratory function grows in relative importance, the university increasingly diversifies its KE activities (H2).
- In both cases, we see similar results for the portfolio of KE channels as well as the portfolio of external stakeholders it engages with.

We also find that the availability of tangible and intangible assets within the university moderate these dynamic relationships significantly.

- The relationship between exploration and diversification of KE portfolio (represented by H2) tend to grow weaker for universities with larger tangible asset bases, and vice versa (H4).
- At the same time, the relationship between exploitation and specialization of KE portfolio (represented by H1) tend to grow stronger for universities with narrower intangible knowledge base (H3 partial, only for the case of KE channels).

Thus generally speaking, those universities which are relatively smaller and/or with narrower knowledge bases are more *responsive* in their KE strategies to changes in the relative incomes from their exploitation and exploration functions, whereas bigger more broad-based universities are less so.

**Figure 1: The Conceptual Framework**



## 5 Conclusion and Recommendations

A limited amount of previous research has focussed on how KE is organized within universities, for instance, on how it is structured (centralised versus devolved) (Bercovitz et al., 2001; Sengupta and Ray, 2017a), or on its business model and location (internal versus outsourced) (Sengupta and Ray, 2017a). At the same time, quite a few papers have examined the choice of KE channels itself, in particular the role of individual, departmental and organizational factors affecting the choice (D'Este and Patel, 2007; Geuna and Rossi, 2011; Lockett et al., 2014; Perkmann et al., 2013). However, while most of these papers have addressed the question of choice of KE profile and strategy from a static perspective, to the best of our knowledge, this study is the first to examine how KE *evolves* dynamically within an organization.

Our findings have important implications for both managers and policy makers within the higher education sector. We have found that increased reliance on exploitation activities encourages the tendency towards specialization of certain channels of KE and certain stakeholders, contingent on the characteristics of the university. For countries where the higher education sector is sufficiently heterogeneous, this move towards specialization within individual organizations does not pose a serious issue, as enough variation among universities will ensure that the entire range of channels and stakeholder types are engaged across all types of universities. On the other hand, a homogenous sector will result in specialization of KE profiles towards similar types of channels and stakeholders across most universities, crowding out the alternatives. This would lead to high concentration of KE activities along some channels and stakeholders at the cost of others. The consequent increased competition for the same type of stakeholders through similar channels may lead to wastage of precious resources, which otherwise could have been diverted towards developing potentially viable alternative KE capabilities. Thus, from the sectoral point of view, specialization may result in high opportunity costs, making the policy intervention sub-optimal. It is therefore very important for policymakers to think carefully about funding policies that leave universities very dependent on their KE income, as this might weaken their incentives to engage in a broad range of KE channels and with a variety of different stakeholders.

### *Implications for the KEF and broader UK policy*

This finding is especially relevant given the recent policy stress on formalising the development of sectorwide metrics of KE in the UK, particularly through the newly introduced KEF. We have seen that making universities overly dependent on KE related funding will very likely lead to *over-specialization* and *development of competitive niches*. This would deprive the overall university system of important interactions which, while not necessarily generating income for the universities, generate a system of lively exchanges of knowledge that spur further innovation within industry and the university itself. The risk that higher dependency on KE income would lead universities to specialize excessively is

higher for universities that are small and with a narrower knowledge base, so systems with many universities of such nature are particularly vulnerable to over-specialization in certain KE activities. Policy makers, particularly when designing the incentive system for the KEF, should not lose sight of these risks, given the longer term implications on the overall innovation ecosystem within the economy. The implications for non-Russell group universities, particularly, those which are relatively smaller in size or are relatively more specialized in specific disciplines could be severe.

### *Implications for University Management*

For university management, these findings can better inform their understanding of the context in which they operate within and of the KE strategies adopted by competitors, thus allowing them to develop better strategies for themselves. It is important to note that universities with similar asset profiles (tangible and intangible) have similar incentives to specialize their KE portfolio as they increase their dependency on private funding. As discussed above, this might increase competition for resources among universities if they specialise in the same direction – as opposed to seeking different niches. Hence if a university pursues a specialization strategy, it is in their interest to clearly identify the niche it wants to occupy – in which it has a particular competitive advantage – rather than seek to contend areas already occupied by many competitors.

The findings from our research also provide helpful indications about the kind of management interventions that are required in order to support different types of changes in KE profiles. Thus, university managers who wish to pursue a KE diversification strategy need to implement belief system interventions in the form of a centralized approach to KE strategizing, as well as interaction system interventions in the form of promoting interactions within the university at all levels (institution, faculties, departments) and collaborations between academics, in order to facilitate the exploration of new areas of engagement. Managers who wish to pursue a KE specialization strategy need to put in place belief system interventions in the form of creating awareness among academics of knowledge exchange and of its strategic importance; boundary systems interventions to support and mentor academics that are already doing some KE, in order to encourage them to improve their performance; and diagnostic control systems interventions in the form of identification and sharing of best practices. Finally, managers who wish to change the mix of KE channels or of KE stakeholders they engage with, need to put in place concerted efforts into exploring new areas of engagement and pursuing them. Hence, they need to implement belief system interventions in the form of renewing the focus of the university's mission and its KE stakeholders, and developing departmental / faculty-level strategies accordingly; as well interactive control system interventions to promote interactions between relevant departments and faculties, organize meetings, workshops and events to promote collaborations in order to explore new areas of engagement.

Boundary system interventions in the form of career incentives for academics and incentives for managers to support particular KE channels might also be important.

### *Further Research*

Further analyses of the data collected in this project are planned after the formal end of the project. In particular, the in-depth semi-structured interviews provide a rich source of material that has not yet fully been exploited. Our plan is to further investigate the breadth of KE channels used by different types of universities and how these activities are combined to take advantage of synergies in the use of institutional resources. This analysis will provide further elements to appreciate the limitations of current metrics to measure KE performance and to articulate possible improvements.

We are currently in the process of collecting additional information, in the form of publicly available strategic documents (HEIF strategies submitted to HEFCE in 2011 and 2016; strategy documents available from universities' websites), about the 12 universities we interviewed, in order to enrich our qualitative evidence base.

Further analyses of the panel dataset we have assembled are also planned. One such example is a longitudinal efficiency analysis of the KE activities of the 150 universities using data envelopment analysis, with the objective to investigate which universities have improved their KE efficiency over time (e.g. which universities have been able to achieve greater KE outputs with the same inputs, or the same outputs with fewer inputs) and link these to universities' structural characteristics, including the universities' funding sources. While some work in this area already exists (Curi et al., 2017; Rossi, 2018) the longitudinal analysis allowed by the panel database would make an original contribution to knowledge as we would be able to track changes in efficiency over time.

On the whole, this project opens up new avenues of research into the dynamics of KE activities and how these are affected by both micro and macro level factors within the university. From a policy perspective, the research has the potential to inform higher education policy from the perspective of measuring and developing metrics of KE. In particular, current UK based initiatives on developing and reshaping the HE-BCI surveys can benefit from the wider implications of our research.

## Appendix

### Tables

**Table 2.1 Distribution of 34 universities with significant changes in their KE profiles**

	KE diversification (14)			KE specialization (14)			KE mixing (6)		
	Change in KE:			Change in KE:			Change in KE:		
	Activities	Stakeholders	Both	Activities	Stakeholders	Both	Activities	Stakeholders	Both
Large	4	1	1	1	3	1	1	0	0
Middle	3	3	0	3	0	0	0	2	1
Small	1	1	0	4	2	0	1	1	0
Total	8	5	1	8	5	1	2	3	1

**Table 2.2 Distribution of 12 universities that were interviewed**

		Pattern of change:		
		KE profile diversification	KE profile specialization	KE profile mixing
Nature of change	KE activities	D-1 D-2	S-1 S-2 S-3	M-1
	KE stakeholders	D-3	S-4 S-5 S-6	M-2 M-3 M-1

**Table 3.1 Main tenets of the four types of control systems and alignment with KE instruments and profile changes**

Control system	Possible instruments	Relevant pattern of change in KE profile
Beliefs systems: inspire employees to engage in activities central to the values, purpose and direction of the organization	Definition of strategies Communication of mission	<ul style="list-style-type: none"> <li>• KE specialization</li> <li>• KE mixing</li> <li>• KE diversification</li> </ul>

Boundary systems: limit strategically undesirable activities and outcomes	Incentives, support activities	<ul style="list-style-type: none"> <li>• KE specialization</li> <li>• KE mixing</li> </ul>
Diagnostic control systems: ensure that activities are in accordance with organizational objectives	Benchmarking, best practices	<ul style="list-style-type: none"> <li>• KE specialization</li> <li>• KE mixing</li> </ul>
Interactive control systems: scan for / communicate strategic information to employees to adjust the direction of the organization	Promoting interactions	<ul style="list-style-type: none"> <li>• KE diversification</li> <li>• KE mixing</li> </ul>

**Table 3.2 Conceptual categories, emerging first and second order themes and their prevalence for different types of changes in KE profiles**

Main categories derived from control systems theory	Second order themes	First order themes	KE specialization	KE mixing	KE diversification	
Beliefs systems	KE strategy definition	Central KE strategy			✓	
		Departmental KE strategy		✓		
		Strategic importance of KE	✓	✓		
	KE focus	Mission			✓	
		Definition of KE			✓	
		KE stakeholders			✓	
		Engagement in KE				✓
Boundary systems	Incentives for KE	Career incentives for academics				
		Incentives for managers		✓		
		Incentives for initiatives				
		Creating awareness of KE	✓			
		Other incentives for academics				
	Support activities for KE	Support for KE – general	✓			
		Support for KE – mentoring	✓			
		Support for KE – meetings	✓	✓		
Support for KE – seminars and workshops				✓		

		Funding for KE	✓		
		Structure of KE			✓
Diagnostic systems	Benchmarking, best practices	KE Benchmarking			
		Best practices in KE assessment	✓		
		Reporting issues in KE assessment	✓		
Interaction systems	Interactions within university	Institution-level collaborations			
		Faculty-level collaborations		✓	✓
		Department-level collaborations		✓	✓
		Student collaborations		✓	
		Interdisciplinary collaborations	✓		
	Incentives for collaboration between researchers	Strategies to encourage collaboration			✓
		Strategies to encourage interdisciplinarity	✓		✓
		Events to encourage collaboration	✓	✓	

**Table 4.1 Impact of Income Shares on Diversification Index**

DV: Diversification Index for	University Fixed Effects	
	Channels	Stakeholders
<i>Income Shares (lagged)</i>		
KE income share	-0.704*** (0.078)	-0.705*** (0.092)
research income share	0.301** (0.147)	0.725*** (0.174)
tuition income share	-0.110 (0.098)	0.257** (0.116)
funding body income share	-0.176* (0.101)	0.088 (0.119)
<i>Time varying controls (log)</i>		
Total CPD income	0.014*** (0.003)	-0.007 (0.004)
Number of contracts	0.012*** (0.004)	0.005 (0.005)
Number of consultancies	0.010*** (0.003)	0.008** (0.004)

Number of facilities contracts	-0.000 (0.003)	0.008*** (0.003)
Number of software licenses	0.005** (0.002)	0.002 (0.003)
Number of non-software licenses	0.000 (0.003)	0.002 (0.004)
Current spinouts	-0.006 (0.004)	0.007 (0.005)
Cumulative student start ups	-0.002 (0.003)	0.009*** (0.003)
Staff time – public free events	-0.001 (0.002)	0.001 (0.003)
Staff time – public non-free events	-0.002 (0.002)	-0.002 (0.003)
Staff time – free performances	0.004 (0.002)	0.001 (0.003)
Staff time – non-free performances	-0.007*** (0.002)	-0.007*** (0.002)
Staff time – free exhibitions	-0.001 (0.002)	0.004** (0.002)
Total income	0.058* (0.030)	0.074** (0.036)
Constant	0.699*** (0.073)	0.385*** (0.085)
<i><u>Fixed effects</u></i>		
Time (Current Year) Fixed Effects	Yes	Yes
Region Fixed Effects	No	No
University Fixed Effects	Yes	Yes
Observations	852	851
Log Likelihood	1,205.900	1,062.690
Wald Test (df = 41)	4,222.409***	3,561.221***

Notes:

\*\*\* Significant at 1 %;

\*\* Significant at 5 %

\* Significant at 10 %



**Table 4.2 Moderation by total income and research breadth of the income share – diversification link**

Moderator: DV: Diversification Index for	(A) Total income		(B) Broadbase	
	Channels	Stakeholders	Channels	Stakeholders
<i>Income Shares (lagged)</i>				
KE income share	-0.507 (1.448)	-2.394 (1.713)	-0.816*** (0.095)	-0.746*** (0.113)
research income share	2.112*** (0.702)	1.948** (0.830)	0.429** (0.177)	0.734*** (0.209)
tuition income share	-0.220*** (0.056)	-0.062 (0.066)	-0.149 (0.099)	0.249** (0.118)
funding body income share	-0.211*** (0.060)	-0.106 (0.072)	-0.206** (0.101)	0.079 (0.120)
<i>Time varying controls (log)</i>				
Total CPD income	0.008** (0.003)	-0.012*** (0.004)	0.014*** (0.003)	-0.007* (0.004)
Number of contracts	0.009** (0.004)	0.006 (0.005)	0.013*** (0.004)	0.005 (0.005)
Number of consultancies	0.004 (0.003)	0.005 (0.004)	0.011*** (0.003)	0.008** (0.004)
Number of facilities contracts	0.001 (0.003)	0.009*** (0.003)	-0.000 (0.003)	0.008** (0.003)
Number of software licenses	0.007*** (0.002)	0.003 (0.003)	0.005** (0.002)	0.002 (0.003)
Number of non-software licenses	-0.001 (0.003)	0.001 (0.004)	-0.000 (0.003)	0.001 (0.004)
Current spinouts	-0.004 (0.004)	0.010** (0.005)	-0.006 (0.004)	0.007 (0.005)
Cumulative student start ups	-0.000 (0.003)	0.011*** (0.003)	-0.003 (0.003)	0.009*** (0.003)
Staff time – public free events	-0.001 (0.002)	0.000 (0.003)	-0.001 (0.002)	0.001 (0.003)
Staff time – public non-free events	-0.002 (0.002)	-0.001 (0.003)	-0.002 (0.002)	-0.001 (0.003)
Staff time – free performances	0.005* (0.002)	0.002 (0.003)	0.003 (0.002)	0.001 (0.003)

	(0.002)	(0.003)	(0.002)	(0.003)
Staff time – non-free performances	-0.007***	-0.009***	-0.007***	-0.008***
	(0.002)	(0.003)	(0.002)	(0.002)
Staff time – free exhibitions	-0.000	0.004*	-0.001	0.004**
	(0.002)	(0.002)	(0.002)	(0.002)
Total income	0.036	0.018	0.056*	0.073**
	(0.034)	(0.040)	(0.030)	(0.036)
Constant	0.281	0.389	-0.041	-0.497
	(0.400)	(0.477)	(0.370)	(0.439)
<i><u>Interaction Effects</u></i>				
KE income share x Total income	0.025	0.164	-	-
	(0.121)	(0.144)		
research income share x Total income	-0.184***	-0.161**	-	-
	(0.058)	(0.069)		
KE income share x broadbase	-	-	0.319**	0.114
			(0.148)	(0.177)
research income share x broadbase	-	-	-0.465	-0.053
			(0.298)	(0.353)
<i><u>Fixed effects</u></i>				
Time (Current Year) Fixed Effects	Yes	Yes	Yes	Yes
Region Fixed Effects	Yes	Yes	Yes	Yes
University Fixed Effects	Yes	Yes	Yes	Yes
Observations	847	846	852	851
Log Likelihood	1,168.281	1,025.211	1,208.982	1,062.897
Wald Test (df = 38)	3,770.628***	3,216.214***	4,262.621***	3,563.670***

Notes:

\*\*\* Significant at 1 %

\*\* Significant at 5 %

\* Significant at 10 %

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