Which stakeholders benefit from third mission engagement? An analysis of priority stakeholders and third mission profiles of HEIs in the United Kingdom

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It has been suggested that higher education institutions (HEIs) may develop different third mission profiles in their attempt to maximise the fit between institutional resources and strategic opportunities; the latter include strategies of engagement with different groups of external stakeholders. Understanding the extent to which HEIs' different third mission profiles are aligned with their strategic prioritisation of different stakeholder groups, allows us to better understand how different HEIs drive socioeconomic development. Using a set of non-parametric techniques - qualitative and quantitative ordinal multidimensional scaling - applied to data on the universe of HEIs in the United Kingdom, this study explores the complex association between HEIs' strategic stakeholder prioritisation, institutional characteristics and development of third mission profiles. The results suggest that HEIs have very varied third mission profiles that are closely linked to HEIs' institutional characteristics, including research or teaching orientation, subject mix and institutional type. Moreover, the choice between prioritising private businesses, employers, and specific geographic localities are key factors in separating the final configuration of the third mission profile of HEIs. Results clearly portray that HEIs with different structural characteristics and attending the needs of different stakeholder groups base their interaction on different third mission activities.

Keywords: Third mission, Higher Education Institutions (HEIs), performance measurement, Higher Education (HE) system differentiation, stakeholders.

1. Introduction

In higher education (HE) systems where higher education institutions (HEIs) increasingly respond to market-type incentives (Casani et al., 2014), it has been observed that HEIs tend to behave strategically, choosing to particularly engage in activities where they enjoy some form of advantage over their competitors (Antonelli, 2008). While HEIs' strategic behaviour has been explored mainly in relation to their teaching and research missions (Adcroft, Teckman and Willis, 2010; Bonaccorsi, Daraio and Simar, 2006; Bonaccorsi and Daraio, 2008), some studies have investigated whether HEIs make strategic choices also in regard to third mission activities (e.g. Hussler, Picard and Tang, 2010; Hewitt-Dundas, 2012; Kitagawa, Sánchez Barrioluengo and Uyarra, 2016; Sánchez Barrioluengo, Uyarra and Kitagawa, 2016).

It has been suggested that HEIs may develop different third mission profiles in their attempt to maximise the strategic fit between their institutional resources (subject mix, degree levels provided, research and teaching intensity and quality) and the opportunities and needs in their socioeconomic contexts (Siegel, Waldman and Link, 2003; Hewitt-Dundas, 2012; Kitagawa, Sánchez Barrioluengo and Uyarra, 2016). These include opportunities in relation to engagement with external stakeholders. Understanding the extent to which different third mission profiles are aligned with prioritising different stakeholder groups, is important in order to better understand the role of different HEIs in driving socioeconomic development. Studies of HEIs' third mission engagement have suggested that highly research intensive institutions privilege interactions with larger firms and more distant partners, while less research intensive institutions mainly interact with SMEs and more local partners (Hewitt-Dundas, 2012; Kitagawa, Sánchez Barrioluengo and Uyarra, 2016). However, the specific links between the HEIs' choice of third mission profiles, and their strategies in terms of prioritisation of different stakeholder groups, have not yet been explored in detail. This study aims to fill this gap in research by investigating whether institutions in a specific HE system adopt differentiated third mission profiles, how these profiles relate to their engagement in their teaching and research missions, and how they align with their strategies of prioritising different groups of stakeholders.

The study's findings have implications for policy and management in the HE sector. On the one hand, they can guide policymakers' decisions on how to support HEIs' third mission engagement in order to sustain particular socioeconomic constituencies. On the other hand, they can

provide HEIs with useful knowledge about the alignment between HEIs' third mission profiles and stakeholder prioritisation, which can help them make more informed strategic decisions.

HEIs in the United Kingdom (UK) have been chosen as the focus for the empirical analysis, for several reasons. First, due to the established presence of market-type incentives, the UK is an exemplary case for other countries where HEIs are increasingly competing with each other for public funds, student enrolments and third mission revenues. The UK's HE system encourages the strategic behaviour of HEIs through its distinctive funding structure, which emphasizes performance-related funding in all main areas of university engagement. By mimicking the profit incentive, performance-based funding introduces an element of market competition among institutions (Dougherty and Hong, 2006), encouraging them to specialise both in specific missions and in specific activities within each mission. HEIs in the UK, in fact, tend to strategically specialise in the areas in which they have greater competitive advantage, whether in performing excellent research or in providing undergraduate education (Antonelli, 2008). Recent evidence points to a process of strategic diversification also in respect to third mission (Hewitt-Dundas, 2012), whereby different HEIs engage in different activities (Wright et al., 2008; Meagher et al., 2008) with different degrees of success (Coats-Ulrichsen, 2014; Day and Fernandez, 2015). In this respect, incentives for strategic diversification include: (i) the ongoing reduction in public funding, which encourages HEIs to seek additional income from third mission activities, focusing in particular on those from which they can gain the greater returns; and (ii) the presence a performance-based funding stream, the Higher Education Innovation Fund, introduced in the early 2000s, which rewards institutions according to their success in generating income from third mission activities and therefore encourages them to adopt strategies to maximise their income in this area (Day and Fernandez, 2015; Rossi and Rosli, 2015; Rosli and Rossi, 2016).

Second, extensive data is available on UK HEIs' engagement in teaching, research and third mission activities. In particular, the UK's Higher Education Statistics Agency (HESA) manages a yearly survey of all HEIs in the UK about their third mission engagement, the Higher Education Business and Community Interaction Survey (HEBCI). The HEBCI is the most comprehensive systematic data collection exercise on third mission activities available to-date (Rosli and Rossi, 2015).

The paper is organised as follows: Section 2 reviews the existing literature about the relationship between HEIs' prioritisation of different stakeholder groups and their engagement in third mission activities. Section 3 illustrates data and methodology, while section 4 presents the results of the empirical analysis. Finally, a discussion of the results and some concluding remarks are presented in section 5.

2. Higher Education Institutions as 'stakeholder organisations' and the implications for third mission

2.1. Higher Education Institutions' stakeholders and missions

HEI management has evolved from a 'republic of scholars' to a 'stakeholder organisation' approach, where stakeholders are key in shaping the HEIs' missions. Stakeholders may be defined as any group or individual who can affect or is affected by the achievement of the organisation's (in this case, HEI's) objectives (Freeman, 1984, p.16).

HEIs have a particularly varied range of stakeholders. Perez-Esparrells and Torre (2013) classify stakeholders into internal and external. Internal stakeholders encompass HEI managers and (academic and non-academic) staff. Internal stakeholders play a fundamental role, since senior management is responsible for defining the objectives and targets of the university missions, while middle management is responsible to ensure that the activity of the university fits with those objectives, and that the academic and non-academic staff has the necessary infrastructure and resources to develop each mission.

External stakeholders may be classified according to the framework proposed by Spaapen, Dijstelbloem and Wamelink (2007). These authors identify three types of stakeholders based on the societal impact of the HEI's activity: (i) policy makers, which not only employ university graduates and use research results and university courses for their own policies, but also facilitate the collaboration between HEIs and external stakeholders; (ii) professional users, i.e. industry and societal organisations (profit and not-profit making) that employ university graduates, seek academic training for their staff in particular professional fields, and use academic knowledge to develop products and services; and (iii) end users, understood as the public at large or individual target groups (e.g. farmers, disabled people). Finally, the scope of the relationships between HEIs and their external communities can be local, regional, national and international (e.g. Culum et al., 2013).

Table 1 contains an extensive list of HEIs external stakeholder groups and their different roles in their relations with HEIs. This table clearly shows the multi-stakeholder nature of HEIs.

The mission (main general goals) and activity profiles (range of activities and fields of knowledge) of HEIs are not determined only by their academic and non-academic communities. Historical institutional and regional characteristics define the institutional and regional contingencies that also influence the relationships a university has with its stakeholders (Laredo, 2007). In other words, 'how the institution relates to its stakeholders, is never shaped entirely by its communities, but also very much path dependent' (Jongbloed, Enders and Salerno, 2008, p.308).

The diversity of HEIs entails that different institutions (public or private, general or specialised, hard science-oriented or business schools, with or without a medical school or university hospital, large or small, offering only undergraduate degrees or all degrees including doctoral degrees, territorially embedded or not embedded), will engage with different stakeholders and will develop different activity profiles. These activity profiles include not only the HEIs' decisions to engage in specific research and teaching activities (such as the choice to introduce specific schools, departments, courses and curricula, and the choice to introduce particular research units and research programmes) but also, perhaps even more strongly, their decisions to engage in specific third mission activities.

Table 1. Main HEI's external stakeholders and their roles.

	HEI stakeholders	***Function/Role***
Students	Alumni (individuals and organisations), students and other friends (e.g. students' parents)	Professional user End user Donors Prestige communication
Industry and government	Governing entities and regulators: e.g. EU, Central (Federal), Regional or Local	Policy maker Provider of institutional/legal frame Representative of other stakeholders Funder
	Research Councils	Professional user Funder Representative of other stakeholders Partners, collaborators, sponsors and project funders
	National and international university rankings	Professional user Prestige communication
	Other universities	Competitors and collaborators
	Patent Offices	Professional user Partners, collaborators, sponsors and project funders
	Technology centres and scientific and technological parks	Professional user Partners, collaborators, sponsors and project funders
Employers	Corporate co-sponsors of research	Professional user Partners, collaborators and sponsors
	Alliances and consortia	Professional user Partners and collaborators
Community	Third sector (foundations, church sponsors, etc.)	Professional user Donors
	Secondary education centres	Suppliers
	Citizens and individual groups	End users Donors

Source: authors' elaboration based on Spaapen, Dijstelbloem and Wamelink (2007) and Perez-Esparrells and Torre (2013, p.336).

Therefore, a HEI's priority stakeholders relate to its choice of activities, including third mission activities, in two ways. On the one hand, the stakeholders the HEI addresses largely depend on the HEI's characteristics, including its research intensity and subject specialisation. These characteristics jointly influence both the types of activities that the HEI engages in, and the stakeholders it responds to. On the other hand, HEIs can prioritise certain stakeholders strategically, which then influences directly the type of third mission activities they perform.

2.2. The complex relationship between stakeholder prioritisation and development of third mission profiles

The linkages between HEI characteristics, strategies including stakeholder prioritisation and the development of third mission profiles are multiple and complex. The characteristics of universities in terms of research intensity, subject mix, endowment of physical and human capital resources, are strongly path dependent and tend to influence both the types of stakeholders they interact with (Jongbloed, Enders and Salerno, 2008), and the range of third mission activities they can perform more effectively and efficiently (e.g. Thursby and Kemp, 2002). Some degree of alignment between HEI characteristics, third mission profiles and priority stakeholders has been demonstrated by several studies. Hewitt-Dundas (2012) distinguished between high research intensity (HRI) and low research intensity (LRI) HEIs in the UK, and explored how these differ in their capability to deliver third mission activities, the scale of their third mission activities and their third mission partners. Hewitt-Dundas found that the two groups strongly differed in the range of third mission activities they engaged in: HRI were more likely to develop and exploit intellectual property (IP) and to maximise returns on research, and engaged mostly with partners outside the region, while LRI stressed their potential contribution to human capital development, and had most of their interactions within the region. These findings were confirmed by a study of HEIs' strategic documents (Kitagawa, Sánchez Barrioluengo and Uyarra, 2016) which showed how institutions with different research and teaching intensity engaged in different activities aimed at different partners and with different geographical scope. Similarly, Schoen et al. (2007) found that European HEIs providing only (undergraduate and master level) education mainly focused on the fit between curricula and local employment needs; while those providing education and research and academic training (PhD degrees) developed third mission activities related to university-industry research, IP rights, spinoff companies and participation in public debates. Moreover, while HEIs specialised or oriented towards engineering, natural sciences or information technology mainly focus on business and industry partners, researchers in the humanities, arts and social sciences usually interact with

public bodies, non-profit organisations, and other community groups with lower purchasing power (Benneworth and Jongbloed, 2010).

Additionally, HEIs may strategically choose to prioritise certain stakeholders as opposed to others, for example in order to intentionally maximise their income from certain activities (Kitagawa, Sánchez Barrioluengo and Uyarra, 2016), leverage their complementary organisational strengths (Ankrah et al., 2013) or increase their influence vis a vis particular socioeconomic constituencies. Not all stakeholders are equally salient for HEIs and the evolving university-social interaction may change the importance of each stakeholder over time (Benneworth and Jongbloed, 2010).

This study aims to investigate the complex relationship between stakeholder prioritisation and development of third mission profiles. As the linkages between these are not uni-directional and are mediated by HEI characteristics as well as other strategic choices, the analysis does not aim to uncover precise causal relationships but to explore the nature of the association between stakeholder prioritisation strategies and third mission profiles. A set of robust data mining techniques, quantitative and qualitative Multidimensional Scaling (MDS) is used in order to position HEIs relative to one another in a multidimensional space that captures the HEIs' intensity of engagement in many third mission activities and their alignment with the HEIs' other missions. The results from the MDS exercise are then used to explore how different profiles align with their strategies in terms of prioritising different groups of stakeholders through qualitative MDS analysis and a multinomial logistic regression on both (quantitative and qualitative) MDS results.

These techniques have a number of advantages that allow us to go beyond current research in developing more refined categorisations of both stakeholder prioritisation strategies and third mission profiles: (i) they take into account a wide range of variables without the need to employ variable-reduction techniques as a first step; (ii) since the techniques are robust to outliers and variables with zero values, they allow us to profile the universe of HEIs in the system rather than just a subset of the existing HEIs; (iii) they position HEIs in relation to one another instead of just clustering them into groups; this provides additional information that can be used for more sophisticated analyses of the differences between HEIs.

3. Data and methodology

3.1. Data sources

The UK HE system is characterised by a large number of institutions (165 universities of which 161 award degrees independently[1]), a decentralised system of funding distribution, whereby different governmental bodies are responsible for distributing funding for research, teaching and third mission to different parts of the UK, and the extensive presence of market-type incentives (most funding is distributed on a performance basis). While most HEIs are publicly funded - although there are a growing number of entirely private institutions - they enjoy considerable decisional autonomy from the government and are formally non-profit institutions.

Table 2. Resources and outputs of the HEIs that are included in the sample and of those that are excluded from it.

	HEIs in the sample (159)	
	Total	***%***
Total grant (thousand GBP)	6,035,504	99.28%
Academic staff HC	394,700	99.74%
Academic staff FTE	596,664	99.70%
Enrolment (undergraduate)	1,752,940	99.60%
Enrolment (postgraduate)	538,745	99.87%
Number of research students	110,650	99.81%
Grants (research) (thousand GBP)	1,958,183	99.86%
N. publications (WOS + SCOPUS)	342,814	-
N. Patents filed	2,086	100.00%
Income from research contracts (thousand GBP)	1,191,151	99.82%
Income from consultancy contracts (thousand GBP)	438,662	99.28%
N. academic days spent on public events	114,425	99.43%
Income from CPD courses (thousand GBP)	656,553	96.68%
Current year spinoffs with some HEI ownership	130	100.00%
Regeneration income (thousand GBP)	178,756	98.98%

Source: authors' elaboration.

A large amount of data is available on HEIs' engagement in research, teaching and third mission activities, from the Higher Education Statistics Agency (HESA). We integrate HEBCI data with general HESA data on HEIs' teaching and research engagement as well as other institutional characteristics[2], together with Scopus and ISI data on publications[3]. Our dataset consists of information for the academic year 2013/14 on 159 out of the 165 HEIs that submit entries to the

[1] An up-to-date list is available at: https://www.gov.uk/check-a-university-is-officially-recognised/recognised-bodies (last checked 16th October 2016).

[2] Data is sourced from HESA's HEIDI database, which includes the results of the HEBCI survey as well as more general information about universities' staff, students and finances.

3 WOS and Scopus have different coverage for different subjects mix. Given that MDS is robust to redundant variables we include metrics from both sources.

HEBCI. Only six HEIs have been excluded from the sample: 4 universities that have recently merged with other institutions and no longer exist independently, as well as two institutions that are federations of colleges. The 159 HEIs account for more than 99% of the total research, teaching and third mission outputs of the UK HE system, and for some outputs they even account for 100% - see Table 2. The size of the sample is one of the strengths of this paper.

3.2. Methodological approach

To explore the relationship between stakeholder prioritisation and development of third mission profiles, we perform sophisticated categorisations of both stakeholder prioritisation strategies and third mission profiles, before investigating the associations between them.

Ordinal multidimensional scaling or MDS (Kruskal, 1964; Kruskal and Wish, 1978) is a non-parametric and distance-based multivariate analysis technique, which produces a low-dimensional representation of the data and visualises this representation graphically (i.e. through statistical maps). Given a set of distances (or similarities) between pairs of HEIs, MDS attempts to place them in the map in such a way that if the similarity between two HEIs is high they are placed next to each other, and if the similarity is low they are placed far apart. This way, MDS makes the results accessible to the non-specialist in an intuitive way (Sagarra et al., 2014).

Other multivariate analysis methods extensively implemented in this kind of studies, such as cluster analysis, usually analyse either variables or observations separately. Cluster analysis has also the problem of explaining the commonalities and differences among the members of different clusters, and redundant variables can influence the final configuration incorporating a bias into the analysis. MDS addresses all those issues, allowing us to work with a high number of variables by grouping them in few dimensions. Moreover, MDS allows accounting for the diversity of the HE system, since it is robust to the presence of outliers and can be applied to the universe of the HEIs in the sector. Given the strong heterogeneity of the HE system in UK, where different institutions engage in different types of third mission activities, several studies that have compared HEIs using other methods such as Data Envelopment Analysis have been forced to leave several institutions out of the sample (Curi et al., 2012; Rossi, 2014).

Although the MDS configuration can be interpreted through visual inspection, we rely on two more formal and less subjective techniques, property fitting and hierarchical cluster analysis, to do so (Sagarra, 2015a). On the one hand, property fitting (ProFit) is a technique that relies on linear or logistic regression and that comes under the general umbrella of biplots (Gower and Hand, 1996; Mar-Molinero and Mingers, 2007). It explores, with a series of vectors through the configuration, if

a particular characteristic of the data grows in a given direction. On the other hand, it is not possible to visualise an n-dimensional MDS configuration, and we are forced to work with projections onto pairs of dimensions: two HEIs may appear near each other in one of those two-dimensional projections while having very different ratio structures. This issue is explored by means of hierarchical cluster analysis, which helps us to find out whether two HEIs are close to each other in the n-dimensional configuration. In particular, we apply the Ward's method, which minimises the within-cluster variance and maximises the inter-cluster variance, to the set of MDS coordinates for each HEI (therefore results are not affected by redundant information).

Examples of the use of MDS in the HE field are Stenberg and Davis (1978), Mar-Molinero (1989, 1990), Mar-Molinero and Mingers (2007), Sagarra et al. (2015b, 2016), and de la Torre et al. (2016). MDS can be applied to either quantitative variables (quantitative MDS) or qualitative ones (qualitative MDS). Because of the nature of the available variables, we use quantitative MDS to map and categorise HEIs' third mission profiles and qualitative MDS to map and categorise HEIs' stakeholder prioritisation strategies. Since our aim is to assess how HEIs' choice of third mission profiles aligns with their stakeholders prioritisation strategies, we use multinomial logistic regression analysis. The dependent variable in the regression takes the values of the clusters emerged from the quantitative MDS analysis of the third mission profiles. As independent variables, we use the coordinates from the qualitative MDS analysis on HEIs' stakeholder prioritisation strategies.

3.3. Variables selection

In order to characterise the HEIs' various third mission profiles, we identify a reasonable set of seven variables representing HEIs' breadth of engagement in third mission activities: income from research contracts, income from consultancy contracts, income from executive education courses (called "courses for professional development", CPDs), regeneration income, academic days spent on public events, number of patents filed and number of spinoffs created. Whenever possible, the income derived from third mission activities is used as a proxy for engagement.

While income is not a good proxy for the impact of HEIs' third mission activities (Rossi and Rosli, 2015) and hence not very accurate in order to rank HEIs according to their impact on society and the economy, it is an acceptable proxy for engagement, particularly when used to compare different activities within the same HEI, this way controlling for reputational effects (e.g. the fact that some institutions may command higher income for similar services thanks to their reputation). However, not all third mission activities can be measured using income. Many kinds of public

events - such as public lectures, exhibitions, performances - are offered to the public for free, so the number of days that academics spent on these activities is a better proxy for engagement. IP income (including the sales of shares in spinoffs, and income from licenses and sales of patents and software), unlike other types of income, is highly volatile being strongly influenced by infrequent events like the occasional sale of a very valuable spinoff or the sale or licensing of a valuable patent. Because IP income is highly dependent on external circumstances rather than being the result of strategic choices, we include the *number* of patents filed and the *number* of spinoffs created, which are less likely to vary year on year and hence provide a more realistic picture of the HEI's engagement. In this way we include a wide spectrum of third mission activities, considering both "hard" third mission activities (e.g. patenting or spin-offs) and "soft" activities (e.g. pubic events or consultancy) – both relevant for the socioeconomic contribution of HEIs (Philpott et al., 2011). The HEBCI survey also reports income from facilities and equipment services, however, unlike other studies (Sengupta and Ray, 2015) we decided not to include it, as it strongly depends on the HEIs' location and estate endowment, i.e. it too largely depends on external circumstances rather than on the HEIs' strategic decision to prioritise this activity as opposed to others.

To eliminate size bias, the above-mentioned seven variables are divided by the total faculty staff (full time equivalent, FTE) of the corresponding HEI.

HEIs place different emphasis on their three missions – some are more teaching oriented, others are clearly research oriented (Bonaccorsi and Daraio, 2009) and finally there are also third mission-oriented HEIs (de la Torre et al., 2016). Different fields of knowledge (Benneworth and Jongbloed, 2010; Rossi, 2014) as well as different teaching and research activities (Molas-Gallart et al., 2002) provide HEIs with different opportunities and resources for third mission activities. In order to portray a complete characterisation of HEIs, we complement the seven variables about third mission engagement with 12 additional variables (also expressed as ratios) that capture their orientation with respect to the other two missions and their main characteristics:

(i) research engagement – including the research productivity of HEIs and the weight of research students in the total student body;

(ii) teaching engagement – characterised by the relative prevalence of undergraduate with respect to postgraduate teaching;

(iii) governance model, measured in terms of the reliance on structured personnel (share of full time equivalent faculty) and reliance on public funding (share of income coming from government grants); and

(iv) subject mix.

These variables are listed in Table 3. We consider these 19 variables to contain enough information to approximate the heterogeneity of the UK HE system, while at the same time being parsimonious enough to make it possible to interpret the results without making the analysis too cumbersome.

Table 3. Variables used to identify HEIs' third mission profiles

	N.	*Variable ID*	*Variable description*
Third mission engagement	1	TM_PAT_FTEF	N. patent applications / Full Time Equivalent Faculty (FTEF)
	2	TM_INCRESCONT_FTEF	Income from research contracts / FTEF
	3	TM_INCCONSCONT_FTEF	Income from consultancy contracts / FTEF
	4	TM_DAYSPUB_FTEF	N. academic days spent on public events / FTEF
	5	TM_INCCPD_FTEF	Income from Continuing Professional Development (CPD) courses / FTEF
	6	TM_SPIN_FTEF	N. current year Spinoffs with some HEI ownership / FTEF
	7	TM_REGINC_FTEF	Regeneration Income / FTEF
Research engagement	8	GRANTSRES_FTEF	Income from research grants / FTEF
	9	SCOPUS_FTEF	N. papers (Scopus) / FTEF
	10	WOS_FTEF	N. papers (WoS) / FTEF
	11	RESSTUD_ENROL	N. research students / total enrolment
Teaching engagement	12	UNDENROL_FTEF	Enrolment (undergraduate) / FTEF
	13	POSTENROL_FTEF	Enrolment (postgraduate) / FTEF
Governance model	14	TOTGRANT_INC	Total grants / total income
	15	FTEF_FAC	Full time equivalent faculty / total faculty
Subject mix	16	SHARE_MED	Share of FTEF in medicine
	17	SHARE_SCI&ENG	Share of FTEF in science and engineering
	18	SHARE_SOCSCI	Share of FTEF in the social sciences
	19	SHARE_ART&HUM	Share of FTEF in the arts and humanities

Source: authors' elaboration.

In order to address our first question - what are the different third mission profiles of HEIs, and how do they align with HEIs' teaching and research mission - we apply a quantitatitve MDS algorithm to the variables listed in Table 3. In so doing, we show that: (i) HEIs in the UK have different profiles in terms of the third mission activities they engage in; and (ii) third mission profiles and various characteristics of the teaching and research activity of HEIs are highly aligned. To describe these profiles we also take into account the nature of the institutions. Following a categorisation of UK HEIs widely used in the higher education literature, we identify four groups of HEIs: (i) former polytechnics that became universities in 1992: in that period, numerous pre-existing institutions, called polytechnics, that provided vocational education in a range of applied subjects (like agriculture, nursing, some applied engineering fields and teaching) were awarded university status; these HEIs have maintained a strong orientation to providing applied education in these fields; (ii) old universities, founded before 1990s (not formerly polytechnics): most of these were founded in the 19th century, but some date back to the Middle Ages, and a few were founded in the first half of the 20th century; (iii) modern universities, completely new HEIs founded after the 1990s; and (iv) higher education colleges, which provide education in the arts such as music conservatoires and schools of fine and performing arts.

To address our second question - how do different third mission profiles align with HEIs' prioritisation of different stakeholder groups - we first identify a range of HEIs' strategic profiles by applying a qualitative MDS algorithm to a set of variables capturing HEIs' strategies in terms of stakeholder prioritisation. Finally we correlate the outcomes of the quantitative MDS and qualitative MDS analyses through a multinomial logistic regression analysis.

To identify the HEIs' strategic priorities, we use information from HEBCI on the areas in which HEIs make the greatest contribution to economic development and their areas of greatest geographical priority. Based on HEBCI data, we develop four variables identifying priority stakeholders (students, employers, industry and local communities) and three variables identifying priority geographical areas (national or international, regional, local), explained in Table 4. HEIs prioritising students (*STK_STUD*) are focused on: widening participation/access; helping with student and graduate enterprises; attracting non-local students to the region; graduate retention in local region. HEIs prioritising employers (*STK_EMP*) aim at: meeting regional skills needs; meeting national skills needs; and management development. Instead, HEIs prioritising industry stakeholders (*STK_IND*) are oriented towards: knowledge exchange; research collaboration with industry; commercialisation (e.g. spinoff activity/licensing); provision of incubator support; and supporting small and medium size enterprises (SMEs). Finally, HEIs prioritising local communities (*STK_LOCCOMM*) intend to: attract inward investment to region; support community development; develop local partnerships; and facilitate networks.

As for geographical scope, *LOC_NATINT* indicates whether HEIs prioritise: meeting national skills needs; international EU; other international. Instead, *LOC_REG* describes HEIs that have chosen to pursue: meeting regional skills needs; attracting non-local students to the region; graduate retention in local region; attracting inward investment to region; regions; and devolved Government region. Finally, *LOC_LOC* approximates HEIs that prioritise: support for community development; developing local partnerships; local authority area; and locality.

Table 4. Variables used to identify HEIs' strategic profiles

	N.	***Variable ID***	***Variable description***
Partners/clients that receive the greatest benefits from the HEIs third mission engagement	1	PRIORITYCOMM	Commercial private business
	2	PRIORITYNONCOMM	Non-commercial social, community and cultural organisations
	3	PRIORITYPUB	Public sector (commercial and non-commercial)
Areas in which the HEI makes the greatest contribution to economic development	4	STK_STUD	Stakeholders: students
	5	STK_EMP	Stakeholders: employers
	6	STK_IND	Stakeholders: industry
	7	STK_LOCCOMM	Stakeholders: local communities
Areas of greatest geographical priority	8	LOC_NATINT	National and/or international
	9	LOC_REG	Regional
	10	LOC_LOC	Local

Source: authors' elaboration.

Since we are dealing with zero/one variables, the qualitative MDS analysis relies on the Russell and Rao (1940) measure of proximity, in which equal weight is given to matches and non-matches. This measure is the default for binary similarity data. The higher the number of coincidences, the more similar the HEIs.

4. Results

4.1. Alignment between the third mission profiles and the characteristics of teaching and research activities of HEIs

The literature states that HEIs' choices of which third mission activities to engage in, depend on the opportunities and resources available to each HEI, and that these, in turn, derive from the HEIs' various institutional characteristics and mission orientation. In order to identify the HEIs' third mission profiles we have performed a quantitative MDS analysis based on 7 third mission engagement variables, and 12 additional indicators of their teaching and research engagement, income and faculty staff structure, and subject mix[4], listed in Table 3.

Looking for a balance between the goodness of fit and the complexity of the model – both increasing with each additional dimension – we consider that the optimal solution is the one producing six dimensions. The addition of a seventh dimension improves very little the goodness of fit of the configuration, and it would render the interpretation of results more difficult.

Table 5 shows the R^2 and directional cosines from ProFit analysis: 19 parallel regressions (one for each variable initially included in the MDS analysis) in which the original variables, treated as dependent variables, are regressed on the six MDS coordinates, used as independent variables. It shows how each dimension correlates with the various variables as well as the goodness of fit of the regression. The six dimensions explain the variables well since the R^2 of the regressions are higher than 0.5 (our criterion for plotting them in the configuration) except for the case of *TOTGRANT_INC*.

As can be seen from Table 5, Dimension 1 is highly correlated to a HEIs' number of patent applications and income from research contracts (*TM_PAT_FTEF*, *TM_INCRESCONT_FTEF*), which is typical of research-intensive HEIs with high scientific publications (*SCOPUS_FTEF*, *WOS_FTEF*), high share of human resources devoted to research (both faculty, *FTEF_FAC*, and students, *RESSTUD_ENROL*), high income generated through research (*GRANTSRES_FTEF*), and

[4] The consistency of the third mission profiles have been tested through an additional MDS analysis based only on the third mission variables in Table 3, which has returned the same profiles as the MDS analysis based on the full dataset. The results of this analysis are available in a technical annex upon request to the corresponding author.

high share of staff in science and engineering (*SHARE_SCI&ENG*). Dimension 2 is highly correlated to the provision of professional education (*TM_INCCPD_FTE*F), high share of staff in the social sciences (*SHARE_SOCSCI*) and postgraduate courses (*POSTENROL_FTEF*). The third dimension is highly correlated to the organisation of public events (*TM_DAYSPUB_FTEF*), HEI research intensity (*GRANTSRES_FTEF*, *RESSTUD_ENROL*) and high share of staff in the arts and humanities (*SHARE_ART&HUM*). The remaining dimensions represent combinations of different profiles that are less distinctively associated with specific third mission activities and specific teaching, research, governance and subject orientations. They allow for a finer graphic interpretation and mainly introduce nuances related to medicine fields, which have very particular third mission activities (Anderson, Daim and Lavoie, 2007).

Table 5. Results of ProFit analysis.

Variable ID	***Dim 1***	***Dim 2***	***Dim 3***	***Dim 4***	***Dim 5***	***Dim 6***	R^2
TM_PAT_FTEF	**0.567**	-0.156	0.019	0.350	**0.649**	-0.331	0.62
TM_INCRESCONT_FTEF	**0.745**	-0.161	0.353	**-0.531**	-0.024	0.113	0.73
TM_INCCONSCONT_FTEF	0.233	-0.074	0.267	**-0.928**	-0.036	-0.079	0.71
TM_DAYSPUB_FTEF	-0.306	-0.064	**0.730**	0.100	0.345	**0.490**	0.64
TM_INCCPD_FTEF	0.045	**0.985**	0.034	-0.054	-0.125	-0.090	0.72
TM_SPIN_FTEF	0.176	-0.056	**-0.368**	0.101	**0.872**	-0.244	0.62
TM_REGINC_FTEF	-0.023	-0.057	**-0.465**	-0.252	**0.736**	**0.419**	0.66
GRANTSRES_FTEF	**0.733**	0.301	**0.568**	0.133	0.151	-0.093	0.82
SCOPUS_FTEF	**0.882**	0.211	0.080	0.288	0.141	0.263	0.83
WOS_FTEF	**0.645**	0.047	0.103	**0.662**	-0.022	0.364	0.87
RESSTUD_ENROL	**0.653**	0.003	**0.416**	**0.623**	0.075	0.079	0.76
UNDENROL_FTEF	**-0.527**	0.005	**-0.799**	-0.228	-0.171	0.057	0.66
POSTENROL_FTEF	-0.134	**0.655**	0.068	0.256	0.201	**-0.665**	0.74
TOTGRANT_INC	-0.142	**-0.558**	-0.243	0.130	-0.162	**-0.753**	0.39
FTEF_FAC	0.294	0.026	-0.306	-0.190	-0.352	**-0.812**	0.59
SHARE_MED	0.324	-0.247	-0.431	0.344	**-0.615**	0.389	0.70
SHARE_SCI&ENG	**0.743**	-0.172	-0.176	**-0.536**	0.295	0.118	0.65
SHARE_SOCSCI	-0.063	**0.769**	**-0.581**	-0.233	-0.057	0.093	0.68
SHARE_ART&HUM	**-0.536**	-0.126	**0.666**	0.122	0.319	-0.370	0.84

Source: authors' elaboration.

In addition, we have performed a hierarchical cluster analysis of the 159 observations using the 6 MDS dimensions as variables. We obtain six clusters, two of them consisting of one outlier[5]. Given the limited number of outliers and their particular nature, we focus the rest of our discussion and analysis on the four main clusters.

Table 6 differentiates the four main clusters on the basis of the 19 variables on which the MDS was performed and the nature of their HEIs. The Kruskal-Wallis test suggests that the differences in means across clusters are significant (except for the variable *TOTGRANT_INC*).

[5] These outliers are the both strongly specialised institutions, one in business and one in tropical medicine.

Cluster 1 is composed of 8 HEIs that have very high number of patents and income from research contracts, very high value of the research-related variables and low values of the teaching-related ones, and finally high shares of staff in medicine and science and engineering: these are highly research-intensive universities that follow a "research commercialisation" model of third mission. They are all old universities founded before the 1990s. We call these "science-based highly research intensive" universities (SHRI).

Cluster 2 is composed of 54 HEIs that have relatively high patents, income from research, consultancy and regeneration programmes, high value of the research-related variables, and relatively low students per academic, as well as a high share of staff in science and engineering. These are also research-intensive universities, but less so than those in the previous cluster, and they have a more mixed third mission profile since they also engage in consultancy and regeneration programmes. We call these "mixed profile research intensive" universities (MPRI). The largest majority (89%) are old universities.

Cluster 3 includes 55 universities with high income from CPDs and high values of the teaching-related variables. They have quite a substantial share of staff in social sciences, and the majority are former polytechnics (62%) and to a lesser extent modern universities (28%). We call these "professional teaching intensive" universities (PTI).

Table 6. Clustering of HEIs based on MDS variables.

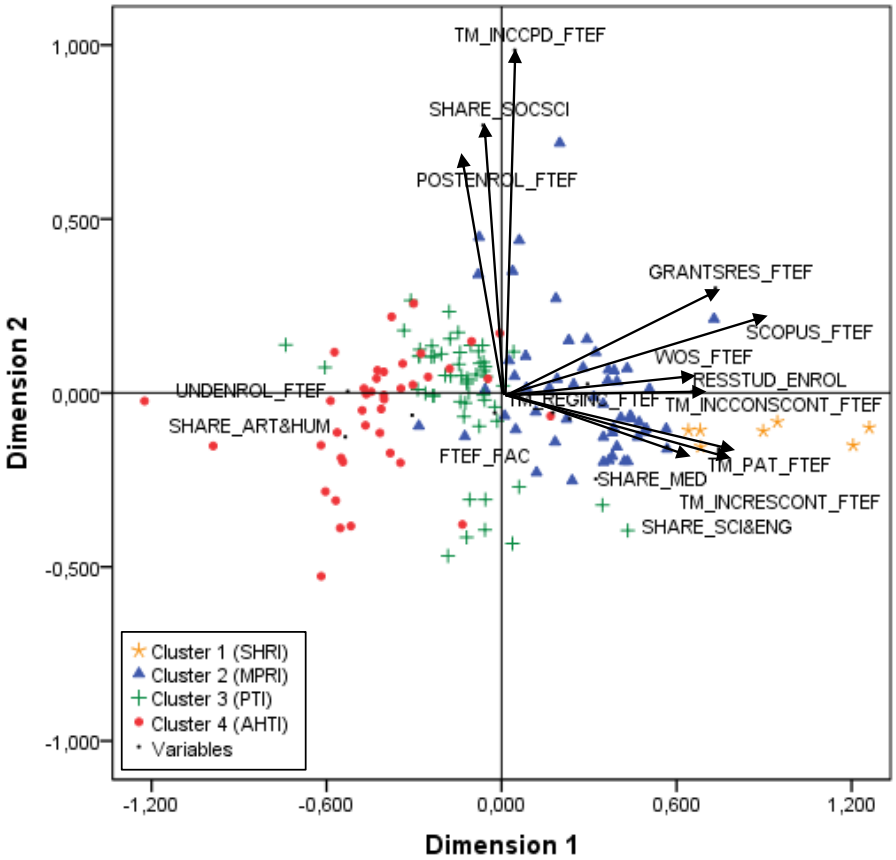
Variable ID	***1 SHRI***	***2 MPRI***	***3 PTI***	***4 AHTI***
TM_PAT_FTEF	**0.02**	**0.01**	0.00	0.00
TM_INCRESCONT_FTEF	**10.91**	**5.03**	1.54	0.61
TM_INCCONSCONT_FTEF	1.68	**2.24**	1.85	1.26
TM_DAYSPUB_FTEF	0.31	0.35	0.52	**4.97**
TM_INCCPD_FTEF	1.64	2.88	**4.53**	2.23
TM_SPIN_FTEF	0.00	0.00	0.00	0.00
TM_REGINC_FTEF	0.06	**1.47**	0.68	0.66
GRANTSRES_FTEF	**18.37**	**9.61**	2.27	3.27
SCOPUS_FTEF	**1.40**	**0.91**	0.37	0.14
WOS_FTEF	**1.65**	**0.81**	0.27	0.14
RESSTUD_ENROL	**0.23**	**0.07**	0.02	0.02
UNDENROL_FTEF	2.13	7.47	**16.00**	**11.48**
POSTENROL_FTEF	1.31	2.87	**3.22**	**3.81**
TOTGRANT_INC	0.18	0.20	0.23	0.23
FTEF_FAC	0.93	0.84	0.81	0.74
SHARE_MED	**0.43**	0.24	0.28	0.06
SHARE_SCI&ENG	**0.41**	**0.36**	0.22	0.04
SHARE_SOCSCI	0.07	0.23	**0.28**	0.11
SHARE_ART&HUM	0.09	0.17	0.23	**0.80**
Former polytechnics	0%	9%	**62%**	7%
Old universities	**100%**	**89%**	7%	23%
Modern universities	0%	2%	**29%**	**30%**
Colleges of higher education	0%	0%	2%	**40%**
N	8	54	55	40

Source: authors' elaboration.

Cluster 4 includes 40 universities with high involvement in public events, high values of the teaching-related variables, and a very high share of staff in arts and humanities; they are mostly higher education colleges (40%) but also modern universities (30%). We call these "arts and humanities-based teaching intensive" universities (AHTI).

The HEIs' different profiles become more obvious in the graphical representation of the MDS and ProFit analyses. Figure 1 maps HEIs onto dimensions 1 and 2 of the MDS analysis. The dots representing each HEI are shaped according to the different four clusters outlined above. It is evident that clusters 1 and 2 (SHRI and MPRI) score highly on Dimension 1 (right-side quadrant), but they differ with respect to Dimension 2: cluster 1 (SHRI) scores low on this dimension (bottom quadrant), while cluster 2 (MPRI) has better scores in line with their more mixed profile. Clusters 3 (PTI) and 4 (AHTI) score badly on Dimension 1 (they are all located in the left quadrant of the map). While cluster 4 (AHTI) also tends to score low on Dimension 2, cluster 3 (PTI) tends to do better on Dimension 2.

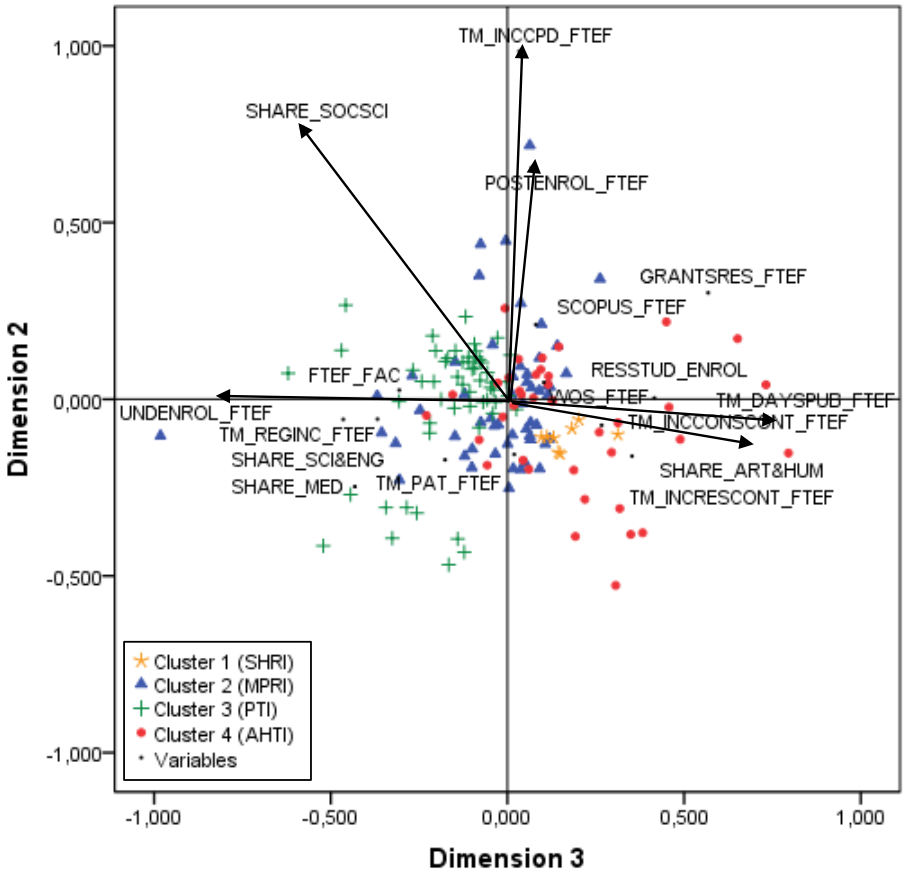
Figure 1. Multidimensional Scaling configuration for Dimensions 1 and 2.



Source: authors' elaboration.

Figure 2 maps HEIs onto dimensions 2 and 3 of the MDS analysis. The dots representing each HEI are again shaped according to the different clusters outlined above. Cluster 4 (AHTI) scores well on Dimension 3 (right-side quadrant), while cluster 3 (PTI) has lower scores in relation to Dimension 3. Most of the HEIs in cluster 3 (PTI) do well on Dimension 2.

Figure 2. Multidimensional Scaling configuration for Dimensions 2 and 3.



Source: authors' elaboration.

These results are consistent with, and further refine, those of Hewitt-Dundas (2012), who stated that highly research intensive HEIs engage in IP exploitation activities, while low research intensive HEIs stress their potential contribution to human capital development. Our analysis further distinguishes the former into two groups: a set of science-based highly research intensive universities that focus on IP and research contracts, and a set of mixed profile research intensive universities that also engage in consultancies and regeneration programmes. Additionally, our results also distinguish the latter into two groups: a set of teaching-intensive HEIs oriented to professional education particularly in the social sciences, and a set of teaching-intensive HEIs particularly focused in the arts and humanities that focus on public events).

4.2. Alignment between third mission profiles and HEIs' stakeholder prioritisation strategies

In this section, we explore whether the four clusters previously identified differ in terms of the stakeholders that HEIs prioritise strategically. Table 7 disaggregates the information about HEIs' priority stakeholders, according to the four clusters. While SHRI and MPRI institutions mainly prioritise commercial private business as partners, AHTIs focus on non commercial social, community and cultural organisations, and PTI prioritise either commercial private business or public sector (commercial and non-commercial) organisations as their partners/clients. Furthermore, while SHRI and MPRI institutions focus their greatest contribution to economic development on industry and, to a lesser extent, on employers, the focus of PTI and AHTI is more diversified on all stakeholder groups. Students and local communities areas gradually increase their role when passing from Cluster 1 to Cluster 4, while industry shows the opposite pattern. Finally, SHRI and MPRI institutions prioritise mainly the national and/or international and regional areas respectively, while PTI and AHTI institutions focus on the regional and local areas, which gradually increase their role when moving from Cluster 1 to Cluster 4.

Table 7. HEIs clusters and nature of stakeholders.

		1 SHRI	**2 MPRI**	**3 PTI**	**4 AHTI**
Stakeholders that receive the greatest benefits from the HEIs third mission engagement	PRIORITYCOMM	**87.5%**	**68.5%**	**49.1%**	22.5%
	PRIORITYNONCOMM	12.5%	0.0%	14.5%	**42.5%**
	PRIORITYPUB	12.5%	31.5%	**52.7%**	32.5%
Areas in which the HEI makes the greatest contribution to economic development	STK_STUD	25.0%	38.9%	**65.5%**	**92.5%**
	STK_EMP	**50.0%**	**42.6%**	**56.4%**	**62.5%**
	STK_IND	**100.0%**	**96.3%**	**78.2%**	**55.0%**
	STK_LOCCOMM	0.0%	24.1%	**32.7%**	**45.0%**
Areas of greatest geographical priority	LOC_NATINT	**50.0%**	31.5%	25.5%	37.5%
	LOC_REG	25.0%	**46.3%**	**78.2%**	**72.5%**
	LOC_LOC	12.5%	16.7%	**43.6%**	**50.0%**

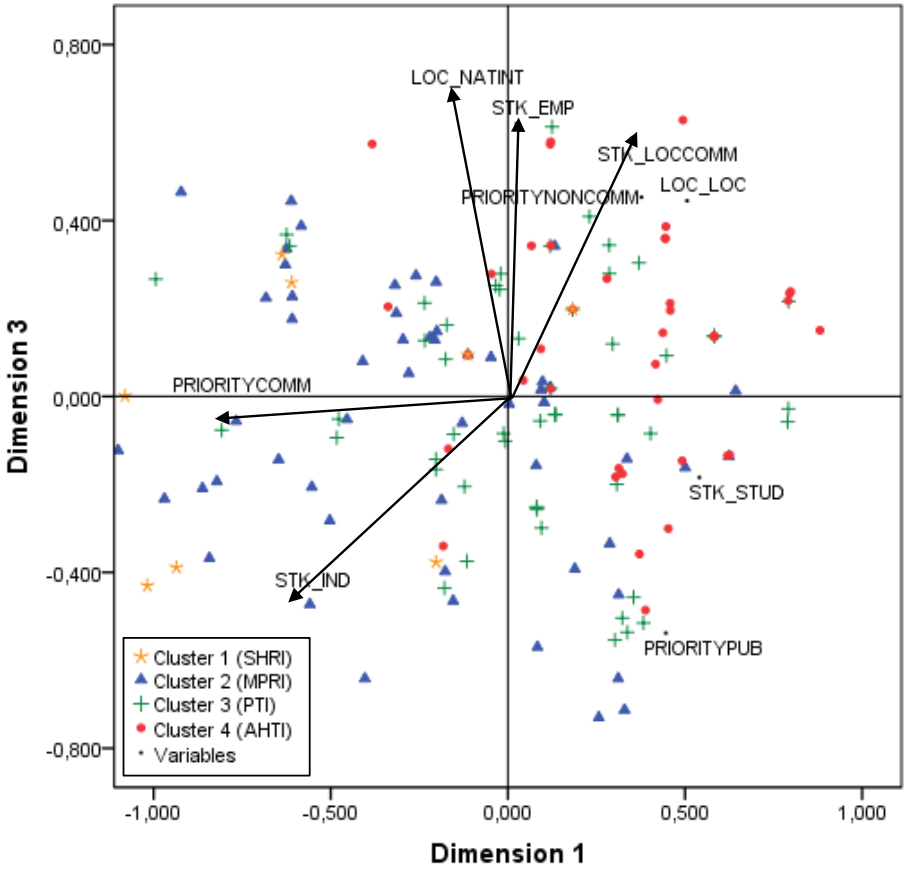
Source: authors' elaboration.

To synthesize and to better comprehend the HEIs' strategic profiles, we perform a MDS analysis using the qualitative information about the stakeholders that HEIs prioritise in their third mission engagement (i.e. the ten binary variables showed in Table 4). We consider the solution of five dimensions as the optimal one, since the corresponding Stress-1 value (0.0386) is considered as 'excellent' in Kruskal's (1964) verbal classification, and the addition of a sixth dimension improves

very little the goodness of fit of the configuration. We show only the projections of the MDS configuration onto dimensions 1 and 3 (Figure 3) because, according to the regression analysis performed later, these are the dimensions that discriminate the most among the different HEI clusters. Only variables with Nagelkerke R^2 values higher than 0.5 are represented.

It can be seen from Figure 3 that variables *PRIORITYCOMM* and *STK_IND* are at an acute angle with Dimension 1, indicating that this dimension is associated with the variables related to: commercial private business, as partners/clients that receive the greatest benefits from the HEIs third mission engagement; and industry, as the area in which the HEI makes the greatest contribution to economic development. This suggests that Dimension 1 could be interpreted as "orientation towards (commercial private) industry stakeholders".

Figure 3. Multidimensional Scaling configuration of binary variables for Dimensions 1 and 3.



Source: authors' elaboration.

The ratios *STK_EMP*, *STK_LOCCOMM* and *LOC_NATINT* are mainly associated with Dimension 3, indicating that this dimension is associated with the variables related to: employers and local communities, as the areas in which HEIs makes the greatest contribution to economic

development; and, to a lesser extent, national/international geographical priorities, as the areas of greatest interest. This suggests that Dimension 3 could be labelled as "orientation towards employers". It is clear that Dimension 1 clearly discriminates between the SHRI group, which is strongly oriented toward industry stakeholders (on the left quadrants), and the AHTI group, which is not. Most AHTI also have a positive orientation toward employers (top right quadrant). Clusters MHRI and PTI have more mixed profiles in terms of their stakeholder priorities.

To better understand how different third mission profiles align with HEIs' prioritisation of different stakeholder groups, we perform a multinomial logistic regression analysis. This technique allow us to deal with multiple outcomes (i.e. the four types or clusters of third mission engagement), and reflects their association with the five different dimensions of the HEIs' priority stakeholders. The results are shown in Table 8 - the PTI cluster (i.e. "professional teaching intensive" universities) was selected as base outcome to which the other clusters are compared.

Table 8. Multinomial logistic regression.

Cluster	Variables	*b*	Std. Error	Marginal effects
1 (SHRI)	**Dim1**	-4.406 ***	1.167	-0.084
	Dim2	-1.329	1.455	-0.025
	Dim3	-2.026	1.567	-0.039
	Dim4	-1.144	1.556	-0.025
	Dim5	-0.706	1.791	-0.005
	Constant	-3.068 ***	0.712	
2 (MPRI)	**Dim1**	-2.341 ***	0.596	-0.649
	Dim2	-0.022	0.591	0.053
	Dim3	-1.524 **	0.760	-0.465
	Dim4	-0.978	0.894	-0.356
	Dim5	0.060	1.130	0.195
	Constant	-0.258	0.220	
3 (PTI) is the base outcome				
4 (AHTI)	**Dim1**	2.668 ***	0.762	0.483
	Dim2	-0.874	0.727	-0.106
	Dim3	2.394 ***	0.916	0.396
	Dim4	2.583 **	1.177	0.388
	Dim5	-3.250 *	1.887	-0.417
	Constant	-1.147 ***	0.327	
N	157			
LR Chi2	85.59 ***			
Log likelihood	-151.0344			
Pseudo R2	0.2208			

* Statistical significance level at the 10%

** Statistical significance level at the 5%

*** Statistical significance level at the 1%

Source: authors' elaboration.

Dimension 1 presents statistical significance in all the different outcomes, indicating that the "orientation towards industry stakeholders" has a strong discrimination effect on the HEIs third mission profiles. The signs of the coefficients confirm our expectations: while SHRIs and MPRIs are more oriented towards commercial private business and industry partners compared to PTI institutions (i.e. one expects a greater likelihood of being either a SHRI or a MPRI by a HEI with a more negative value in Dimension 1), AHTIs are less oriented in this sense. Considering that we use multinomial logistic regression, the computation of marginal effects gives us a more reliable notion of how much the probability of having a specific third mission profile increases given a specific variation in the explanatory variables (i.e. dimensions). Therefore, in the case of AHTIs, a marginal effect of the Dimension 1 variable equal to 0.483 means that when this Dimension increases by one unit, the probability of having such third mission profile will increase by 48.3%, when all the other variables are controlled for. On the other hand, Dimension 3 presents statistical significance for the MPRI and AHTI outcomes, indicating that the "orientation towards employers" dimension has a discriminating role in having a MPRI or an AHTI third mission profile, considering the PTI as the base outcome.

These results are consistent with previous studies on universities' third mission engagement using data from the UK, which concluded that HEIs with high research intensity tend to interact with larger firms and more distant partners, while those with low research intensity mainly interact with SMEs and more local partners (Hewitt-Dundas, 2012; Kitagawa Sánchez Barrioluengo and Uyarra, 2016). Our theoretical framework and results go a step further, indicating that third mission profiles are shaped by their institutional strategies including stakeholder prioritisation. In particular, prioritising or not business/industry stakeholders (Dimension 1) or employers and geographic focus (Dimension 2) seem to be key factors in the final configuration of the third mission profile of HEIs in the UK.

5. Conclusions

This study explores the nature of the association between stakeholder prioritisation and development of third mission profiles in UK. To do so, we have first analysed the mix of third mission activities and institutional characteristics of HEIs applying a quantitative MDS analysis to HEBCI data (academic year 2013/14). This method has allowed us to include enough information to approximate the heterogeneity of the HE system in UK and the multidimensional nature of HEIs, while considering the universe of the HE system and not a subset of institutions.

Results provide a more refined categorisation of third mission profiles than previous attempts. They indicate that UK HEIs have very varied third mission profiles, as highlighted among other things by the fact that it is difficult to reduce the number of dimensions to less than one third of the initial variables. As trend, however, we identify a few main profiles: (i) "science-based highly research intensive" universities (SHRI), which are old universities that focus on research commercialisation; (ii) "mixed profile research intensive" universities (MPRI), mostly old universities with more mixed third mission profile since they engage in research commercialisation as well as consultancy and regeneration programmes; (iii) "professional teaching intensive" HEIs (PTI), mostly former polytechnics oriented towards postgraduate education (including PDCs) and social sciences; and (iv) "arts and humanities-based teaching intensive" HEIs (AHTI), mostly colleges providing undergraduate and postgraduate teaching.

These results suggest that third mission profiles are closely linked to universities' research or teaching orientation and to their subject mix, which is consistent with previous results for the UK case (Hewitt-Dundas, 2012; Kitagawa, Sánchez Barrioluengo and Uyarra, 2016). There also appears to be a consistent pattern between type of institution and third mission profiles.

Secondly, we have performed a multinomial logistic regression analysis based on the third mission profiles identified (dependent variables) and the categorisation of stakeholder prioritisation portrayed by an additional qualitative MDS analysis (on stakeholder strategic objectives of HEIs). This analysis reveals that third mission profiles are shaped by their institutional strategies including stakeholder prioritisation. The choice between prioritising business/industry stakeholders and employers are key factors in the final configuration of the third mission profile of HEIs.

This study offers a new, more comprehensive and more detailed look at third mission profiles and the role of stakeholder prioritisation on the HEIs activity mix. Results clearly portray that HEIs with different structural characteristics and attending the need of different stakeholder groups base their interaction on different third mission activities. Such results have a number of implications for policymakers, since they provide information on which HEIs should be supported in order to sustain particular stakeholder groups. For example, policies aiming at enhancing the international competitiveness of UK economy should consider the role of SHRI universities in supporting private industry stakeholders or in communicating internationally the excellence of UK's socioeconomic performance. Likewise, policies aiming at accelerating local economic development, should involve MPRI and PTI HEIs in their implementation.

The (quantitative and qualitative) MDS results provide relevant information to HEIs: visualising the relative positioning of universities may help them to make better informed strategic decisions and benchmarking analyses.

In terms of further research, wide knowledge areas, such as social sciences, humanities and arts or medicine may hide variability related to the specific nature of each sub-field. However, additional data than the currently available for the UK case may be needed to address such studies. Additionally, a causal analysis identifying the additional factors determining the profile of HEIs should provide valuable information on their third mission processes.

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