RISIS

RESEARCH INFRASTRUCTURE FOR SCIENCE AND INNOVATION POLICY STUDIES

EXPLORING HIGHER EDUCATION INSTITUTIONS CLASSIFICATION A CHALLENGE FOR DIFFERENTIATED POLICY STRATEGIES

CONTENTS

This study advances our understanding of the heterogeneity of Higher Education Institutions (HEIs) in Europe by leveraging on an extended version of the European Tertiary Education Register (ETER, www.eter-project.com) enriched with research output data within the RISIS2 project (risis2.eu). By using advanced statistical techniques, we are able to classify more than **2,000 HEIs 28 European countries** in six classes, that differ in terms of two main dimensions, i.e. the orientation towards education vs. research and the subject specialization towards natural sciences vs. human and social sciences.

Further, we show how the classification can be mobilized for comparative analysis of the structure of national higher education systems. On this basis, we distinguish between **three types of national systems,** based on the role of universities in education and on the extent of specialization in technological research and education. We further demonstrate different patterns of blurring between the universities and the college sector, including a model where colleges develop a distinct specialization towards technical education and applied research.

The classification has relevant scholarly, policy and managerial implications. **It allows investigating heterogeneity in higher education beyond national specificities and might contribute to a better understanding by policymakers and higher education managers of the diversity of the classes of HEIs found in the system.** The latter will be relevant in order to design **tailored policies to specific classes of HEIs,** but also for HEIs themselves to develop strategies that fit their own characteristics and positioning within the system.

1. INTRODUCTION

Higher Education Institutions (HEIs) have been described "as different as chalk and cheese" (Huisman 2000) and, indeed, when looking to the institutions includes in the reference dataset of HEIs in Europe, i.e. the European Tertiary Education Register (ETER; www.eter-project.com), it is difficult to find commonalities between educational organizations such as the University of Oxford, the Polish Air Forces Military Academy and the Leonardo Da Vinci Engineering school, beyond the fact that all of them are delivering some tertiary education degree. While only few hundreds HEIs are competing globally for excellence (Lepori, Geuna and Mira 2019), most HEIs are oriented to serve educational needs and keep strong rooting with their local communities (Jongbloed, Enders and Salerno 2008). While some large universities and colleges are multidisciplinary, most HEIs in ETER are characterized by the subject specialization, such as theological schools, universities of education and engineering schools (Lepori, Baschung and Probst 2010).

Organizational heterogeneity is not just a curiosity for scholars: the different missions, activity profiles and, relatedly, available resources have deep implications for the HEI management: HEIs more oriented to regional development and education are likely to have different markets and competitors that those in the world class league, and will need different strategies in terms of markets to be addressed, but also of internal organization, human resources development, etc.

Such heterogeneity represents also **a puzzle for public policies**: types of classes of HEIs have been frequently established to address special needs, like technological development for engineering school and the training of teachers for universities of education. Yet, institutional integration of higher education meant that different subsectors were increasingly subject to similar rules (Kyvik 2004), a tendency further reinforced by the emergence of New Public Management and the increasing importance of uni-dimensional hierarchies such as rankings. The extent to which higher education can be organized along **similar principles vs. maintaining specialization therefore represents a core issue for current higher education policies.**

The development of organizational classifications has been a popular way to address such issues (Brint 2013). Classifications "serve as a shorthand to quickly characterize an institution, especially if the groupings are widely understood and consensually accepted" (McCormick and Borden 2019), such as in the case of the US Carnegie classification. **They provide important information for policy-makers to design targeted policies,** and to students and staff to identify potential HEIs to join.

Classifications are also important tools for research, as they allow accounting for 'essential' differences between HEI groups (Ruef and Nag 2015), for example when analysing differences in performance.

This work builds on a novel **dataset on European Higher Education Institutions developed within the RISIS2 project, which extends ETER** by also including output data, and on novel statistical techniques such as latent class analysis (Vermunt and Magidson 2002), to develop a novel classification of European HEIs, which focuses on differences in activity profiles (education vs. research vs. third mission; Huisman, Lepori, Seeber, Frølich and Scordato 2015) and subject scope (Van Vught 2009). The classification is grounded on the assumption that **organizational characteristics are not randomly distributed, but there are interdependencies between attributes that generate a small** number of configurations (Fiss 2007). Hence, the relationships between observable variables reveals underlying structures within organizations and in their interaction with the environment (Ruef and Nag 2015).

We then mobilize data on resourcing to interpret the classes as of their positioning in terms of activity profile and, relatedly, the niche HEIs occupy in the resource environment (Ruef and Nag 2015). Further, we propose an application for comparative analysis of the structure **of national higher education systems.** As compared with analyses based on the legal status, the classification allows for a more nuanced and robust comparison as of the extent of blurring between the university and college sector (Kyvik and Lepori 2010), but also of the level of specialization in engineering and technical sciences.

2. METHODOLOGY AND DATA

The analysis is based on an **enriched version of the European Tertiary Education Register** (ETER; Lepori, Bonaccorsi, Daraio, et al 2015). ETER provides a very comprehensive coverage of the European HEI landscape, broadly defined as the population of educational institutions delivering at least degrees at the bachelor level.

Within the RISIS project (risis2.eu), ETER has been enriched with data on scientific publications from the Web of Science version at the University of Leiden, on European projects from the **EUPRO database** and on patents from the **PATSTAT version** at IFRIS in Paris.

The selection of variables is inspired by the relevant dimensions suggested by the higher education literature (Huisman, Lepori, Seeber, Frølich and Scordato 2015).

We first consider two **core institutional characteristics that are associated with the HEI's mission and position in the resource space:** institutional control proxied through HEI's public vs. private status (Teixeira, Rocha, Biscaia and Cardoso 2014) and the research mandate, as represented by the legal right to award a PhD (Kyvik and Lepori 2010), i.e. the main distinguishing feature of universities vs. colleges.

Second, the HEI's activity profile is described in terms of the balance between education, research and third-mission, proxies by the number of undergraduate students, respectively of PhD students, scientific publications and participation to EU-FP programs, and the number of priority patents.

Third, the subject scope is described in terms of the diversity of the subject domains covered by HEI's activities, measured through the distribution of undergraduate students by broad educational fields.

Fourth, we include a measure of organizational size, proxied by the main HEI resource, i.e. the number of academic staff.

When excluding cases with missing observations, the final sample includes 2,034 observations in 28 European countries, with the largest numbers in Germany (385 HEIs), Poland (281 HEIs), Italy (210 HEIs), UK (159 HEIs) and France (125 HEIs). Data refer to the year 2014.
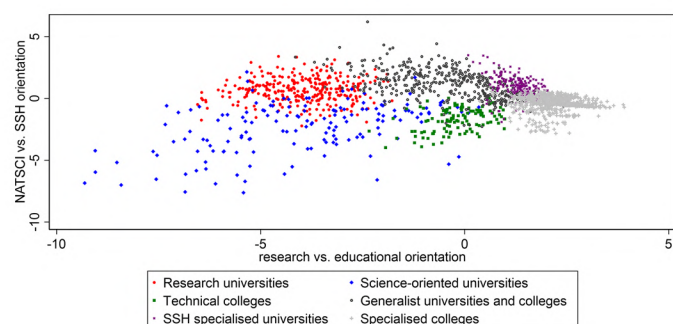
To attribute HEIs to classes, we use latent class clustering (Vermunt and Magidson 2002), i.e. a statistical model that attempts to reproduce the observed data by assigning HEIs to classes with different underlying characteristics. The output of the model is the 'best' assignment of HEIs to classes, in the sense that it reproduces more accurately the observed data. The number of classes has to be pre-defined, but models with different number of classes can be compared with statistical measures of fit.

3. FINDINGS

When dropping a few outliers, **six classes of HEIs can be identified,** which can be distinguished in terms of two main dimensions, i.e the research vs. education orientation and the orientation towards natural sciences vs. human and social sciences (Figure 1).

Figure 1. Positioning of HEI classes

The figure displays the position of individual HEIs according to the two main dimensions identified by discriminant analysis.

Legend	
· Research universities	· Science-oriented universities
· Technical colleges	· Generalist universities and colleges
· SSH specialised universities	· Specialised colleges

Class 1 (research universities; 312 HEIs) is composed by universities that have a sizeable education activity and a large research output. This class includes the European top-ranked international universities, such as Cambridge and Oxford, as well as the largest universities in terms of enrolments (Rome, Madrid) and many middle-size universities with a sizeable research output (Basel, Twente). While there is quite some variation in terms of size and enrolments, this class is characterized by higher research intensity than the other classes. It can be considered as the prototype of the research and education university covering most subject domains.

Class 2 (science-oriented universities; 156 HEIs) is composed by large research universities specialized in natural and technical sciences, such as TU Munich or ETH Zurich, at to a lesser extent medical sciences, such as Karolinska. These universities have a similar research intensity as class 1, but a much larger patent intensity, as associated with their subject specialization. While originally created as technical universities (as indicated by their names), they expanded their subject scope to most natural sciences and, in some cases, also to (bio)medicine.

Class 3 (technical colleges; 113 HEIs) is composed by non-university HEIs with an orientation towards natural and technical sciences. The main group are German Fachhochschulen (69 HEIs), Austrian Fachhochschulen (8), Swiss Universities of Applied Sciences (7), Portuguese Polytechnics (10). While research output is low, this class is characterized by a sizeable patenting activity, suggesting they are also engaged in applied R&D and innovation. This class therefore reflects a country-specific orientation of the non-university sector towards technical sciences and applied research (Jongbloed, Enders and Salerno 2008).

Class 4 (generalist universities and colleges; 408 HEIs) is composed by middle-size universities and colleges, which are multidisciplinary but with most of the students enrolled in social sciences and humanities; most of them have a sizeable research production (particularly PhDs), but

research intensity is much lower than for class 1. Within this class, we identify regional universities (Messina and Macerata in Italy, Klagenfurt in Austria), SSH oriented universities in large agglomerations such as Paris (Pantheon-Assas University), most UK 'new universities' and colleges acquiring university status in Nordic countries (Mid Sweden University), as well as some specialized universities (Bocconi university). This class also includes Universities of Applied Sciences having some research output (publications, EU-FP participations) in Finland, Germany and Norway. Within the HEI system, these can be characterized as newcomers in terms of age or of being peripheral in geographical terms.

Class 5 (SSH universities; 206 HEIs) is composed by small and specialized institutions in social sciences and humanities, such as academies of arts and music and theological universities, with a high intensity in PhD education. Their highly specialized nature becomes identifiable by looking to institutional names. These are niche players with strong reputation in their domain, including some of the oldest schools of arts in Europe.

Class 6 (specialized colleges; 807 HEIs) includes non-PhD awarding institutions with no research activity, among them many private colleges. Most HEIs are specialized, including teacher education institutions, music colleges, colleges of economics and of public administration. This group also includes some larger multidisciplinary colleges with no or little research activity, such as the Dutch Universities of Applied Sciences.

3. IMPLICATIONS

The classification allows for a comparative analysis of European higher education systems, which does not rely on country-specific categories or attributes.

At the European level, research and science-oriented universities account for the lion share of research output, while **technological output is concentrated in the science-oriented universities**. These two classes account for the largest part of the resources (70% of revenues and academic staff), but, on the European average, only for half of the bachelor students.

Further, the classification highlights a second dimension of differentiation, i.e. subject specialization, which combines with the research and technological orientation; **research universities enrol 70% of the students in natural sciences, while over half of the students in engineering are enrolled in science-oriented universities and in technical colleges.**

When comparing, national systems using two indicators, i.e. the share of bachelor students in the research-intensive universities and the share of engineering students in science-oriented universities and technical colleges, three types of systems can be identified (Figure 2).

First, the university-dominated systems, in which education and technology production are concentrated **in (generalist) research universities, such as Italy and Spain.**

Second, the **hybrid generalist systems,** in which research universities account for less than half of the bachelor education, typical of binary systems such as **the Netherlands, Norway and Sweden.**

Third, the hybrid specialized systems, in which engineering education and technology production are concentrated in specialized HEIs, both in the university and college sector, as in central-European countries such as **Austria, Germany and Switzerland**. While building on the longstanding distinction between university-dominated and dual systems, our results provide a more fine-grained distinction, dealing also with cases, such as the UK, where the system is formally unitary, but distinctions between "Old" and "New" universities remain important.

Furthermore, we identify a second dimension of distinction, i.e. the extent of specialization of technical education and technology production.

Figure 2: Classification of European HEI systems
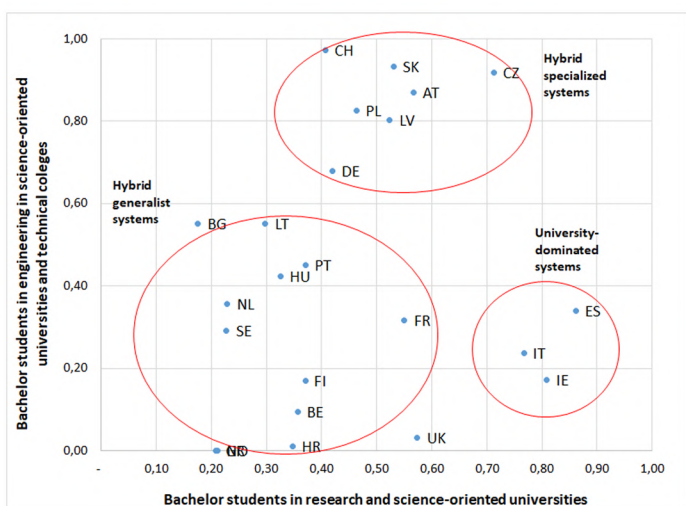
These applications show that a robust and comparable classification across European countries is a useful tool for a comparative analysis that that takes into account legal and historical distinctions, but allows comparing individual HEI's profile independently from national specificities

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