Establishing a European Tertiary Education Register

Final report

Contract EAC 2013-0308

Brussels, 2016

Benedetto Lepori, Andrea Bonaccorsi, Alessandro Daraio, Cinzia Daraio, Hebe Gunnes, Elisabeth Hovdhaugen, Michael Ploder, Monica Scannapieco, Daniel Wagner-Schuster

Education
and Culture

Europe Direct is a service to help you find answers to your questions about the European Union.

Freephone number (*)**:**
00 800 6 7 8 9 10 11

(*) The information given is free, as are most calls (though some operators, phone boxes or hotels may charge you).

More information on the European Union is available on the internet (http://europa.eu).

Luxembourg: Publications Office of the European Union, 2016

ISBN 978-92-79-52368-7
doi: 10.2766/755061

Printed in Belgium

PRINTED ON ELEMENTAL CHLORINE-FREE BLEACHED PAPER (ECF)

European Commission | Education and Culture

Establishing a European Tertiary Education Register

Contract EAC 2013-0308

Benedetto Lepori, Andrea Bonaccorsi, Alessandro Daraio, Cinzia Daraio, Hebe Gunnes, Elisabeth Hovdhaugen, Michael Ploder, Monica Scannapieco, Daniel Wagner-Schuster

Università della Svizzera italiana | Facoltà di scienze economiche

JOANNEUM RESEARCH POLICIES

NIFU
Nordic Institute for Studies in Innovation, Research and Education

SAPIENZA
UNIVERSITÀ DI ROMA

Executive summary

What is the European Tertiary Education Register?

The European Tertiary Education Register (ETER) is a database that provides a core set of data on a subset of educational institutions delivering degrees at the tertiary level.

ETER is a project funded by the European Commission's Directorate General for Education and Culture (contract EAC-2013-0308). The project began in August 2013 and ended in July 2015. A new contract for a further two years will begin in August 2015 and cover data collection for the years 2013 and 2014. It is a joint undertaking of four partners - USI, Università della Svizzera Italiana, Lugano, JOANNEUM RESEARCH, POLICIES, Graz, NIFU – Nordic Institute for Studies in Innovation, Research and Education, Oslo, University of Rome La Sapienza, Rome – in close collaboration with EUROSTAT, with a network of national experts and with the National Statistical Authorities of the participating countries.

ETER currently provides information on 2,239 HEIs in 31 European Research Area countries for the years 2011 (academic year 2011/2012) and 2012 (2012/2013); data are available for all EU-28 countries, except the French part of Belgium, Slovenia and Romania, plus the Former Yugoslav Republic of Macedonia, Iceland, Liechtenstein, Norway and Switzerland.

Most ETER data can be freely downloaded from the project website (http://eter.joanneum.at/imdas-eter/) and reused for analytical purposes, making ETER a truly common resource for policy-makers, administrators and scholars. A small part of ETER data is available only for research purposes under the signature of a non-disclosure agreement.

What is the rationale for ETER?

ETER represents an important contribution to the strategy for the modernization of European higher education, as a fundamental component of the Europe 2020 strategy. In this respect, higher education is facing fundamental challenges, like increasing the number of graduates, reaching international excellence, and contributing to economic development.

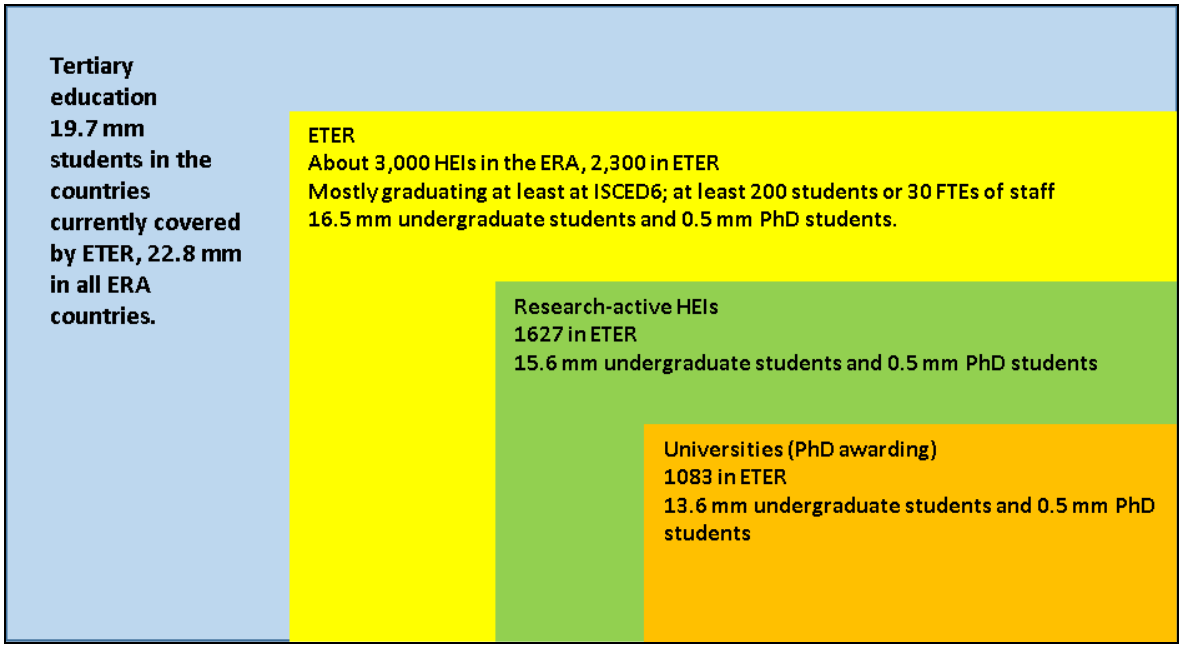
Reliable information is key for this process as it lays the groundwork for evidence-based policies: for example concerning the promotion of excellence, differentiation of higher education institutions, and the design of competitive funding policies. Information at the institutional level is also important to allow stakeholders to make sensible choices, for example concerning the selection of study's location, by comparing HEIs across dimensions of interest, like the type of subjects offered, quality of education, employability, and research quality.

EUROSTAT has for many years provided statistical data on tertiary education and Research and Development, but data are only available at the national level or, at best, at the regional level. In this respect, ETER represents a significant advance since data are provided for each HEI individually. In this way, ETER allows one to fully grasp the diversity of characteristics, size and profiles of European higher education.

How many higher education institutions exist in Europe?

Answering this question depends on what we consider to be the constitutive characteristics of an HEI. If we take into account all institutions delivering degrees at the tertiary level, the overall figure in Europe is probably significantly higher, however most of them are smaller in size, deliver short-cycle professional diplomas and have no research activity (Figure 1). According to EUROSTAT data, they comprise more than 20 million students in ERA countries.

Figure 1. The structure of European tertiary education



Those institutions that award at least a bachelor degree and are officially considered to be part of the national higher education system make up a smaller perimeter. Their number in the ERA is around 3,000 and they enrol about 20 million students. This perimeter broadly corresponds to ETER's, with the lower figures mostly due to a few missing countries. Many of them perform some research activity, but in many cases at a low level. Finally, the smallest perimeter is composed by universities, i.e. those institutions which have the right to award doctoral degrees; ETER includes slightly more than 1,000 universities in the 31 countries currently covered, which enrol more than 13 million students and perform almost all research activity.
In summary, we can describe European tertiary education as being constituted by different layers: a core of slightly more than 1,000 universities which enrol most of the students and perform almost all of the research; a larger set of about 3,000 HEIs who deliver at least bachelor degrees, including universities of applied sciences (colleges), specialized HEIs like art and music schools and many private HEIs; a much larger set of professional education providers, mostly quite small, which are currently not covered by ETER.

Which types of data are provided by ETER?

ETER provides the following information on HEIs:

- *Institutional descriptors* identify the HEIs and their official status and provide information on their foundation, history and annexed units (university hospitals).
- *Geographical information* localizes HEIs in terms of region, city and geographical coordinates and provides information on additional campuses (not in the same city as the main seat).
- *Staff data* provide information on HEI personnel divided by academic and non-academic staff; for academic staff, information is provided on their gender, nationality, scientific field, and the number of full professors.
- Data on *students* and *graduates* are particularly rich in ETER: numbers of students and graduates are divided by educational level (diploma, bachelor, master), by educational field, gender, nationality and mobility. These data therefore allow for a fine-grained analysis of HEI's educational offerings and composition of the student body.

- Data on *expenditures* and *revenues* provide information on the overall level of resourcing, on the breakdown of revenues between core funding, third party funds and student's fees. They allow characterizing the competitive position of HEIs on different markets.
- Data on *R&D activities* include the number of PhD students and graduates, as a major component of HEI research activities, as well as the volume of R&D expenditures.

While ETER includes less data on research and technological output, such data are largely available from international databases, like in the case of publications and patents. The availability in ETER of an HEI reference list, allows researchers to easily combine different data sources for *ad hoc* analyses.

Can I trust ETER data?

ETER did not collect its own data: most of the data has been delivered by the National Statistical Authorities, based on an on-going data collection for educational and R&D statistics. Since these data are based on international guidelines from EUROSTAT and OECD, in principle the data is comparable across countries. Previous experience with ETER data collection shows however that for some aspects, national data might be based on different definitions, particularly concerning staff and financial data.

To cope with these issues, as well as with possible mistakes in the data collection process, ETER has developed a systematic approach to data validation and quality, where data has been systematically checked at different stages in the data collection process, also with the use of advanced statistical techniques to detect outliers. These procedures ensure a very high level of internal *data consistency* and allow the identification of a number of problematic cases, for example HEIs with very few staff members but an extremely large number of students. Such cases are now clearly identified and annotated in the database. Additionally, so-called *metadata* (i.e. information on definitions, data collection processes and methodological problems) are available for each country.

Experience with the ETER data shows that, in most cases, they can be used for meaningful analyses and they are quite robust. Data should however be used in a careful way and users should consider the provided metadata and annotations in the database, particularly when analysing individual HEIs (data are more robust for statistical analyses).

Data are almost complete when considering institutional descriptors and geographical information and very complete for students and graduates (including PhD students). Most countries managed to provide staff data (with the important exception of France and the UK), but breakdowns are not always available. Financial data (expenditures, revenues and R&D expenditures) are available only for slightly more than half of the countries.

The follow-up ETER project aims to substantially improve the comparability and availability of data concerning HEIs staff, revenues and expenditures.

What can we learn from ETER?

The purpose of ETER, when compared with EUROSTAT statistics, is to provide fine-grained information on individual institutions, which allows for a comparison in terms of their different characteristics, profiles and differentiation. This is important for some key questions in higher education and research policy, like whether it is good to concentrate research into a few leading universities, whether systems where research and education are structurally separated perform better, how are different activities of the higher education system distributed in space.

Some highlights of the analyses presented in this report are the following:

- The distribution of HEI *size* is very uneven. Despite the large number of small and very small HEIs, functions (i.e. students and research) are concentrated in large

and very large institutions, the core of European higher education being constituted by less of 1,000 institutions. There are clear differences between countries in this respect.

- Despite almost one-third of the ETER sample being composed by private HEIs, these account for a limited proportion of European Higher Education, with the exception of Central and Eastern Europe. Private HEIs are smaller, more teaching-oriented and more specialized than public HEIs.
- 60% of the HEIs in ETER are not universities and do not award a doctorate degree. There is a clear-cut distinction in Europe between systems dominated by universities and binary systems, where universities of applied sciences enrol a substantial share of the students, especially at the bachelor level.
- European HEIs are mostly funded through a core allocation from the State, while private funding and student fees are quite limited. Only private HEIs are largely funded through student contributions. Third-party funds (research contracts) are strongly concentrated in research-oriented universities.
- While all institutions covered by ETER offer education, nearly 70% are also research active and about 40% can deliver a PhD. This shows that the research mission extends beyond doctorate-awarding universities, even if the latter account for most of the research volume and output.
- The mobility of students increases with educational level from the bachelor to the master to the PhD; country differences are limited for undergraduate students, much larger for PhD students. There are also large differences in the internationalization of academic staff, driven by international reputation and national investment in R&D.
- A core of generalist institutions, in terms of the subject disciplines covered, dominates European higher education, but there are also a large number of specialized institutions, particularly in arts and humanities, but also in technical sciences.
- Gender equality has been reached in most European HEIs for undergraduate students and PhD students, while the median share of females among academic staff is now 40%. However, the share of female professors in European higher education remains very low (median 20%), even if there are large differences between countries and HEIs in this respect.

Table of Contents

Table 1. List of abbreviations

Abbreviation	Full Name
DG EAC	Directorate General Education and Culture
DG RTD	Directorate General for Research and Innovation
EC	European Commission
EEA	European Economic Space
EFTA	European Free Trade Agreement
ERA	European Research Area
ETER	European Tertiary Education Register
EU	European Union
EUMIDA	European Microdata Project
EUROSTAT	European Statistical Office
FOE	Fields of Education
FTE	Full Time Equivalents
FYROM	The former Yugoslav Republic of Macedonia
HC	Head Count
HEI	Higher Education Institutions
ISCED	International Standard Classification of Educational Degrees
NE	National Experts
NIFU	Nordic Institute for Studies in Innovation, Research and Education
NSA	National Statistical Authority
OECD	Organisation for Economic Cooperation and Development
UAS	Universities of applied sciences
UOE	UNESCO OECD EUROSTAT handbook on education statistics
USI	Università della Svizzera italiana

Introducing the European Tertiary Education Register

It goes without exaggeration that higher education is one of the key pillars of the advanced knowledge society, which fulfils three critical functions:

- training skilled human resources for our societies and their economies;
- developing advanced knowledge;
- transferring knowledge to innovation.

Figures for European higher education are impressive in this respect: in 2012, over 20 million students were enrolled in tertiary education and 37 per cent of the European population aged 30 to 34 had completed tertiary education, approaching the Europe 2020 target of 40 per cent (source: Eurostat). Further, the higher education sector accounted for nearly two-thirds of R&D expenditures in the public sector and for more than half of public-sector participations in European Union Framework programmes and in public-sector patent applications (European Commission 2011a).

Yet, to fully contribute to the Europe 2020 strategy (European Commission 2010), European higher education is facing a number of challenges, as its potential for growth and employment remains partially unexploited (European Commission 2011b). The number of graduates has to increase substantially in the next years to meet the demand for skilled labour from a knowledge intensive economy. Global competition for scientific excellence is strong and, as shown by international research rankings, European universities are currently not well placed at the top of the rankings when compared to their US counterparts (Albarrán, Crespo, Ortuno and Ruiz-Castillo 2010). Despite progress in recent years, the ability for European university research results to be transferred to the economic sector remains substandard when compared to other countries worldwide (Dosi, Llerena and Labini 2006). As highlighted by the European Union modernization agenda, these challenges require reforms in how European higher education is governed and funded, moving towards increasing autonomy, competition and performance-based funding (Aghion, Dewatripont, Hoxby, Mas-Colell and Sapir 2010). Change in this respect in Europe has been rather gradual and piecemeal (CHEPS 2010).

Unfortunately, our knowledge basis on European higher education is somewhat limited. Since the '60s and '70s, OECD and EUROSTAT have produced statistics on both educational activities (UOE 2013), and research and development (OECD 2002). Data are aggregated at the level of countries or, at best, regions (levels NUTS2 and NUTS3), while no information is provided on individual Higher Education Institutions (HEIs). Even their number is largely unknown, with available estimates ranging from a few thousand to tens of thousands. More extensive information is only available for those HEIs included in the international rankings (a couple hundred in Europe) and solely focused on their international research performance (Waltman, Calero-Medina, Kosten, et al 2012).

Yet, creating transparency on characteristics and the performance of individual HEIs is critical to the modernization agenda (Hazelkorn 2012).

ETER in a nutshell

2,293 individual Higher Education Institutions in 31 ERA countries (combined dataset 2011/2012).

Data on organizational characteristics, staff, revenues, expenditures, students, graduates, research.

Data for the years 2011 and 2012.

Most data can be downloaded from the public ETER website http://eter.joanneum.at/imdas-eter/

Box. Who is who in ETER

The European Tertiary Education Register (ETER) is a project funded by the European Commission's Directorate General for Education and Culture (contract EAC-2013-0308), which aims to establish a register of European Higher Education Institutions (HEI) and collect a comparable set of data for the HEIs in the perimeter. The project began in August 2013 and ended in July 2015. A new contract for a further two years will begin in August 2015 and cover data collection for the years 2013 and 2014.
The contract is a joint undertaking of four partners:

- USI, Università della Svizzera Italiana, Center for Organizational Research, Lugano (Benedetto Lepori, coordinator),
- JOANNEUM RESEARCH, POLICIES – Institute for Economic and Innovation Research, Graz (Michael Ploder, Daniel Wagner-Schuster),
- NIFU – Nordic Institute for Studies in Innovation, Research and Education, Oslo (Elisabeth Hovdhaugen, Hebe Gunnes),
- University of Rome La Sapienza, Department of Computer, Control and Management Engineering Antonio Ruberti, Rome (Cinzia Daraio, Tiziana Catarci, Leopold Simar, Alessandro Daraio, Monica Scannapieco).

The project partners were supported by Andrea Bonaccorsi, former EUMIDA coordinator, as an individual expert and by a number of national experts (Patrick Llerena, France; Achilleas Mitsos, Greece; Michele Cincera and Reinhilde Veugelers, Belgium; Krysztof Leja, Poland; Karel Sima, Czech Republic; Ben Jongbloed, Netherlands; Pedro Teixeira, Portugal; Isidro Aguillo, Spain).
The ETER contract is supervised by the Directorate General for Education and Culture of the European Commission, in cooperation with DG Research and Innovation and EUROSTAT, and by a task force composed of representatives from the National Statistical Authorities in the participating countries. The role of the task force is to discuss and make decisions concerning the design of the dataset, the selection of variables, and how to address methodological issues.
The ETER project is executed in close coordination with the National Statistical Authorities (NSA) in the participating countries: NSAs provide important input concerning data and methodology and are the providers of most of the data included in ETER. They also gave consent for the publication of most ETER data. Even if it is not directly part of the European statistical system, the ETER project would have never been possible without this close cooperation with EUROSTAT and the National Statistical Authorities.

It is therefore no surprise that the core initiatives of the EU modernization agenda include two instruments to increase transparency, i.e. the multi-dimensional ranking tool U-MULTIRANK (http://www.umultirank.org) and the establishment of a European Tertiary Education Register (ETER).
Comparable information on HEI characteristics allows stakeholders to make sensible choices, for example concerning the selection of the place of study, by comparing HEIs across dimensions of interest, like the type of subjects offered, quality of education, employability, and research quality. Hence the need to move beyond international research rankings, with their focus on academic research performance, towards tools which allow for a multidimensional characterization of HEIs (Van Vught 2009).
HEI-level information also represents an indispensable support for public policies, like the design of higher education governance and the distribution of public funds.

Limitations in the data available at the level of individual institutions are one reason why it is problematic to give clear answers to the following policy-relevant questions:

- To which extent is the competition for resources increasing the performance of HEIs and which funding instruments are more effective (Jongbloed and Lepori 2015)?
- Are large HEIs more efficient and able to earn spots at the top of the international rankings (Daraio, Bonaccorsi and Simar 2015b)?
- Is there an optimal university size and are small HEIs less efficient (Brinkman and Leslie 1986)?
- Is the differentiation of higher education systems, for example the establishment of distinct types of HEIs, beneficial to performance and responsiveness to societal needs (Meek, Goedegebuure, Kivinen and Rinne 1996, Bonaccorsi 2009)?

The European Tertiary Education Register is a contribution to this transparency goal. It provides for the first time a comprehensive list of Higher Education Institutions in Europe, based on a set of common criteria, which are comparable across the European Research Area (ERA) countries.[1] Based on this list, it makes a public website available with a large number of descriptors and statistical data on individual HEIs, covering their staff, financial data, educational and research activities.

ETER builds on a long-standing process of methodology development for data collection at the level of individual HEIs, which began around the year 2000 with an experimental project named AQUAMETH (Bonaccorsi and Daraio 2007; Daraio, Bonaccorsi, Geuna, Lepori and et. al. 2011) and continued with a large-scale feasibility study supported by the European Commission (European MIcroData, EUMIDA; Lepori and Bonaccorsi 2013). This process allowed for the development of common and shared definitions of what HEIs are and how to analyse them. It also constituted the basis for a systematic cooperation with the National Statistical Authorities, which are the main data providers for ETER.

This report introduces the rationale for ETER and the conceptual and methodological foundations grounded in its design, while also highlighting the complementarity of ETER with EUROSTAT statistics and other tools like U-MULTIRANK (page 15). Then, it provides a description of the content of the dataset (page 25) and gives a short guidance on how to access and use ETER data (page 43).

The core of the report is in the analytical chapter, where we provide examples on how ETER data can be used to characterize Higher Education Institutions (page 49). We deal with central policy questions like the number of HEIs and their size distribution, the relative size of private higher education, how European HEIs are funded, and, whether European higher education is moving towards gender balance. Finally, we advance our recommendations on how to establish the ETER database on a regular basis and enhance its value in the future (page 81).

Two annexes accompany this report:

- A technical report, including more details concerning ETER definitions, variables, coverage and content.
- The ETER handbook, which provides a full description of the ETER methodology and a basis for data collection.

[1] The European Research Area includes the EU-28 member states, the four EFTA countries (Iceland, Liechtenstein, Norway and Switzerland) and the five EU candidate countries (Albania, Montenegro, Serbia, the Former Yugoslav Republic of Macedonia and Turkey).

A database on European universities: rationale and challenges

Producing a register of Higher Education Institutions is not simply putting together a list of HEIs and adding a few variables, based on data availability and statistical traditions. While education and R&D statistics provide many useful bricks for its construction, in the form for example of standardized classifications of degrees and subject fields, an organizational level database is very different from a dataset providing country-level aggregated figures. Not only does the number of units of observation and the level of disaggregation of data increase strongly – from a few dozen units to more than 2,000 – the definition of the unit of observation also requires careful choices and a new set of indicators has to be identified. The careful selection of indicators takes into account that the goal is to characterize Higher Education Institutions as multifunctional organizations who deliver – with the same set of inputs – education, research and their third mission (Bonaccorsi and Daraio 2007; Van Vught 2009). This marks a sharp contrast with education statistics, whose main units of analysis are constituted by education curricula, independent of where they are delivered within a country (UOE 2013).

Therefore, ETER is not simply a more disaggregated version of education statistics, as the perimeter and the conceptual foundations differ, which also drives differences in how to count personnel, students, and graduates. Just to provide an example: students enrolled in more than one university (for example in dual degrees) are counted in national education statistics only once, whereas in ETER they are counted in each university they belong to.

As sociology of science informs us, constructing delimitations and statistical definitions is never an objective decision, but largely responds to socio-political forces concerning how to interpret reality and how to manage society (Porter 1995, Godin 2005). ETER did not escape this fate: its design, definition and methodology largely reflect the institutional context in which it was created, the specific understanding of what higher education is by its promoters, as well as definitions and conventions from official statistics (Lepori and Bonaccorsi 2013). Therefore, users need to contextualize the ETER data and understand the underlying assumptions in order to make the data set relevant.

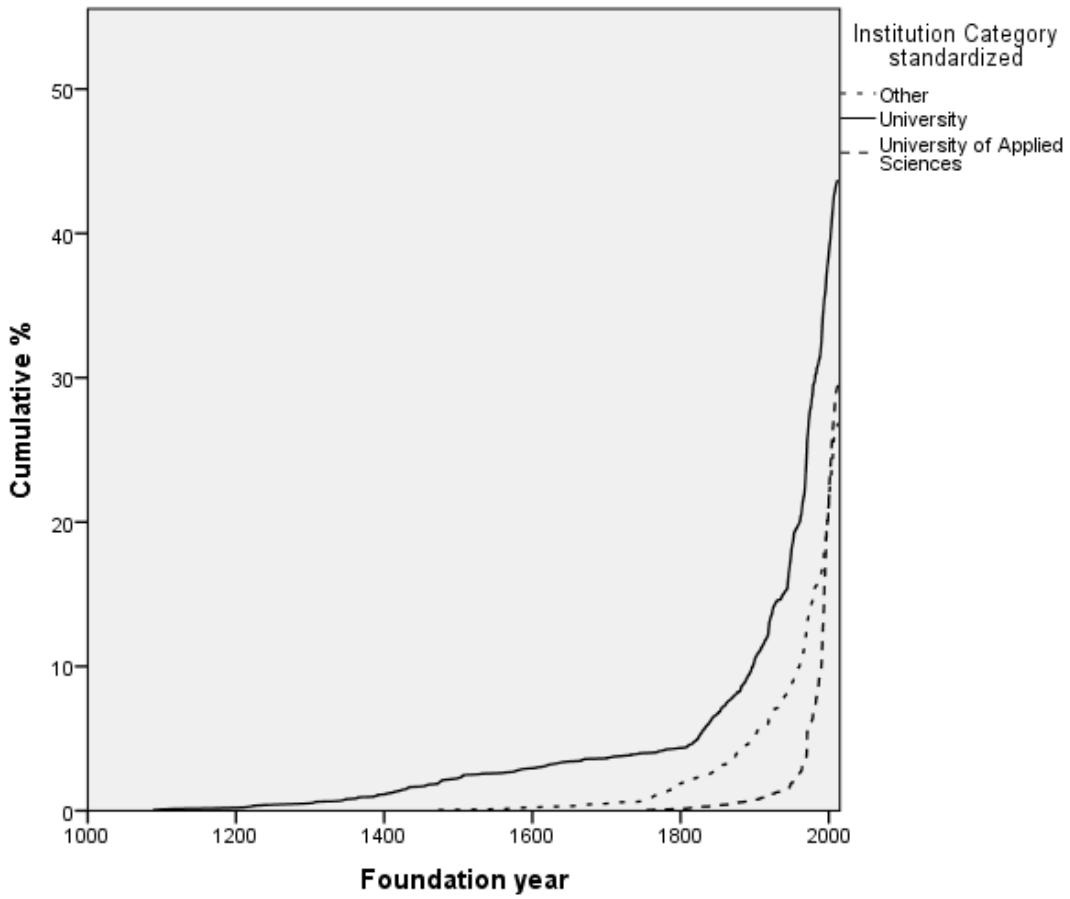
Why a register of European HEIs?

From a US perspective, the question of why a register of HEIs is important for public policy would seem rather odd. Rich data at the institutional level are provided by the National Center for Education statistics (https://nces.ed.gov/) and by the National Science Foundation's statistical unit (http://www.nsf.gov/statistics). Building on the data, a comprehensive classification of Higher Education Institutions has existed since 1973, the famous Carnegie Classification (http://carnegieclassifications.iu.edu/; McCormick and Zhao 2005).

On the contrary, in Europe, statistics on higher education and R&D focused on the production of national aggregates based on a standardized statistical methodology (UOE 2013; OECD 2002). The two main reasons for the methodology was the fragmentation of the European space, where National States were mostly responsible for governing and funding research and higher education, and the limited autonomy of public universities, which was largely conceived as a part of the public administration steered directly by the State (Clark 1983) and essentially non-existent as organizational entities (Musselin 2013). This also largely explains why Higher Education Institutions were not considered as meaningful units for scholarly analysis and policy decisions – and therefore, there were no systematic attempts to collect data on them.

In this respect, the European context deeply changed in the last 20 years.
First, research and higher education have undergone a process of Europeanization (and, in a more general sense, of internationalization; Lepori, Seeber and Bonaccorsi 2014), associated with different processes, like increasing international competition for students and skilled researchers and the emergence of global university rankings, fostering international competition for reputation (Hazelkorn 2009). Starting with the Maastricht Treaty of 1992 and with the launch of the European Research Area (ERA) in 2000 (Commission of the European communities 2000), the European Union has also become more proactive in coordinating policies for research and higher education and in integrating the European research and higher education area. The Bologna process, i.e. the introduction of a commonly structured European qualification system at three levels – bachelor, master and PhD – was a major factor, which drove the integration of the European higher education system. It has also been incorporated in educational statistics with the revision of the International Standard Classification of EDucation in 2011 (ISCED). Accordingly, both the need and the feasibility of comparing HEIs across Europe increased.
Second, since the late '80s, a wave of reforms known under the label of New Public Management (Ferlie, Ashburner, FitzGerald and Pettigrew 1996) transformed national higher education policies towards a clearer separation between the State and Higher Education Institutions, providing the latter with more strategic autonomy and introducing competition in the allocation of resources (Paradeise, Reale, Bleiklie and Ferlie 2009). The evaluation and performance-based allocation of funding has spurred the development of data and indicators at the HEI level, as these are increasingly required to distribute public funds (Jongbloed and Lepori 2015). The public nature of the data is a fundamental pre-requisite for a market system in order to achieve transparency on how public funds are allocated and to allow customers (for example students) to make informed choices (Teixeira, Jongbloed, Dill and Amaral 2004). A project like ETER has been possible only because, for these reasons, many European countries have already started to produce and to publish HEI-level data at the national level.
Third, the size and the heterogeneity of European higher education has increased in the last 30 years. Historically, tertiary education was mostly characterized by a rather small number of doctorate-awarding universities, alongside an extremely large and differentiated number of providers of professional education. The notion of higher education, as a subset of tertiary education which extends beyond universities, did not exist until the '70s and '80s – more than half of the ETER HEIs were founded after 1970 (see Figure 2). From the '70s, as a response to the increase in the number of students, a new type of HEI ("Universities of Applied Sciences") was created in many countries, whereas other countries relied on the foundation of new universities or on the development of private HEIs (Kyvik 2009; Bonaccorsi and Daraio 2007).

Figure 2. HEI foundation year by type.
Source: The ETER project.



As an outcome of this process, today's higher education sector in Europe is much larger and more diverse than traditional doctorate-awarding universities, which constitute barely one-third of the ETER HEIs. Hence, the need for more data and a methodological approach in order to compare HEIs with traditional generalist universities founded in the middle ages, for example a highly specialized music school with a few dozen students, and a private university founded ten years ago that is mostly funded by student fees.

Growth in size *and* heterogeneity also spurred the insight that not only the size of the system matters – the number of HEIs, the volume of research, the enrolled students - but also its internal structure and how functions are distributed among HEIs. Scholars and policy-makers generally believe that HEI diversity is beneficial as it allows the organizations to fulfil many different functions, such as excellence in research, human resources training and transfer to society and economy (Meek, Goedegebuure, Kivinen and Rinne 1996). Indeed, a key function of the Carnegie classification was to materialize the system's structure, and particularly, the layering between educational institutions and research universities (McCormick and Zhao 2005). Unfortunately, our understanding of the structure and diversity of higher education systems in Europe is mostly limited to country studies (Huisman, Meek and Wood 2007), while comprehensive studies at the European level are rare (Van Vught 2009, Schubert, Bonaccorsi, Brandt, et al 2014). Therefore, a central function of ETER is to advance our understanding of the structure of European higher education and whether the claimed lack of differentiation is supported by empirical evidence (Bonaccorsi 2009, Daraio, Bonaccorsi, Geuna, Lepori and et. al. 2011).

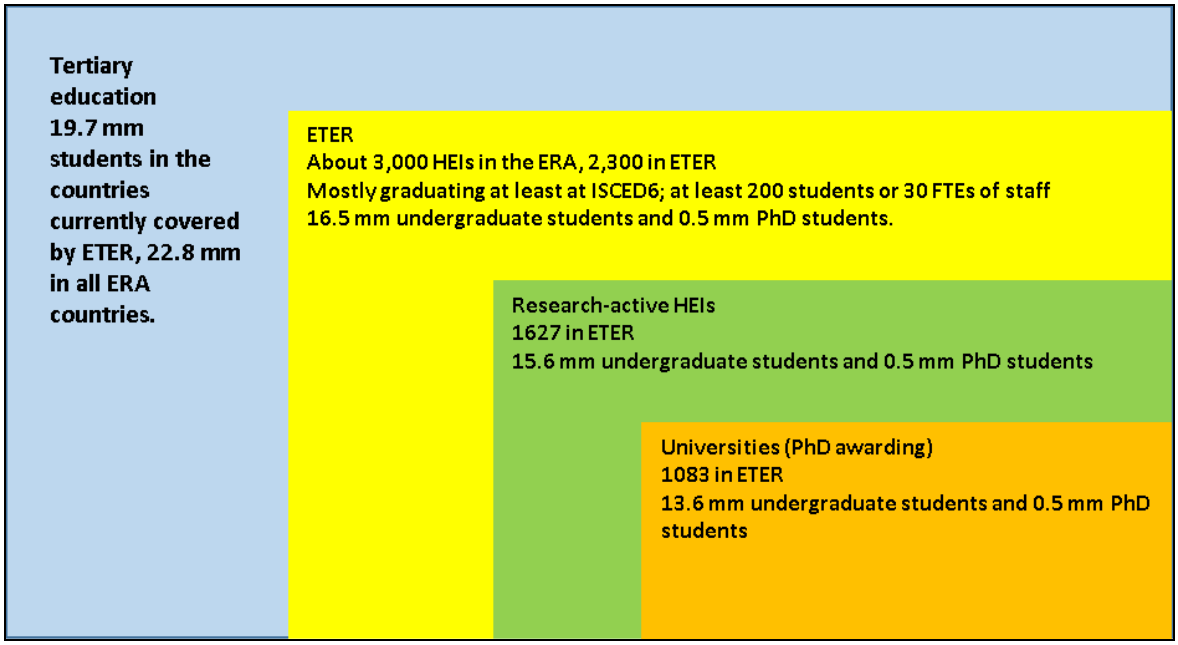
How many HEIs are there in Europe? The ETER perimeter explained

A symptom of how fuzzy the concept has been until now is represented by widely different estimates on how many "universities" or "Higher Education Institutions" exist in Europe. Some sources called for more than 10,000 universities, other more prudent sources provided estimates of only 4,000-5,000. When looking at international rankings, the figures are far lower: the Leiden ranking includes only slightly more than 200 universities and the European Innovation Report largely focuses on these 200 "research-intensive" universities, which constitute the core of European higher education in terms of research activities and international reputation (European Commission 2011a).

This contrasts with the US, where there is a well-defined perimeter of about 7,000 institutions for which data are collected by the US National Center for Educational Statistics. Interestingly, the delimitation criterion is purely administrative, i.e. institutions participating in the federal financial assistance program for higher education. Among these 7,000 HEIs, only about 200 are classified as research intensive in the Carnegie classification.

In some sense, all these figures are correct, as they refer to different understandings of what constitutes higher education, for example focusing more on education or on research. An important outcome of the ETER project is to be able to empirically observe the stratification of European higher education, and therefore, understand the meaning and implications of different perimeters (see Figure 3).

Figure 3. Delimitation of European tertiary education



The broadest possible perimeter is constituted by so-called tertiary education. Tertiary education has been defined in education statistics as learning activities in specialized fields, aimed at students who learn at high levels of complexity and specialization, and who are required to have completed their education at the secondary level for access (so called degrees at levels 5 to 8 in the International Standard Classification of EDucation, ISCED; UOE 2013).

There are no reliable estimates of how many institutions deliver tertiary education degrees in Europe, but according to EUROSTAT data, in the 31 countries currently covered by ETER, this perimeter included slightly more than 20 million students in 2012.

A smaller perimeter would include only those HEIs that offer degrees at least at the bachelor level (ISCED level 6). In many countries, this perimeter corresponds closely to the national definition of what higher education is, as codified by law. While the formal definition of the ETER perimeter includes all tertiary education (see chapter 0), the actual perimeter corresponds largely to HEIs offering degrees at least at the bachelor level. Indeed, ETER includes only 23 HEIs only delivering diplomas below the bachelor level.

ETER data display how short-cycle diplomas and higher education (graduating at least at the bachelor level) are institutionally distinct: however, among the 2,300 HEIs in ETER (combined dataset 2011/2012), a significant 20% (470 institutions) also deliver degrees at the diploma level. ETER comprises only 300,000 students at the diploma level, which probably corresponds to only about 10% of tertiary education diploma students. On the contrary, ETER covers more than 95% of all students enrolled at levels 6 (bachelor), 7 (master) and 8 (PhD). We notice that boundaries are somewhat shifting, as some countries are classifying part of the professional education degrees at ISCED6.

This suggests that most tertiary-level diplomas are delivered by institutions, which do not deliver degrees at the bachelor and master level. Furthermore, evidence provided by the EUMIDA project shows that professional tertiary education in some countries is fragmented into a large number of smaller HEIs – France had nearly 3,000 higher professional schools in 2008 (source: EUMIDA country reports). This is even more complex in countries with a traditionally strong vocational education at the tertiary level, where diplomas are not necessarily associated with a formal curriculum (like in Switzerland). According to contact with National Statistical Authorities, the availability of institutional-level data for professional tertiary education is also problematic, both because of the fragmentation of the sector and the importance of private actors.

Being part of higher education does not necessarily mean performing research: in ETER, more than 500 HEIs (one quarter of the total) are labelled as non-research active, i.e. not even having an institutionalized research mission. These enrol less than 1 million students, out of a total of more than 17 million, and are therefore mostly quite small when compared to universities. A more restrictive definition would consider only universities, defined as those institutions that have the right to award PhD degrees. In ETER, there are slightly more than 1,000 PhD-awarding HEIs, which enrol about 70% of all students in the database (and perform most of the research activities). Finally, an even smaller group would be about 200 European research universities that are included in the Leiden ranking and comprise the bulk of doctoral education, publications and participations in the European Framework Programs (European Commission 2011a).

This discussion shows how important it is to be clear about the goals behind a count of the number of HEIs in Europe. Indeed, by looking at the number of educational providers at the tertiary level, it is a very different issue than counting internationally reputed universities.

Since higher education is inherently multifunctional, these different perspectives are all legitimate, and depending on the goal of the analysis, a different perimeter will be selected – for example, when focusing on international reputation it would be reasonable to focus only on research universities. The specific advantage of ETER is to allow users to assess what is excluded when analysing a specific subset of HEIs.

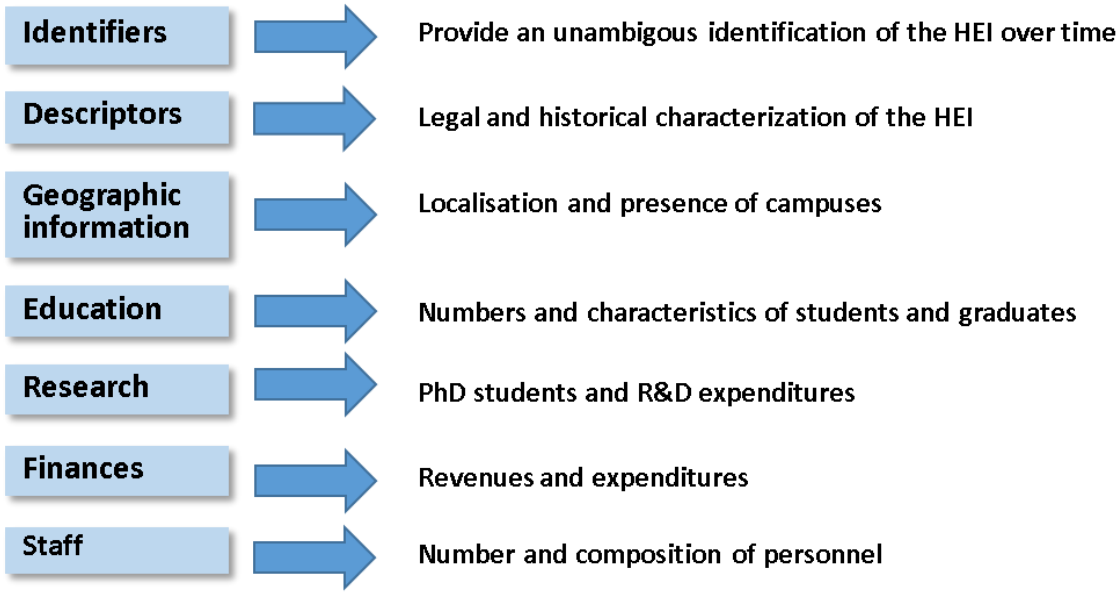
HEIs as multifunctional organizations. Identifying key dimensions

Constructing a system like ETER means that choices need to be made concerning the dimensions selected for HEI characterization (see Figure 4). While theoretically many different HEI features might be of interest to some audiences, practical consideration suggests limiting the scope of a dataset like ETER to a few central dimensions.

Their selection follows three main criteria (Barré 2001):

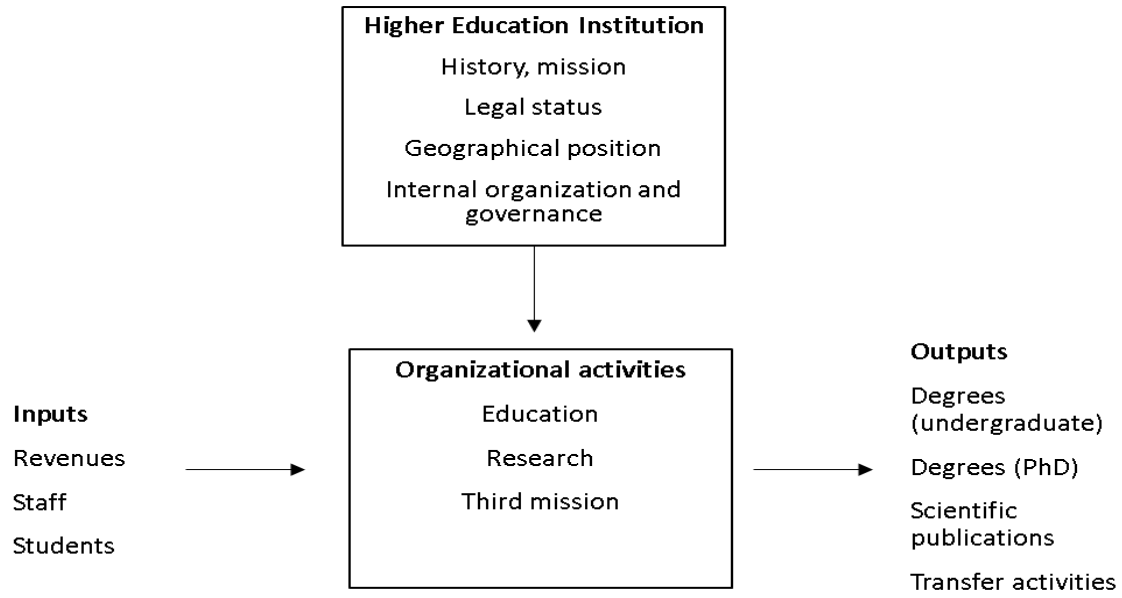
- First, the *conceptual value* of a dimension and of the selected indicators, as they are meant to describe some essential features of an HEI. This relates to a general understanding that the main HEI missions are research, tertiary education and third mission.
- Second, the *reliability* of the measures and the *practical feasibility* of their collection. Some measures, while potentially relevant, might be problematic either because there is no standard on how to measure them or because the burden for data collection would be disproportionate.
- Third, the *policy relevance*, i.e. the extent to which some indicators might shed light on questions which are central to today's policy debate on higher education, like internationalization, mobility of students or gender balance in academia.

Figure 4. ETER dimensions



The current list of variables and of indicators in ETER reflects these criteria, as well as practical issues concerning resources and feasibility. By construction, ETER is however not a closed system: variables included can be expanded in the future and there are many opportunities to link ETER with additional data sources (see box on page 34).
Two complementary frameworks justify the selection of variables in ETER: the idea of comparing HEI profiles across a range of dimensions and an (economic-oriented) understanding of Higher Education Institutions as multifunctional organizations, which bundle a set of inputs to produce different outputs through a series of internal processes and activities (Figure 5). Therefore, ETER does not deal directly with internal management processes, for example how resources are distributed to departments and activities, but with their aggregated outcomes at the organizational level. Relevant questions in this perspective are, for example, whether bundling different subject domains in an institution increases its efficiency (so called *economies of scope*) or whether increasing the HEI size also increases its efficiency (*economies of scale*; Bonaccorsi, Daraio and Simar 2013).

Figure 5. A framework for the analysis of Higher Education Institutions



Inputs are characterized in terms of three dimensions:

- *Money*, i.e. the level of HEI revenues and their composition, distinguishing between the core institutional allocation from the State, third-party funds (public and private) and tuition fees (Jongbloed and Lepori 2015; see also at page 62).
- Personnel, particularly focusing on the academic personnel engaged in teaching and research, its composition and origin.
- Students analysed in terms of their origin, characteristics (mobility, gender) and their distribution by field and educational level (bachelor, master, PhD).

Outputs can be described in terms of the main HEI missions. Educational outputs are usually considered in terms of the number of degrees delivered (the easiest to be measured), but could be expanded to consider characteristics like the qualification level of graduates or their employability in the labour market, as proxies of the quality of education. Research output is usually associated with scholarly publications, for example those recorded in international databases, paper's citations and the training of researchers, particularly PhD graduates. Third mission activities include a broad set of activities, which can be characterized according to different dimensions (Gulbrandsen and Slipersaeter 2007), including transfer of technology (frequently measured by the number of patents), contribution to the creation of enterprises (for example spin-offs; Mustar, Renault, Colombo, et al 2006), contribution to public policies (consultancy, public contracts) and, more in general, to society and culture (like exhibitions, collaboration with non-governmental organizations, and media presence).

As we will discuss later in this chapter, not all of these dimensions are covered by ETER, either because data are available in other places besides receiving them from the National Statistical Authorities, or due to methodological problems, or a lack of consensus on the collected measures (like in the case of scientific outputs). This particularly concerns third-mission activities, which are increasingly relevant for higher education policies, but on which there is an open debate on how to best measure them at the institutional level.

Finally, ETER provides information on some key organizational attributes, which are likely to influence the production process, and therefore, the observed HEI profile and relationships between inputs and outputs. These include:

- the HEI history (when the HEI was founded, possible transformations experienced during its history),
- the legal status and regulatory status, like the legal possibility of awarding a PhD, since these have a deep impact on HEI activities,
- the geographical location of HEIs, as the characteristics of the city and region where the HEI is located impact the availability of research funds, the educational demand from students and the cooperation opportunities with business and society.

Developing multi-dimensional profiles

The notion of profile is grounded in a conception of higher education and research as multifunctional activities, which are oriented towards different audiences (Larédo 2003): the (international) academic community for knowledge production, parents and students for educational offers, and business enterprises and societal stakeholders for third mission and transfer activities. Since higher education needs to fulfil at the same time these different functions, it is considered that there is value in having HEIs display different balances (profiles) towards these dimensions within a national system.

Therefore, ranking HEIs on a single dimension – as is done by most international rankings focusing on international research reputation (Weingart and Maasen 2007) – is methodologically not correct, as HEIs with different missions, characteristics and orientations are compared with the same measures (Daraio, Bonaccorsi and Simar 2015b). This practice is also dangerous in policy terms, as it pushes all HEIs to compete along the international research dimension, with the risk of reducing the systems' diversity, and therefore, its ability to respond to societal needs.

On the contrary, multi-dimensional profiles compare different HEIs in terms of their missions, for example assessing whether an HEI is more oriented towards knowledge production or towards transfer to society. This is relevant as it allows students and stakeholders to select the HEI that best fits their specific needs.

A similar framework has been systematically developed by the U-MAP project (http://www.u-map.eu/; van Vught, Kaiser, File, Gaethgens, Peter and Westerheijden 2010). By involving higher education stakeholders, U-MAP has identified a set of core profiling dimensions and proposes a set of indicators for each of them (Table 2). This approach was also adopted in a slightly different way in the U-MULTIRANK project (http://www.umultirank.org), in order to identify HEIs with similar profiles, which can then be compared in terms of performance indicators, what has been known as smart benchmarking (Bogetoft, Fried and Vanden Eeckaut 2007). This avoids the well-known problem of comparing HEIs with the same indicators that are fundamentally different, like a music school and an international research university.

Table 2 compares the current list of variables and indicators in ETER with the U-MAP profiling dimensions, showing that many of them can be covered through indicators derived from ETER data. This reflects the fact that dimensions included in ETER, like the subject domains covered by HEIs, the focus on different levels of education, and the internationality of HEIs, have already been a focus of international data collection for many years, since they correspond to central topics in the current policy debate.

Table 2. U-MAP profiling dimensions (source van Vught, Kaiser, File, Gaethgens, Peter and Westerheijden 2010).
The dimensions currently covered by ETER appear in italics.
**Integrating ETER with additional data sources and data from international databases could produce these indicators.*

Teaching and learning profile	**Student profile**	**Research involvement**
Degree level focus *Range of subjects* Orientation of degrees Expenditure on teaching	Mature students Part-time students Distance learning students *Size of student body*	Peer reviewed publications* *Doctorate production* *Expenditure on research*
Involvement in knowledge exchange	**International orientation**	**Regional engagement**
Start-up firms Patent applications filed* Cultural activities Income from knowledge exchange activities	*Foreign degree seeking students* Incoming students in international exchange programmes* Students sent out in international exchange programmes* *International academic staff* International sources of income	Graduates working in the region First year bachelor students from the region Importance of local/regional income sources

The overview in Table 2 shows that some dimensions of HEI profiles are already covered by ETER, like teaching students and international orientation; for research involvement, the combination of ETER with international publication databases would provide suitable information.
On the contrary, limitations appear concerning knowledge exchange activities on the one hand, and regional engagement on the other hand.

The construction of ETER. Methodology, processes and content

Constructing ETER is a conceptual, methodological and managerial challenge, which requires combining different elements in a smooth way (see Figure 6).

The process starts with the definition of what an HEI is and the criteria for including it in ETER (what we call the perimeter; see at page 27); this is important in order to achieve some comparability across countries, since the definition of what tertiary and higher education are varies by national context. Then, a list of variables has to be created together with definitions, which ensure that national correspondents and National Statistical Authorities have clear guidelines on how to collect data (see at page 31). These methodological elements are presented in the ETER methodological handbook, which is annexed to this report and represents the core instrument to ensure that ETER is implemented in a comparable way and can be reproduced over different years.

On this basis, a data collection process is set up, a non-trivial enterprise when dealing with 36 national systems (and, therefore, at least 36 different data providers), each of them with their specificities (page 37). This process is made more complex because of the sheer amount of data: the current ETER dataset includes more than 400 records for each of the roughly 2,300 HEIs over 2 years, i.e. more than 2 million records. A well-constructed data management process, where data are collected using standard templates and then integrated into a central database is therefore required.

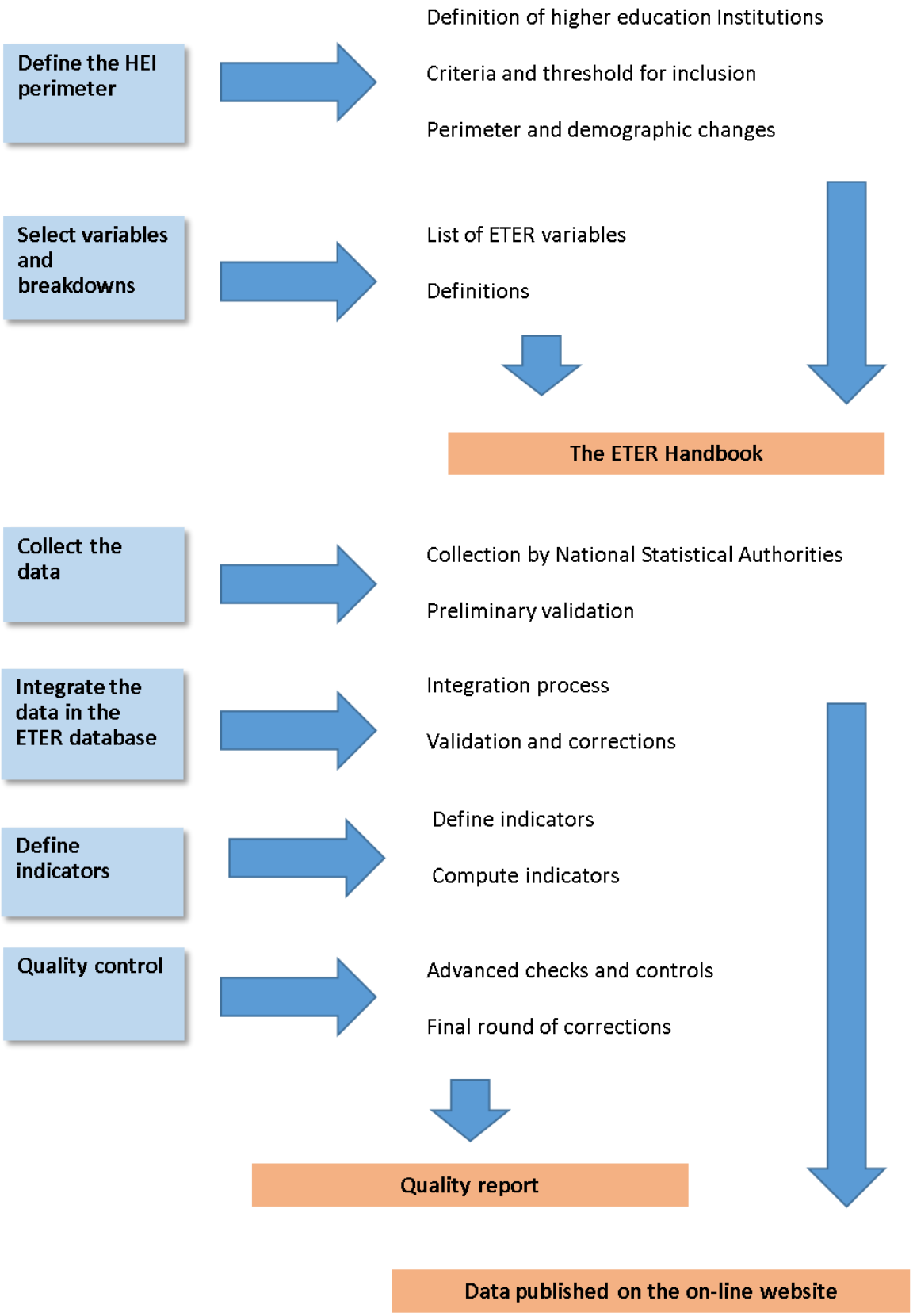
Collected data need to be validated, to correct simple mistakes and inconsistencies, and their quality needs to be thoroughly analysed, as there are many reasons why data might be not comparable by country (see at page 38). Data validation and quality might lead to corrections, but also to the addition of flags and methodological remarks, explaining why a value is deviant.

The final step of the process lies in publishing the data on the website and in providing users with the required information to allow for sensible data usage (see further at page 43).

The ETER project managed to integrate these elements and to organize them into a yearly cycle, starting in the summer of each year with the launch of the data collection process and concluding in late spring of the following year with the publication of data. ETER has therefore been designed for continuous annual data collection in order to produce a longitudinal database on the evolution of European higher education. This timeline is also broadly consistent with the Eurostat data collection on education statistics.

In the following section, we shortly present the main components of the process. For more in-depth and complete information, the reader should refer to the annexed technical report.

Figure 6. An overview of the ETER components and process



What is included in ETER? Perimeter and coverage

As highlighted in section 0, there is no "natural" definition of higher education in Europe. Also, the concept of a Higher Education Institution was until now rather general and not precisely defined, since the main units for data collection in education statistics are programs and not organizations.

Therefore, ETER, building on the EUMIDA feasibility study, developed a set of definitions and guidelines to decide which institutions should be included in the database. The ETER definition (see box) refers to educational providers, which can be identified as distinct organizations and are nationally recognized.

In practice, ETER obviously includes (doctorate-awarding) universities, which constitute about 40% of the HEIs included, as well as non-university higher education institutions, so-called universities of applied sciences (Fachhochschulen, Colleges, Hogescholen, etc; Kyvik and Lepori 2010). ETER also includes a larger number of smaller educational providers, like arts and music schools, business schools, institutes of technology, etc.

Excluded are institutions offering tertiary education degrees as a side activity, like professional education or secondary educational institutions. Also, public research organizations are excluded, even if they award some PhDs – the only exception being the Bulgarian Academy of Sciences given its importance in the national system.

Further, institutions having less than 200 students and at the same time less than 30 units of staff (in full time equivalents) are also excluded. This has been done in order to reduce the burden of data collection and because data availability for these smaller educational providers is usually more limited. Combining students and staff allows for the inclusion of HEIs with very few students, but a rather large number of staff and research activities (for example graduate schools).

In terms of country coverage, ETER should include all ERA countries, i.e. the 28 Member States of the European Union, the four EEA-EFTA countries (Iceland, Liechtenstein, Norway and Switzerland), as well as four candidate countries (the former Yugoslav Republic of Macedonia, Montenegro, Serbia, Turkey). For 2012, 31 countries have data available, since Romania, Montenegro, Serbia and Turkey did not deliver data (the same applies for the French part of Belgium; see Figure 7).

HEI definition

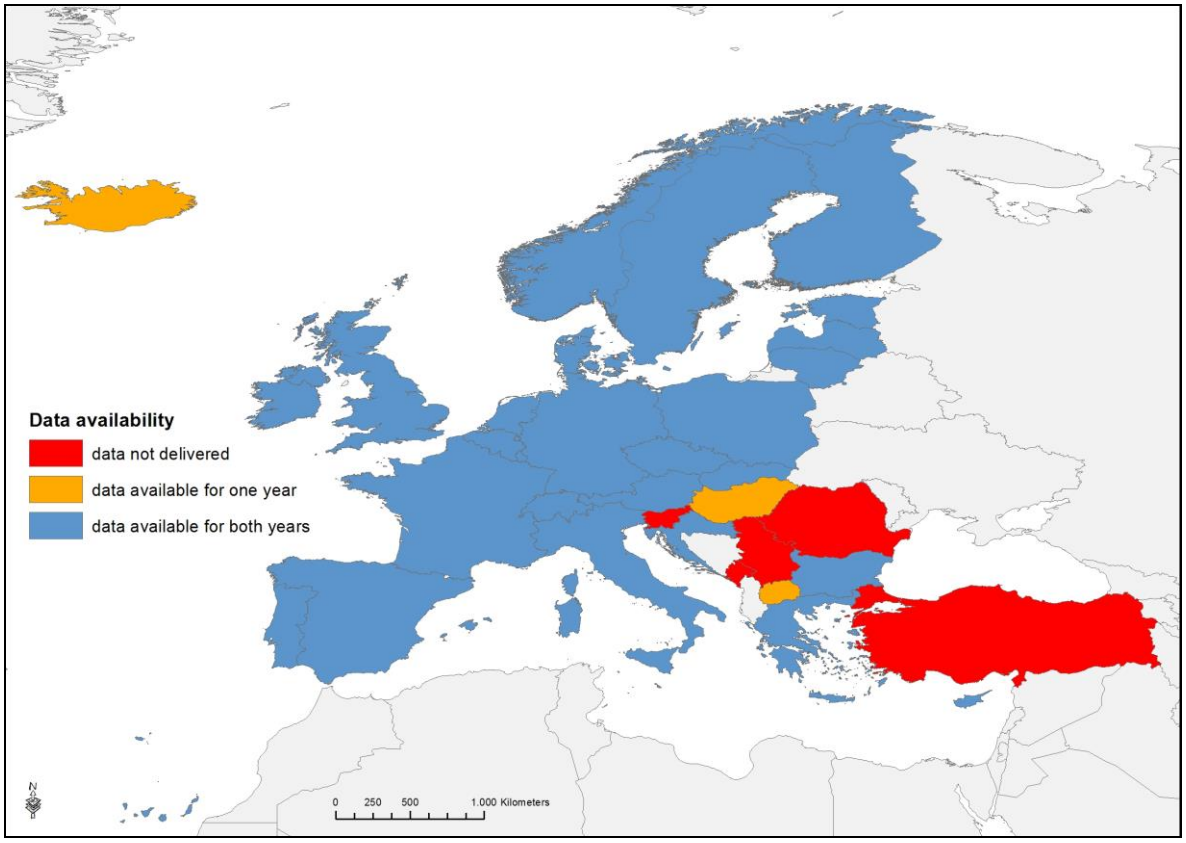
Higher Education Institutions are defined as entities

- which are recognizable as distinct organizations,
- which are nationally recognized as HEIs, and
- whose major activity is providing education at the tertiary level (ISCED 2011 levels 5, 6, 7 and/or 8). R&D might be present, but it is not a condition for inclusion.

A HEI is nationally recognized, if it is officially accredited as such by a legitimate organization in a country. Recognizable as a distinct organization means that the perimeter of these institutions can be identified rather unambiguously, they have an internal organizational structure and, at least in principle, their own budget.

Source: The ETER handbook.

Figure 7. Country coverage of ETER



Error! Reference source not found. provides a comparison between the number of students in ETER and those for the whole of tertiary education at the national level provided by EUROSTAT. In the 31 countries currently covered, ETER comprises 87% of the undergraduate students and 70% of PhD students in the EUROSTAT national totals. The lower coverage of the PhD level is due to the fact that two large countries, Spain and the UK, have yet to deliver data at this level, while data on Germany are incomplete since not all PhD students are registered in student's statistics. Lower figures for the Netherlands are also due to the fact that PhD numbers are in Full Time Equivalents (as of their contractual engagement with the university). Otherwise, coverage of PhD education is nearly complete.

Table 3. Coverage of ETER as compared to EUROSTAT
Data for 2012, except for HU, IS, LU, MK (2011).

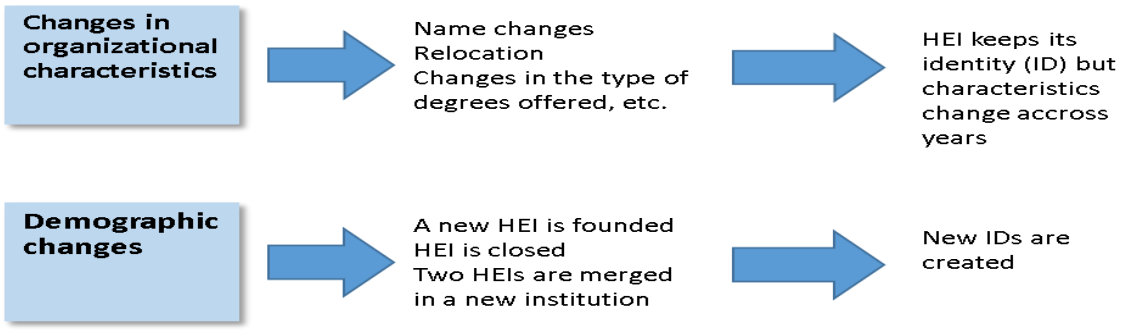
	ETER		EUROSTAT		ETER/EUROSTAT	
	undergraduate (ISCED5-7)	PhD (ISCED 8)	undergraduate (ISCED5-7)	PhD (ISCED 8)	undergraduate (ISCED5-7)	PhD (ISCED 8)
AT	323'151	26'394	350'447	26'052	0.92	1.01
BE (Flemish)	224'933	11'144	263'163	8'031	0.85	1.39
BG	278'471	5'184	280'292	4'703	0.99	1.10
CH	199'452	22'716	247'561	22'012	0.81	1.03
CY	29'398	829	31'062	710	0.95	1.17
CZ	367'476	25'284	414'125	26'105	0.89	0.97
DE	2'384'265	110'611	2'730'963	208'500	0.87	0.53
DK	273'151	9'517	250'075	8'857	1.09	1.07
EE	61'762	3'044	64'556	3'051	0.96	1.00
ES	1'548'569		1'943'287	22'542	0.80	-
FI	288'324	20'593	288'729	20'195	1.00	1.02
FR	1'622'748	72'093	2'225'725	70'581	0.73	1.02
GR	336'710	23'887	640'251	23'447	0.53	1.02
HR	158'827	3'632	154'054	3'235	1.03	1.12
HU	348'355	7'200	373'503	7'254	0.93	0.99
IE	181'638	8'163	183'717	8'930	0.99	0.91
IS	18'259	452	18'367	478	0.99	0.95
IT	1'781'395	35'053	1'891'301	34'629	0.94	1.01
LI	762	20	854	106	0.89	0.19
LT	154'443	2'456	172'191	2'875	0.90	0.85
LU	4'320	390	5'018	358	0.86	1.09
LV	89'488	2'519	94'518	2'523	0.95	1.00
MK	58'064	456	67'490	:	0.86	
MT	13'248	78	12'126	77	1.09	1.01
NL	680'936	8'710	781'136	12'542	0.87	0.69
NO	239'810	9'532	230'006	8'218	1.04	1.16
PL	1'605'575	39'352	1'966'949	40'263	0.82	0.98
PT	349'106	19'470	371'046	19'227	0.94	1.01
SE	461'017	21'578	431'976	21'352	1.07	1.01
SK	193'525	10'953	209'082	12'145	0.93	0.90
UK	2'324'000		2'400'831	94'949	0.97	-
	16'601'178	501'310	19'094'401	713'947	0.87	0.70

The comparison for undergraduate students provides similar results. The lower figures for Greece are due to the fact that in ETER the new legal definition of students was adopted, which sets a cap on the number of enrolment years. Coverage in the other countries is quite good, with some lower figures in those countries having a well-developed professional sector (France, Germany, Switzerland). We conclude that most of tertiary education and almost all of higher education (at the bachelor, master and PhD level) are included in ETER.

Organizations change over time. Demography

Many ETER users will be interested in analysing the change of HEIs over time, for example whether an HEI is increasing the number of students, changing the composition of revenues, the composition of subject fields offered in research, and teaching, perhaps as an outcome of increased educational demand in some areas. ETER currently provides data for only two years (2011 and 2012), but older data can be retrieved from the EUMIDA feasibility study (2008) to some extent, while data collection for the years 2013 and 2014 are foreseen.

Figure 8. Organizational demography in ETER



However, like all organizations, HEIs change over time. Indeed, their change tends to be less frequent and rapid than for companies and many universities have witnessed continuity in their existence, locations, and name over long periods of time; just think of cases like Bologna or Oxford. Nevertheless, change is present. Foundations are a relatively frequent event (31 cases between 2008 and 2012 in the ETER perimeter), closures are also not infrequent, especially for private HEIs (38 cases) – in most of these cases, the national accreditation for higher education degrees was not renewed by the State.

Cases of mergers, i.e. two or more HEIs becoming a single institution is also not infrequent; in many cases they are an outcome of a political will to achieve critical mass by establishing larger HEIs. Splitting HEIs is less frequent, but some important cases happened in the past, like the split in 1971 of the ancient and prestigious Sorbonne University (whose roots date back to the medieval times), into the current system of twelve universities in the Paris region.

Other changes are less dramatic, but nevertheless important for understanding the dynamics of higher education. Some HEIs change names, partially for marketing purposes, but also because of regulatory changes; the Norwegian Bodø University College received their accreditation as a university in 2011 and changed its name to University of Nordland. From the name only, it would be impossible to recognize that the two HEIs are the same entity. Such changes are particularly problematic when integrating ETER with publication and patent databases, since attribution to institutions is largely based on their name.

Demographic events

Merger. In Finland, the University of Art and Design, the Helsinki School of Economics, and the Helsinki University of Technology were merged in 2010 to create Aalto University. In the EUMIDA 2008 data, the three parent IDs (FI0007, FI0009, FI0020) are still present, in the ETER 2011-2012 only the new ID assigned to Aalto University (FI0025).

Split. In 2012, the Teacher Training University of central Switzerland (CH0027) was split into three cantonal HEIs. In 2012, three new IDS are attributed to these three HEIs, whereas CH0027 is no longer present.

Take-over. In 2010, the four architecture schools in the French part of Belgium were integrated into universities. Their IDs are present in the EUMIDA 2008 data, but not in the ETER 2011/2012 data. The user is warned that the university perimeter has changed over time.

To handle this issue, ETER has introduced a distinction between demographic changes, when it is considered that the *identity* of the organization has changed, and changes in characteristics within the same institution. Therefore, each HEI in ETER receives a unique identifier, which is stable over years and marks organizational continuity: for example, the identifier "NO0018" is attributed to an HEI whose name was Bodø University College in EUMIDA (2008) and is University of Nordland in ETER (2011/2012). The user will then be able to follow the HEI over time using the identifier.
In contrast, when a demographic event occurs, identifiers are reassigned (see the examples in the box on page 30). The database also includes the corresponding information on what happened to the HEI. This identifier-based approach, which follows practices already adopted for companies in the Business Units Register (EUROSTAT 2010), is particularly important for matching ETER with other databases, in which HEIs might be recorded with slightly different names.

Variables and classifications

The selection of variables in ETER follows the conceptual framework introduced on page 15, but also practical and institutional considerations: ETER is a database developed together with the National Statistical Authorities and, therefore, focuses on the data collected by NSAs, which until recently were only available at the national level. Data from international databases (publications, patents) have not been integrated in ETER, but this should not be considered as a limitation (see box on page 34). Other data could be collected only through a dedicated survey, which is currently out of the scope of ETER.
It is useful to consider the groups of variables in terms of their rationale, the extent to which the same data are also collected as national totals by EUROSTAT and their availability.

Classifications in ETER

International Standard Classification of EDucation (ISCED). ISCED is the international classification of education programs and qualifications developed for statistical purposes by OECD, UNESCO and EUROSTAT. ISCED allows for the classification to be made in a comparable way to programs and qualifications labelled differently in the national educational system.
Relevant for ETER are ISCED levels 5 (short-cycle tertiary diplomas), 6 (bachelor or equivalent), 7 (master or equivalent) and 8 (doctoral or equivalent).

Fields of Education (*FET-2013*). FET-2013 classifies educational programs in 11 subjects. In ETER, it is used to classify students and graduates (based on the subject of the curriculum), as well as academic personnel (based on department domain).

Citizenship. Students, graduates and HEI staff are classified in nationals and foreigners (not having the nationality of the HEI country).

Mobility. Students, graduates and HEI staff are classified in resident and mobile, i.e. those students that received their upper secondary education degree in another country.

Gender. Students, graduates and staff are classified in men and women.

Source: the ETER handbook. All classifications conform to EUROSTAT practices.

a*) Institutional descriptors and geographical information* represent an important contribution of ETER to our knowledge of European higher education. Particularly important variables are the legal status (see section 0) and the classification of HEIs between universities, universities of applied sciences and other institutions (see section 0), as these can be combined with quantitative data to identify the types of roles HEIs play in European higher education. ETER also comprises information on HEI history via the ancestor year, foundation year and legal status year.
Geographical information is equally important: ETER HEIs have been attributed geographical coordinates (based on the main seat), allowing for fine-grained analysis of the spatial structure of higher education and of their collaborations. ETER also includes information on whether an HEI has campuses in different locations. This information allows us to easily connect ETER with regional statistics.

b) Data on *staff* are important for many purposes. They represent the most reliable measure of HEI size, which is more comparable than financial data between countries. Breakdowns by gender, nationality and scientific field provide relevant information on HEI profile, personnel composition and internationality.

c) *Data on education (students and graduates)* closely follows the definitions adopted by EUROSTAT in education statistics (UOE 2013). ETER introduced the ISCED-2011 classification of education levels and FOET-2013 classification of educational fields, which are better suited to higher education after the Bologna reform (see box at page 31). Two additional variables inform on whether an HEI has the right to award a degree level (particularly the PhD).

d) Data on *research activities* are somewhat limited in ETER, which includes only information on PhD students and graduates (an important proxy of the extent of research, since they have to be considered in most cases as researchers) and on R&D expenditures. The latter are based on a breakdown of the use of time by academic staff, but are available only for a limited number of countries. The *research-active variable* (new to ETER) identifies those HEIs having an institutional research mission, even if they cannot award the doctorate. It is therefore meant to observe the extension of the HEI research mission beyond PhD-awarding HEIs (Lepori and Kyvik 2010).

e) Data on *expenditures and revenues* are largely new to ETER, as very few data in this area are provided by education statistics. In this respect, ETER has introduced an important distinction of sources of revenues between core budget, third-party funds and students' fees, which is relevant to characterize HEIs competitive position (see at page 62). Unfortunately, the level of completeness and comparability of these data are not yet fully satisfactory (see at page 38).

Table 4. List of ETER variables and their completeness
Percentage of HEIs for which data are available.

Dimension	Variables	Level of completeness
Identifiers	ETER ID National identifier (optional) Institution name (in own language) English institution name (if available) Year	Almost 100%
Basic institutional descriptors	Country Code Legal status Institution category, national definition (in own language) Institution category, national definition (in English, if available) Institution category standardized Foreign campus Foundation year Legal status year Ancestor year University hospital Institutional website	Almost 100%
Geographic information	Region of establishment, NUTS2 code Region of establishment, NUTS3 code Name of the city Postcode Multi-site institution Geographical coordinates	Almost 100%
Educational activities	Highest degree delivered Lowest degree delivered Number of enrolled students at ISCED levels 5, 6, 7, by fields of education, gender, citizenship and mobility Total number of students enrolled at ISCED 5-7 Number of graduates at ISCED levels 5, 6, 7, by fields of education, gender, citizenship and mobility Total number of graduates at ISCED 5-7 Distance education institution	80-90% (lower for mobility)
Research activities	Research active institution Number of enrolled students at ISCED levels 8, by fields of education, gender, citizenship and mobility Number of graduates at ISCED levels 8 (doctorates), by fields of education, gender, citizenship and mobility R&D expenditures	80-90% for ISCED 8 students and graduates, 40% for R&D expenditures.
Expenditures	Personnel expenditure Non-personnel expenditure Capital expenditure Accounting of capital expenditures	Around 50%
Revenues	Core budget Third party funding Private funding Tuition fees Student fees funding	Around 50%
Staff	Number of academic staff in FTEs and headcounts Number of academic staff by fields of education, gender and citizenship in headcounts Number of administrative staff in FTEs and headcounts Number of professors by gender Inclusion of PhD students Number of total staff in FTE and HC	Around 60% for the total, much lower for citizenship and staff by field.

Box. ETER as an open system. Interoperability

At a first glance, the list of variables provided in ETER might look slightly deceiving: few variables are provided to characterize the research mission of HEIs and none concerning the third mission. Concerning education, the provided information deals principally with the amount of education provided, but not with the quality of outputs (for example graduates' competences or their employability).

To some extent, these limitations depend on methodological problems on how to measure these dimensions and on limitations concerning data availability.

Yet, these limitations also underscore an important characteristic of ETER: ETER is not meant to be an all-encompassing database, which answers all relevant questions on European HEIs. It is rather a core facility providing three basic types of information: a consistent list of HEIs maintained over time, basic descriptors on HEI characteristics and spatial position and a number of core data on their volume of activities, which are needed for different comparisons to be made (for example to normalize other measures against HEI size).

Once this is available, it becomes relatively easy to combine ETER data with other data sources. For example, the number of publications of European universities is available from sources like the Leiden ranking (Waltman, Calero-Medina, Kosten, et al 2012) or the Scimago Institutional ranking (Bornmann, De Moya Anegón and Leydesdorff 2012); the same applies for the number of patent applications (Lissoni, Llerena, McKelvey and Sanditov 2008) and participation in European Framework programs (Roediger-Schluga and Barber 2008). Rich data on publications and the third-mission are also available from the U-MULTIRANK project, even if the raw data are not currently publicly available.

All these databases made an effort to standardize their data based on a list of HEIs and, therefore, matching them with ETER is relatively straightforward.

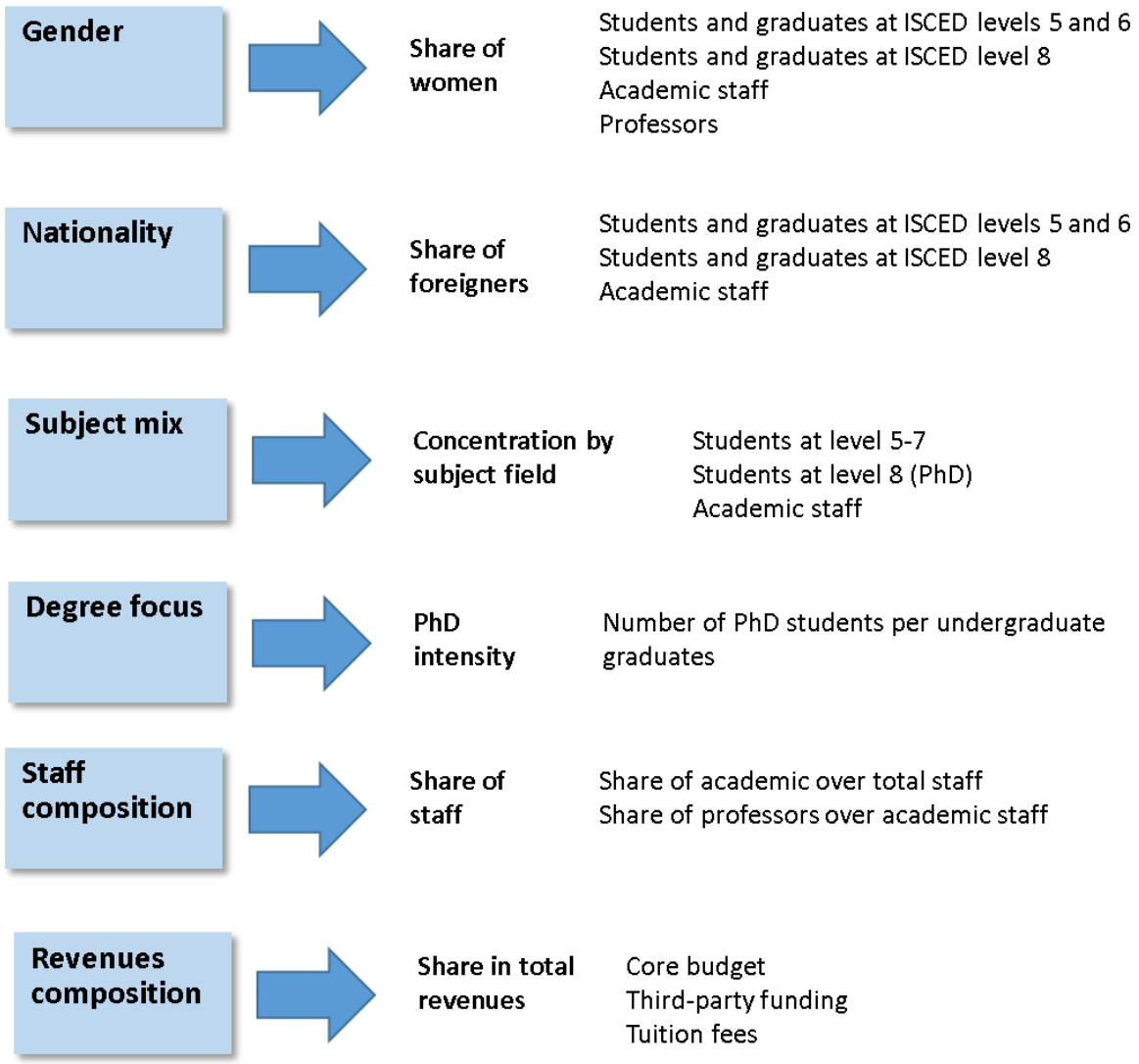
There are at least three reasons why this 'combine' approach is preferable to building an all-encompassing database. First, data need to be continuously updated, and it is preferable that specialized providers, who best know the corresponding data sources, complete this task. Second, the ETER perimeter is extensive, while for many purposes, a smaller perimeter would be enough: for instance, among the 2,300 HEIs in ETER only 600 to 700 have a sizeable publication activity as revealed by international databases. Therefore, an analysis of international publishing could focus on this smaller perimeter, strongly reducing the effort required. Third, some data sources are subject to restrictions in terms of their availability because of legal or commercial issues. While it might still be possible to access such data for analytical purposes, it would not be feasible to integrate them in a public database like ETER.

To address issues of interoperability between datasets on research, innovation and higher education, the European Commission has launched within the 7 EU Framework Program a specific infrastructure action on Research Infrastructures for Science, Innovation and Society, to which ETER is closely connected (RISIS; at www.risis.eu). Additional data from ETER can be requested from RISIS (http://datasets.risis.eu/).

Indicators to characterize HEIs

Indicators are useful in order to characterize HEIs in terms of some dimensions of substantive interest and for comparing them based on relative characteristics. For example, the absolute number of foreign students enrolled in an HEI is not a very good measure of the degree of internationalization, as one needs to take into account differences in the total number of students. Hence, the percentage of foreign students is a more interesting and easily comparable indicator.

Figure 9. ETER indicators



Therefore, in addition to the variables presented on page 31, ETER also includes 23 indicators calculated by combining different variables. These are meant to represent a selection of all possible indicators based on three important criteria. First, the substantive interest needed to characterize HEIs and compare their profiles (see page 22). Second, the methodological robustness of the indicator, i.e. to which extent it is, or is not subject to flaws which may compromise its validity to compare HEIs. Third, the sufficient availability of data in ETER allows for meaningful comparisons to be made. For example, indicators concerning costs, like costs per students, have been excluded, since it is well known that they are strongly dependent on the subject

composition of HEIs. The selection of indicators in ETER is therefore also meant to guide users in their analysis.
The current selection of indicators is displayed in Figure 9. Most of these indicators will be used further in this report to compare HEIs and to analyse European higher education.

a) *Gender balance*. These indicators compute the share of women among students, graduates and different levels of academic staff. They follow a central goal of higher education policy, i.e. to achieve equality of changes between women and men concerning access to higher education and the academic career. An interesting feature of ETER is to compare gender balance at different levels of education and of academic staff (PhDs, total academic staff, professors). As it is well known that gender balance has been largely achieved for undergraduate and PhD education, but the composition of academic staff is still unbalanced, particularly for higher levels of the academic hierarchy like professors ("leaky pipeline"; European Commission 2012). Furthermore, there are large differences between fields, with women accounting for a much lower share of students and staff in sciences and engineering. The gender balance in higher education is further analysed on page 74 of this report.

b) *Citizenship and mobility*. Internationalization of the student body – and even more so, of academic staff – is a major goal of the HE modernization agenda, as it is expected to increase the quality of higher education and research and offer students a broader range of experiences in different countries. Two sets of indicators are provided: those based on citizenship (i.e. the share of students, graduates and staff who are not citizens of the country) and those based on mobility, i.e. the share of students and graduates that received their upper secondary degree in a foreign country. The latter definition avoids biases due to foreign citizens who were born and/or trained in the countries and, therefore, does not correspond to the notion of internationality. Information on mobile students is however available for less countries (see further at page 70).

c) *Degree focus*. Indicators on degree focus characterize HEIs by the share of degrees awarded at different levels and, therefore, are an important characterization of HEIs in terms of their mission and activities (van Vught, Kaiser, File, Gaethgens, Peter and Westerheijden 2010). Particularly, the ratio between PhD graduates and undergraduate graduates (*PhD intensity* or *research intensity*) is a key indicator to compare HEIs concerning the importance of research activities, which is also used in the Carnegie classification (see further at page 65).

d) *Staff composition*. The two indicators provide important information on the structure of staff in HEIs. The ratio between academic and total staff is a useful measure of the level of bureaucratization of HEIs, since those HEIs with strong central administration and central management practices will tend to have lower shares of academic staff. The ratio between the number of professors and total academic staff is informative for the pyramid structure of personnel and the extent to which professors represent an élite group within the institutions – a feature distinguishing higher education from compulsory schools.

e) *Revenue composition*. The division of revenues between three major streams – the core allocation from the State, third-party funds and student's fees – is highly informative of the competitive position of the organization in the higher education field (Jongbloed and Lepori 2015). Highly reputed research-oriented HEIs will usually be able to acquire large streams of third-party funds, whereas other HEIs, particularly the private ones and those in specific fields, like business, might be able to acquire substantial parts of their revenues from student fees. Differentiating the sources of

revenues and acquiring more funds from students also represents a policy choice in many European countries (see further at page 62).

How data have been collected and integrated

Constructing and maintaining a database like ETER is also a management challenge, which requires coordinating a large number of actors throughout Europe, obtaining data and then integrating the data into a database, which allows for data management, updating, validating and, finally, providing interfaces to users. In this respect, ETER has constructed both a *technical infrastructure* – composed by a database, templates for data collection, guidelines – and a *human infrastructure*, composed by people at the European Commission, EUROSTAT, members of the project and National Statistical Authorities in the participating countries, which are well acquainted with the rationale and approach of ETER, know its methodology and are able to perform data collection tasks in a reliable manner. Constructing this network and the related communication processes was a major achievement for ETER and the best guarantee for its continuity.
To the extent possible, these processes have been codified in the ETER handbook in order to ensure that the whole system can be transferred to other actors when required.

Figure 10. Data collection, validation and integration (NEs=National Experts)
Source: ETER interim report.

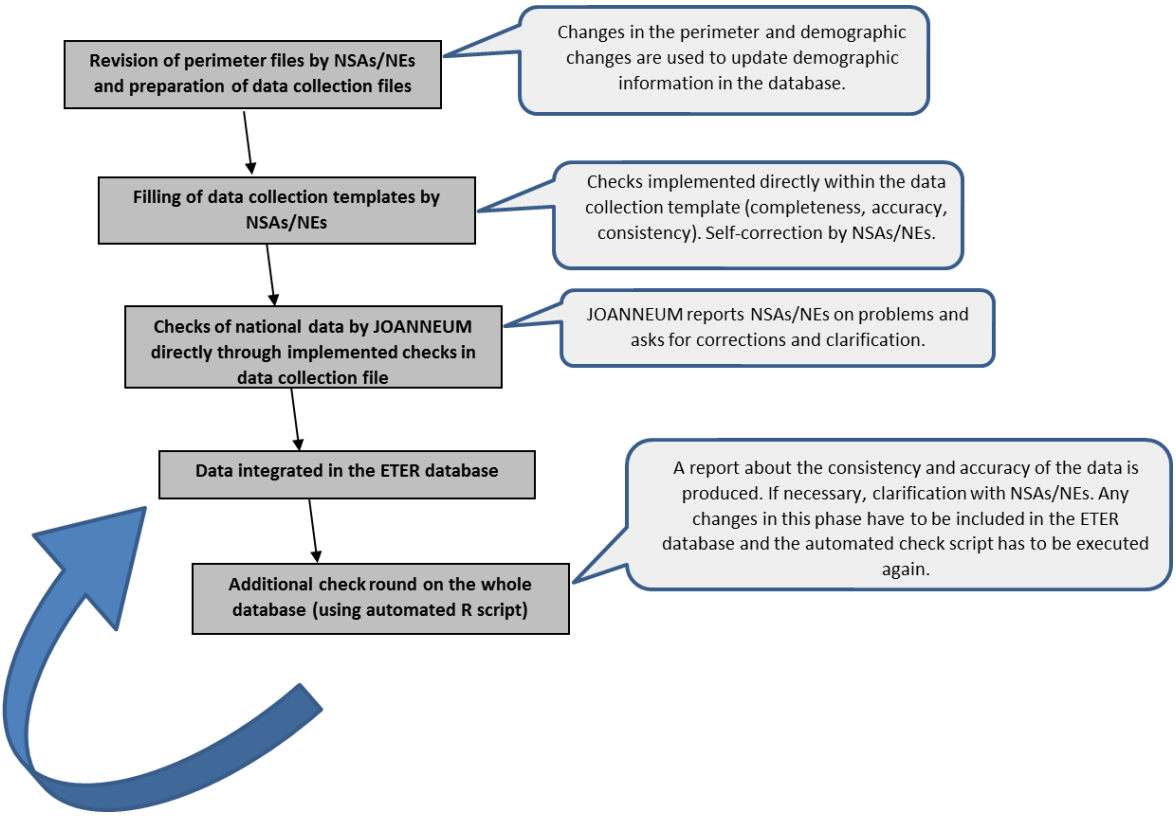


Figure 10 summarizes the data collection process (for full details the reader should refer to the annexed technical report and to the ETER handbook). The process starts by updating the list of HEIs in the database and tracking the demographic events that have occurred since the last round of data collection (see at page 29), in order to obtain a reliable list of institutions for collecting data.

Based on this list, the national correspondents of ETER receive a template for collecting data. From year to year, it also includes the information not expected to change frequently, like descriptors, foundation years, and HEI location. The file already includes a number of basic controls in order to detect simple mistakes.
Once delivered, the collected data are subject to different cycles of validation and data quality to detect any mistakes and problems (see at page 38); this leads to intensive communication between the ETER project and national correspondents to correct mistakes, but also to explain data that look deviant upon first glance.
Once ready, data are integrated into the central ETER database, which not only stores numerical variables, but also all the additional information required to analyse data, like data flags, specific remarks on particular cases and, most of all, metadata which describe the data content for each country, deviations from ETER definitions, data sources, and reference dates for data collection. The ETER database also provides the infrastructure for the user interface, which allows users to search and download data based on their specific needs (see at page 43).

Quality and comparability of data

Data quality is one of the most important, yet elusive notions for statistical databases. In their essence, perfect data does not exist, but users would like to be reasonably sure that the data meet good professional standards and that the results of their analyses are not affected by data problems.
Data quality also has different dimensions beyond the concept of data accuracy (i.e. the closeness of statistical figures to the correct representation of the real-life phenomenon) including completeness, consistency, timeliness, and comparability.
Internal quality control is a major issue for HEI-level international data collections.
The lower level of disaggregation of data makes ETER more sensible to quality issues and increases the chances of mistakes; there are also many different sources of comparability problems among HEIs and countries.
Aggregate data are less volatile over time and more likely to hide or reduce the impact of special cases or special events.
In addition, a practical issue is

Some comparability issues in ETER

Total expenditure is not perfectly comparable for countries, for example due to the omission of capital expenditures. Different perimeters of HEI expenditure (i.e. inclusion/exclusion of ancillary services to students) hamper full comparability.

The breakdown of income by categories may hide different classification choices. The presence of large unclassified income hampers the comparability of breakdowns.

Specificities about the inclusion and classification of staff across countries and among HEI categories (university vs. colleges) may impact comparability.

Availability of FTE and Head Count measures of staff are jeopardised.

In several countries the ISCED-97 classification of fields of education is still used (this is expected to be solved in the next years).

Breakdowns of students and graduates by mobility status are not fully comparable among countries.

Information on R&D expenditures are only available in a sub set of ETER countries.

represented by the sheer amount of data to be treated: for each yearly data collection, ETER produces about 800,000 data cells to be systematically checked.
Higher Education Institutions are highly heterogeneous organizations, ranging from large and internationally reputed research universities to small-scale, mostly teaching oriented, specialized schools. In this respect ETER includes a set of basic descriptors to help the identification of more homogeneous clusters, which are also taken into account for quality control.
In addition, there are systematic differences in the organization of national systems of higher education across Europe, which also have an impact on the comparability of the data collected (i.e. the perimeter of institutional expenditure which may include capital expenditures and ancillary service provisions, or they may not; the delimitation and meaning of staff categories, and so on).
Finally, it should be taken into account that ETER is a sort of "second level" collection performed by integrating data autonomously collected by statistical institutions at the national level by means of different surveys or administrative data. This aspect has implications for ETER data quality since a large part of the statistical production process is out of direct control. Despite efforts toward harmonization and the existence of common standards developed at the international level for most variables, data might be collected in a slightly different manner by country, including a large variety of collection procedures and timeframes. Since ETER relies entirely on data provided by NSAs, these kinds of comparability problems can only be highlighted by the end user, but cannot be solved in any way.
ETER is not only intended for research purposes, but also for providing transparency of the activities of individual HEIs; therefore care has been taken to guarantee the accuracy and the comparability between individual observations.

Dimensions of data quality

Format accuracy refers to the compliance of data with the required format, for each variable (i.e. dates in the format DD.M.YY).

Completeness evaluates the share of missing values and their distribution in ETER.

Consistency verifies possible violations of semantic rules defined over the involved data, and specifically between different variables (i.e. the sum of students by gender should equal the total).

Timeliness evaluates the time lag between the ETER collection date and the Source Release date. Ideally, it should be envisaged to reduce as much as possible this lag, but in the case of ETER, this might come at the price of lowering completeness, because of wide differences among countries.

A systematic approach to validation and quality

To face this situation, ETER has developed a systematic approach where controls of increasing complexity are implemented throughout the whole data collection process.
The first level of checks are already implemented within the data collection files, where users are automatically warned of evident problems, like incorrect sums, remaining blank cells and inconsistent variables (for example an HEI which is labelled as non-research active, yet has a non-null value for R&D expenditures).
The project team implements a second visual check after receiving the data from the NSA. As soon as data are integrated into the database, an automated script is run which controls for the accuracy of the data format, for consistency, and computes a number of ratios, which might allow for the detection of mistakes and problems (e.g.,

students to staff and expenditures to revenues). These kinds of checks allow, for instance, for one to detect mistakes, such as financial amounts provided in thousands rather than in units or numbers of foreign and national students being exchanged.
The third step consists of a thorough analysis of data quality performed on the entire dataset; it includes a statistical analysis of selected indicators for outlier detection, i.e. values that are exceptional in respect to the distribution of data. The stability of data over time is also an important indicator of quality when multiannual data are available (most HEIs are expected to evolve rather slowly over time).
Finally, in suspect cases, external checks were performed by comparing ETER data with external information, which might provide an explanation of deviant data. The national totals of students and graduates were also checked with EUROSTAT statistics at the national level: since definitions are the same, the two totals should be quite similar (at the net of differences in the perimeter). Large deviations found are due to the incompleteness of institutional-level data (PhD students in Germany) or on definitions of students departing from EUROSTAT practices (undergraduate students in Greece).
A full data quality report has been produced for each data collection wave, which contains a computation of quality indicators as well as an overall assessment of data quality.

Solving problems

Once problems have been detected, different approaches were mobilized in order to address them.
In the simplest cases, data are corrected directly by the project team or, when needed, by the NSAs. In many cases, data cannot be corrected because the deviation is due to differences in the underlying data collection: for example, the classification of revenues of HEIs in some countries does not comply with ETER definitions and, therefore, it is not possible to correct the problem with a reasonable effort. In such cases, a flag is appended to the data ("d" = definition differs) and an explanation is inserted into the dataset, to explain the problem to the users.
In many other cases, detected issues are essential and due to the HE system's individual characteristics: for example, in some French cases, HEIs enrol students, but the degrees are awarded elsewhere, leading to large discrepancies between numbers of students and graduates. The Dutch distance university offers courses to students mostly enrolled in other HEIs and therefore the number of students per unit of staff is unexpectedly lower than for traditional universities. Again these cases are annotated in the dataset so that users are aware of these differences and take them into account when using the data.
An additional important source of information is the so-called *metadata*, i.e. detailed information on the data collection methodology for each country: metadata include information on the original data sources, on the reference period for data and on deviations from definitions. Furthermore, for staff and financial data, more in-depth information is provided on the coverage and correspondence with ETER categories. Metadata highlights the presence of some important comparability problems in advance.

Can I trust ETER data?

The final round of data quality controls showed that the ETER dataset has reached a very high level of internal data quality: data are well formatted and internally consistent and most deviant cases have been carefully annotated.
Comparability across countries and with aggregate official figures are slightly more problematic, in most cases for reasons which cannot easily be addressed as they depend on different national structures. The situation concerning staff and finances in this respect is more difficult. The personnel structure of European HEIs differs between

countries: in some countries, PhD students are employed by the university and counted as part staff members, in other countries they are external (self-financed or supported by grants). Concerning finances, accounting systems are widely different across countries: in some countries, HEIs have an accrual accounting system, where large investments are discounted year by year, whereas in other countries such investments are made directly by the State and do not figure into the HEIs own accounts. The extent of inclusion of ancillary services, like housing for students, also differs by country.

Thus far, the experiences earned from using the EUMIDA and ETER data shows that they can indeed provide valuable and robust insights on general patterns of European higher education. Some types of data, particularly staff and financial data, are however less reliable than, for example, data on students and graduates. At the same time, while general patterns are rather robust, individual observations have to be considered more carefully. This is particularly the case when looking at special categories of HEIs, like distance universities or private HEIs, whose accounting system is quite different from the public ones and, therefore, less comparable.

Data quality has to be considered as a permanent task in a project like ETER. Significant improvements in the future can be provided by more in-depth methodological work on classifications of personnel and financial accounting systems of HEIs. Other improvements will be generated by the wide usage of ETER data, as users are likely to remark on deviations from expected patterns and to detect mistakes.

How to access and use ETER

The ETER database provides a detailed set of micro data about Higher Education Institutions for research purposes in the sector. The complexity of the field requires the inclusion of additional information such as metadata, flags and special codes in order to enable the user to cover all aspects in the analysis. Therefore, this chapter will guide the user, beginning with access to the database and data downloads, to some examples of analyses.
The current ETER website provides basic functionalities in order to export data in an excel format and then use it for analysis purposes in statistical software. In the future, it is envisaged to add a number of ready-made tables and visualization tools to allow non-expert users to better exploit ETER content.

How to download ETER data

ETER acquired the consent of National Statistical Data to make the data public. Two types of access are provided:

a) An open public access, where no log in is necessary. In the data available using this access, small numbers referring to persons and all data, for which public access was restricted by national statistical authorities, are coded.
b) A restricted access (*Member Login*), where accredited users receive access to the entire data set for research purposes under the condition that individual data are not disclosed. In order to receive access to all data, interested users have to contact the ETER project team and sign a non-disclosure agreement.

To retrieve data from the website, the user has to follow the subsequent path:

- Access the ETER website (with or without member log in), and select *Download ETER Data*.
- Choose year(s) and country(ies) of interest in and select *Search*.
- Open the export menu (*Export Results / create reports*) and choose the requested variables (*Fields*) and data format (*Export-Type*).
- Alternatively, the whole data set can be downloaded directly by choosing *Download whole Data Set (xlsx)* or *Download whole Data Set (csv)*.
- Select the download symbol in order to start the data export.

Quick guide to ETER

Access the ETER website http://eter.joanneum.at/imdas-eter/

Select Download ETER Data

Choose year(s) and country(ies).

Select *Search*

Open export menu by clicking Export Results / create reports
Choose variables (*Fields*) and data format (*Export-Type*)
Select download symbol 

Download special codes and flags plus the handbook in *Information about ETER data.*

Download country level metadata in *Demographic Events & Metadata.*

Figure 11. ETER website and download of data

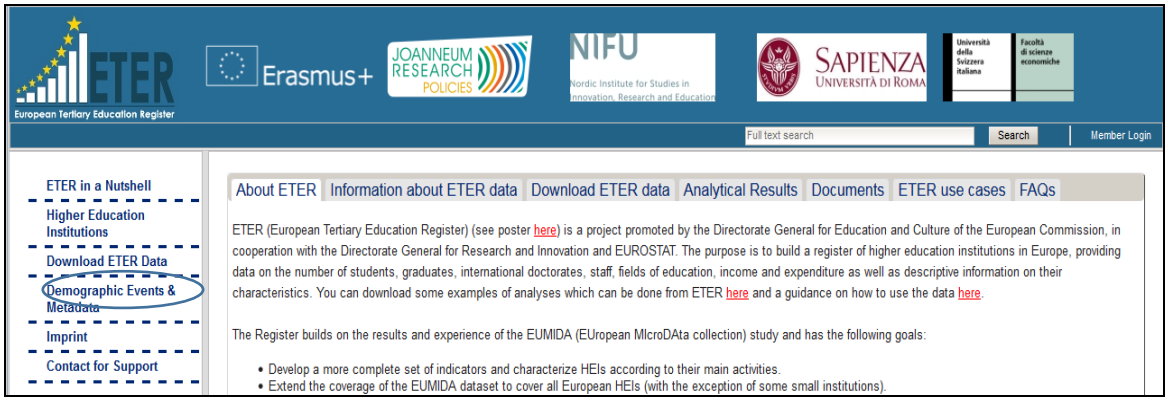
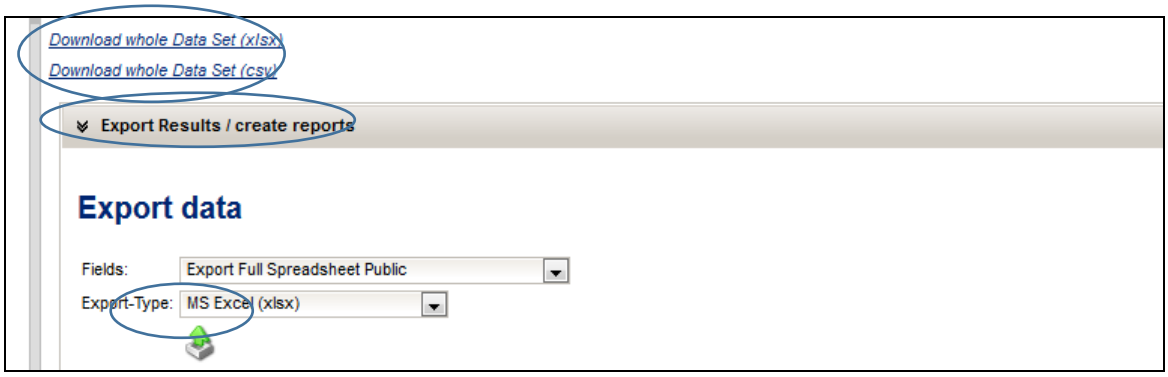


Figure 12. ETER download and export menu



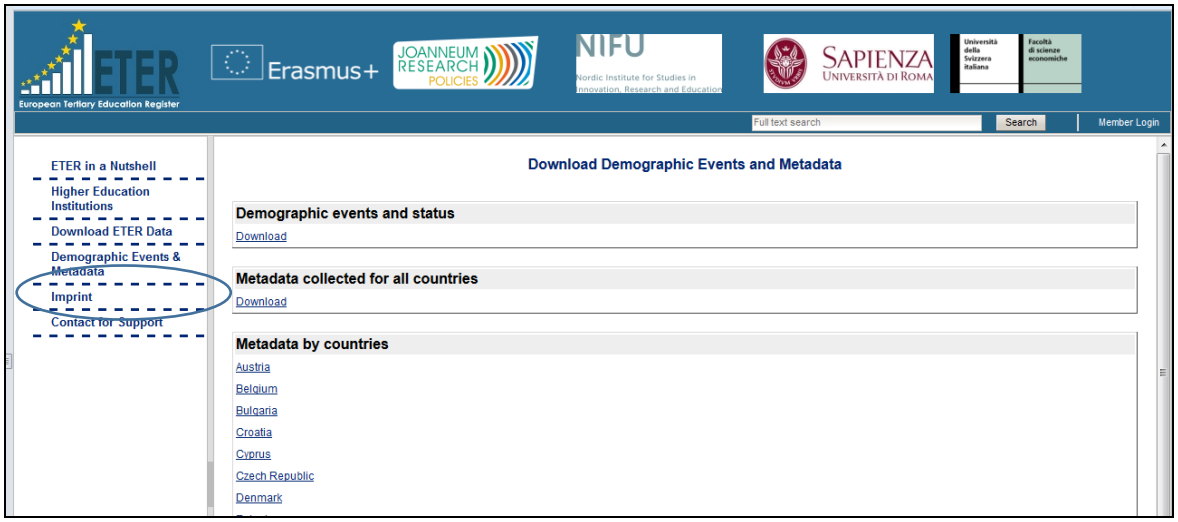
In addition to the data, the user should download information about special codes and flags used in the ETER data set.
Special codes are necessary in order to identify cases where data are not available, for example distinguishing between cases where the data are truly missing ("m"), from cases where the variable is simply not applicable ("a", for example the number of PhD students for an HEI which does not award the PhD degree is obviously not applicable). Special codes need to be considered carefully when doing an analysis; for example, the "not applicable" code could be recoded in many instances as "0" in order to avoid cases that are excluded from the analysis.
On the contrary, flags indicate irregularities or deviations in the data, like cases when the definition underlying the data is not consistent with ETER, and therefore, there might be comparability problems (flag "d"). In most cases, a specific explanation has been added directly in the dataset under "remarks", while more in-depth explanations are provided in the metadata sheet.
A detailed list of the coding system used in ETER can be found on the starting page (*ETER in a Nutshell*) in the tab *Information about ETER data* (see Figure 13).

Figure 13. Special codes and flags used in ETER

Special codes	
a	not applicable
m	missing
x	breakdown not available, but included in total
xc	included in another subcolumn
xr	included in another row
c	confidential
s	value larger than 0 and below or equal to 3 recoded for confidentiality reasons
Data flags	
b	break in time series
d	definition differs
i	see metadata
ic	inconsistent
rd	rounded
c	confidential
ms	missing subcategory

Due to the heterogeneity of the higher education sector within and between countries, metadata at the country level have to be taken into account as a complementary data source when conducting analyses. They provide more detailed information on data sources and delivery dates, departures from definitions and the correspondence between national classifications and ETER categories.
This information can be found on the website by choosing the option *Demographic Events & Metadata*. Within the menu, the user has the possibility to download all metadata at once or metadata by country.

Figure 14. ETER demographic events and metadata



The exported data can be used for further analysis. In order to receive detailed information about the methodology used in ETER and the sources, respective of data limitations, it is also recommended to use the ETER handbook as an additional source when dealing with the ETER data. The handbook can be found in the tab *Information about ETER data* (

Figure 11).

The ETER project team appreciates any information about the usage of ETER data and also offers the possibility to publish the contributions on the ETER website. Publications of analyses using the ETER data should include a reference to the ETER project in the following way: "Data source: ETER project. Download data XXX". Any scientific publications and reports should additionally include the following acknowledgement: "Data have been provided by the European Tertiary Education Register (ETER) as funded by the European Commission under the contract EAC-2013-0308".

Prepare the data for analysis

ETER is a unique statistical database including a large amount of data on the level of Higher Education Institutions. The database provides a good basis for professional usage in higher education research. In order to use the data, some basic competencies in data analysis are needed. A few steps are necessary before importing the data for analyses:

- Special codes have to be replaced by numerical values, depending on the statistical software used in the analysis, in order that they can be interpreted as numerical values. In order to analyse data in SPSS for example, special codes have to be converted to values (e.g. in Excel) and be defined as "missing" in SPSS, while in STATA, default missing codes for numerical values can directly be used (codes like ".a").
- In ETER, data are stored as text in order to enable the usage of special codes. Thus, the data have to be converted into numbers before starting the analysis. While the data should be converted in Excel before importing them into SPSS, STATA allows for the conversion to be made within the program.
- The ETER data set includes different variable codes in order to simplify data collection. For graphical representation and reporting it is useful to label these variable codes within the statistical software used. A list of all variable codes can be found on the ETER website in the tab *Information about ETER data* (see Figure 15).

Figure 15. Examples of variable codes used in ETER

Variable codes	
Legal status	0 = public, 1= private, 2 = private government dependent
Institution Category standardized	0 =other, 1 = university, 2 = university of applied sciences
Foreign Campus	0 = HEI is not a foreign campus, 1 = HEI is a foreign campus
University hospital	1 = HEI has a university hospital, 0 = HEI has not a university hospital
Multi-site institution	0 = not multi-sited, 1 = multi-sited

Analysis of ETER data

The ETER dataset includes a large amount of multilevel data, which allows detailed observations of the European higher education sector to be made. In order to take advantage of the richness of the data, the computation of national aggregates and country averages should be avoided. Instead, detailed analyses of characteristics of single institutions and groups of institutions within countries and also within Europe enable the user to fully exploit the ETER dataset.

There are many useful techniques for presenting ETER data in an understandable way, which can readily be produced using standard statistical software like STATA and SPSS.

Some examples are:

Distribution plots, where the distribution of the score for a certain variable (for example number of academic staff) is plotted for the whole sample of HEIs or for some subgroups (see Figure 25).

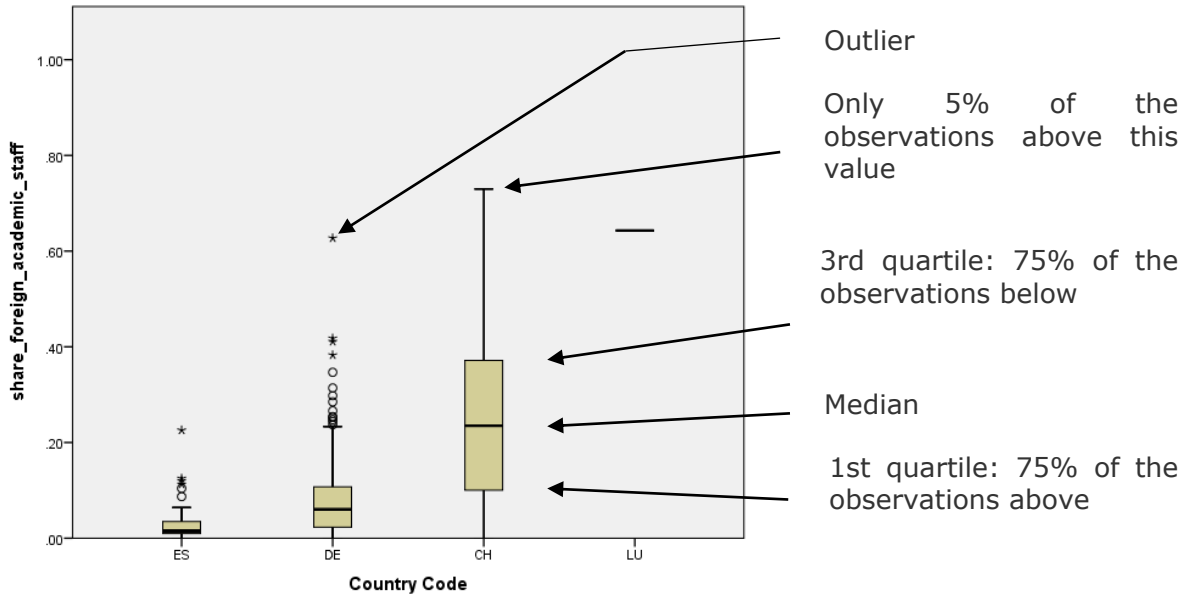
Cumulative percentages, for example displaying the percentage of HEIs founded before a year (see Figure 2).

Cross-tables comparing HEIs between groups (for example comparing public and private HEIs) through the median value of some characteristics (for example the number of academic staff; Table 5). Medians are generally preferred to averages since most of the HEI characteristics are highly skewed.

Distributions of HEI characteristics by countries, for example to display the share of HEIs (in terms of the number of institutions or of enrolled students) by group of size (see Figure 18).

Boxplots are another useful visualization approach, which will be used frequently in this analysis. Boxplots display some essential characteristics of the distribution of observations within a group, for example a country, like its median, 1st and 3rd quartile and the presence of outliers (see Figure 16).

Figure 16. Boxplot of the share of foreign academic staff by country



Thus, they are a choice technique when wishing to analyse both between and within group differences. Figure 16 shows that there are large differences in the average level of foreign academic staff between countries, but also within countries distributions differ: HEIs in Spain are much more homogeneous than those in Switzerland, where there are large within country differences in the level of internationalization.

The European higher education landscape. A characterization

In this chapter, we present some examples of analyses based on ETER, by focusing on some key characteristics of European HEIs, like their size, the importance of private education, and the HEI funding structure. We devote specific analyses to important policy questions like internationalization of the student body and of academic staff, as well as the gender distribution in higher education.
Consistent with the characteristics of ETER, we focus on the distribution of characteristics by HEIs in the whole of ETER, on differences between types of HEIs, for example public vs. private and universities vs. universities of applied sciences and on the differences between countries in the distribution of HEI characteristics.

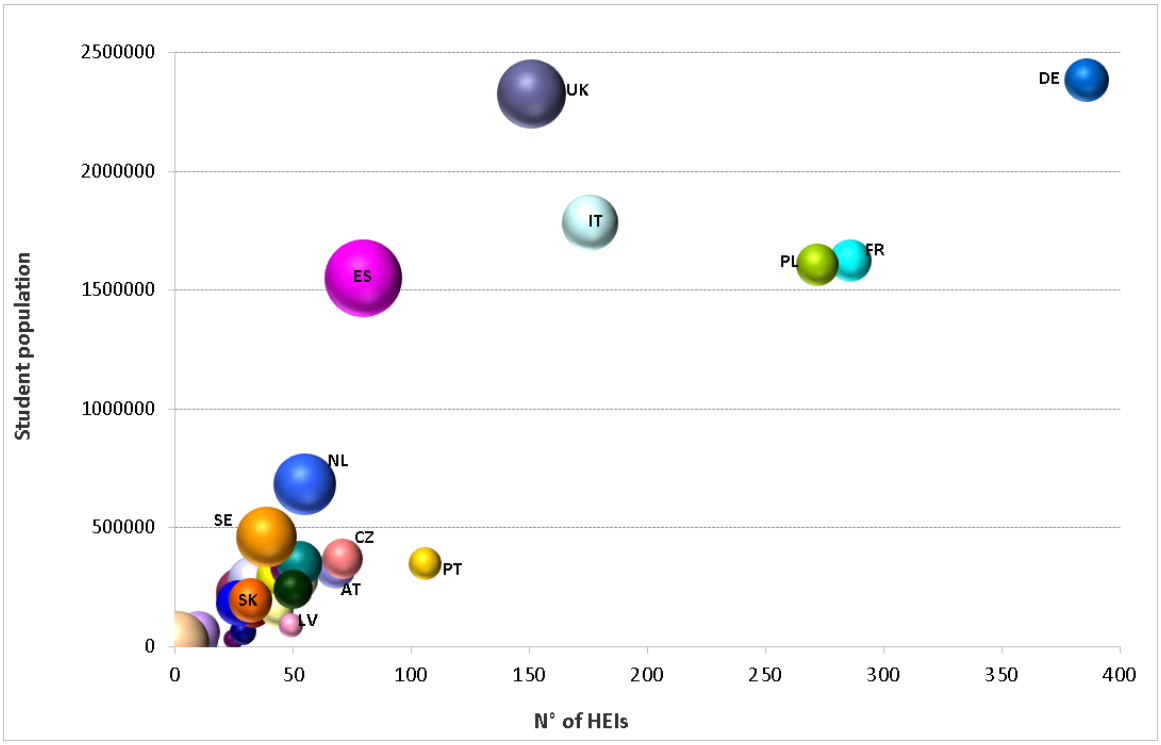
How many HEIs are in Europe and how large are they?

The size of institutions is a relevant aspect often investigated in the analyses of higher education systems and with important policy implications. In general the literature has addressed the issue as one regarding the presence of economies of scale and specialization (e.g. Daraio, Bonaccorsi and Simar 2015a). The relevance of size even goes beyond its importance, since many rankings that receive a great deal of attention from policy makers and the media are systematically biased in favour of old and large institutions (e.g. Daraio, Bonaccorsi and Simar 2015b), while international reputation is closely associated with size (van Raan 2008).
Previous research on the European higher education system (Daraio et al., 2011) indicates that HEIs are unevenly distributed with respect to the size measured by either students or academic staff numbers.
ETER basically confirms these results with a higher coverage of the HE sector and countries.
There are dramatic differences in size among European HEIs, either measured in terms of student body or faculty. The range spreads from micro institutions with no more than 10 students and a few academic staff units, to giant ones enrolling more than 100,000 students and employing more than 5,000 academic staff.
To reduce heterogeneity the ETER perimeter foresees a minimum size threshold of at least 30 academic staff in FTEs and 200 enrolled students. Nevertheless, NSAs have the possibility to apply the rule with a certain degree of flexibility and to adapt to specific national conditions so that the ETER dataset also includes a number of HEIs below the size threshold.
In the whole ETER dataset, the average size of an HEI is 7,352 enrolled ISCED 5-7 students (PhD students are mostly considered as part of the academic staff and, therefore, are not counted here).

The ETER sample

2,293 individual Higher Education Institutions in 31 ERA countries (combined dataset 2011/2012).
16.6 million undergraduate students.
0.5 million PhD students.
1.44 million FTEs of academic staff.
Six large countries with more than 1 million students, 17 middle-size countries and 8 small countries with less than 100,000 students.
Largest numbers of HEIs in Germany (387), France (286), Poland (273).

Figure 17. Number of HEIs, student population and average size by country



As shown in Figure 17, average size (represented by the dimension of the bubble in the chart) is only partially correlated with the dimension of the country. Apart from small countries, which necessarily host smaller HEIs on average, in medium and large countries the average dimension seems more dependent on the higher education system's settlement and diversification, than the total (or student) population. For example, the average size in the Netherlands is double the average size in Germany, which has a population five times larger; the total (and student) population in Hungary and Portugal are quite similar, but in Portugal there are twice the number of HEIs than in Hungary and the average size is one half.
Spain is the country with the highest average size, followed by the United Kingdom, Malta (which only comprises one university in the ETER perimeter), the Netherlands, Sweden and Italy. For Italy the average mixes the university pillar and the non-university institutions, like art schools, whose institutions have a very different size distribution. At the opposite side of the distribution there is a group of small countries with an average small dimension of HEIs (below 3,000 students), which includes Liechtenstein (only one HEI), Cyprus, Latvia, Estonia, and Iceland. The majority of countries are in the middle with average dimensions between 3,000 and 9,000 students.

Profiling European HEIs by size

In addition to heterogeneity, the size distribution of European HEIs is very uneven. There are a large number of very small HEIs and only very few large institutions. Indeed the median HEI has slightly more than 2,500 enrolled students, while the average value is around 7,350. Following previous literature on European higher education systems (Daraio et al. 2011), we describe the size distribution of HEIs in ETER according to a taxonomy including five size categories, defined as follows (based on students, respective academic staff):

- very small (<500 students ISCED5-7, or <50 academic staff);
- small (500–2,000 students ISCED5-7, or 50–200 academic staff);
- medium (2,000–20,000 students ISCED5-7, or 200–2,000 academic staff);
- large (20,000–50,000 students ISCED5-7, or 2,000–5,000 academic staff);
- very large (>50,000 students ISCED5-7, or >5,000 academic staff).

According to the classification based on the student body, 18% of European HEIs are very small, 27% are small, 44% are medium sized, 10% are large and less than 1% very large. Considering different categories and characteristics, the size of the student body is a function of age (young universities are very small or small), the highest degree delivered (doctorate awarding HEIs are larger), and research activity (research active HEIs are larger). The organization model is also very important: not surprisingly the two largest universities in ETER are distance education institutions.

Figure 18 highlights that individual countries show different patterns that partially reflect their overall student population dimension, but also depend on specific settlements. On the one hand we have a group of countries where 60% or more of HEIs are small and very small (AT, CY, CZ, EE, FR, HR, IS, LI, LV, PT), while on the other extreme there are countries where over 80% of the institutions are medium or larger (BE, ES, FI, IE, LU, MT, UK).

Although small and very small HEIs prevail in the ETER dataset, educational activities are concentrated in the larger institutions. Therefore, when looking to the distribution of enrolled students according to the size of the institution, a very different picture emerges: very large HEIs which are less than 1% of the sample enrol almost 10% of total students, while very small HEIs representing almost 1 out of 5 European institutions only account for 0.7% of students. Almost one half of all students are enrolled in medium sized institutions, which therefore constitute the backbone of European HE systems, and a further 39% are accounted for by large HEIs.

The share of students enrolled in small and very small institutions is well below 10% in most European countries, with the noticeable exception of CY, EE, LV, also followed by AT, HR, IS, LT, PT. It is also interesting to note that very large HEIs are present in only eight countries, but in half of them they host more than 25% of total students (AT, ES, HR, IT).

Measures of size

A number of variables in ETER can be used to measure the size of HEIs.

Student populations, defined as the number of enrolled students at level ISCED 5-7.

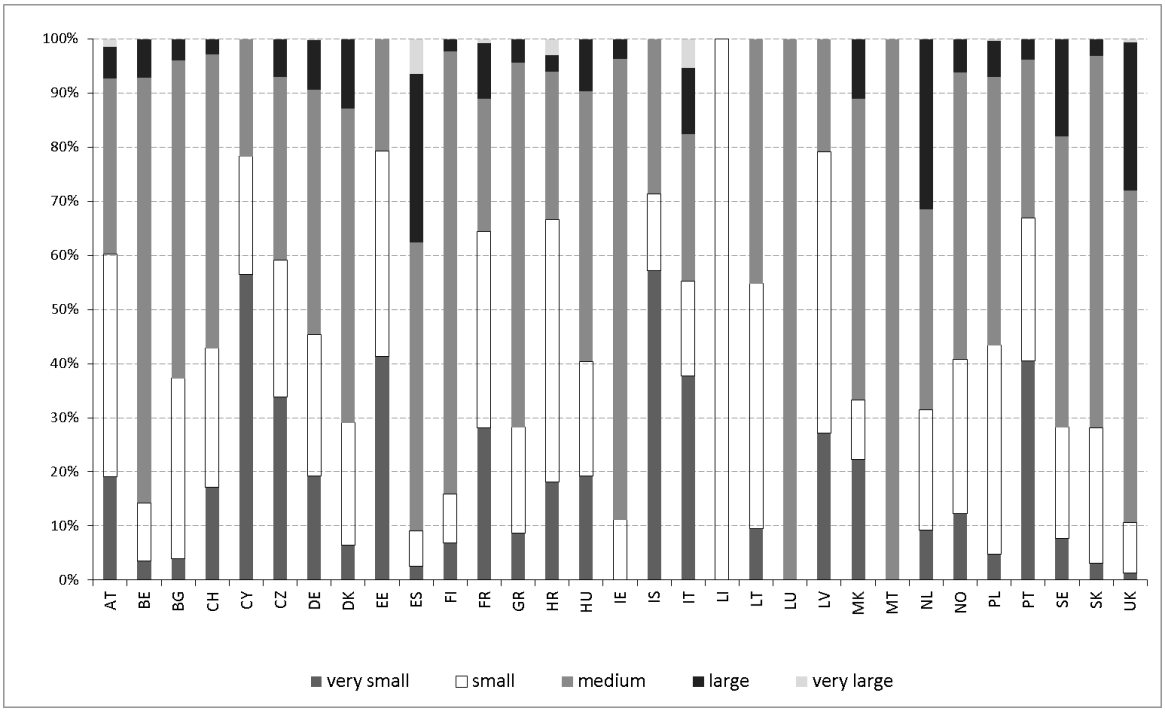
Faculty, here defined as the total number of academic staff in FTE (when available, in HC otherwise).

Financial data (total expenditure or income) might be a further alternative, but it is not considered here because of lower completeness and comparability across country.

ETER variables: "total enrolled students ISCED 5-7"; "total academic staff (FTE)".

Completeness: students 2261 HEIs, academic staff 1557 HEIs (1812 integrating with academic staff in head count) over 2293.

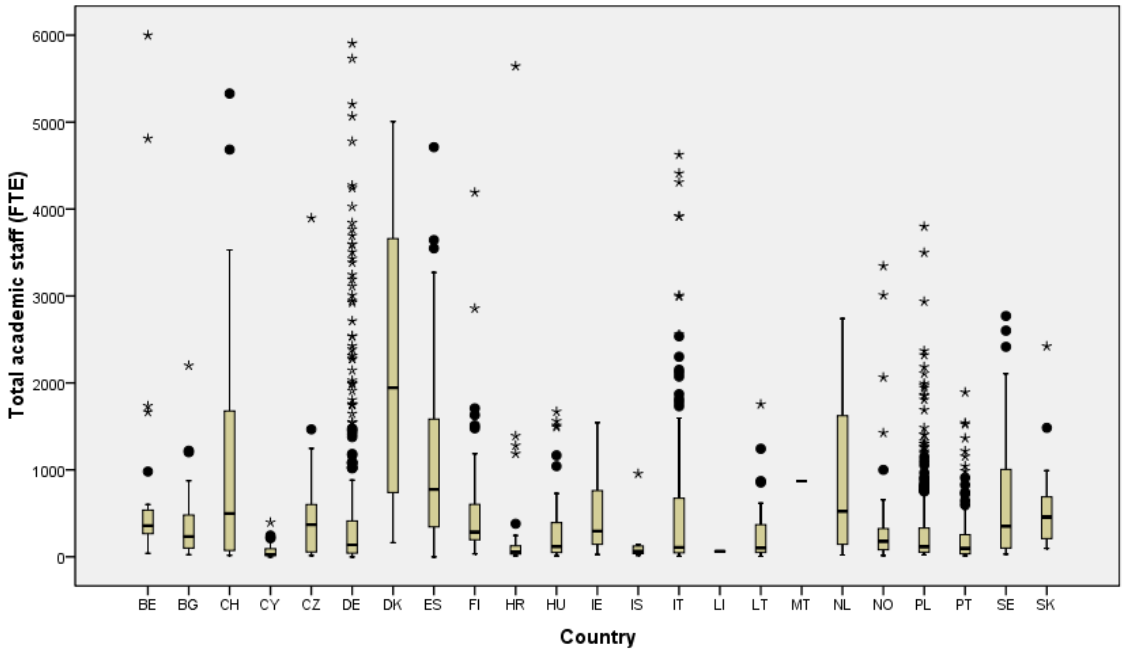
Figure 18. Distribution of HEIs by size and country



Alternative rank: number of academic staff

Considered from the point of view of academic staff, the size distribution of HEIs is more homogeneous since the impact of giant institutions is less evident. The average in this case is 520 academic staff in FTE, with the largest institution almost reaching 6,000 units. The rank of countries with the largest size on average is quite different than the one obtained when looking at students (but note that the availability of data is lower for academic staff and several countries are excluded by the comparison). The inclusion/exclusion of PhD students within academic staff can further distort the comparison across countries. Denmark reports the highest median size of academic staff (but the information could be biased by the availability of data limited to one fourth of HEIs), followed by Spain and Switzerland. The group of countries with smaller institutions is quite stable (LI, CY, IS, PT, LT), while in most countries the average size is in the range 300-900 FTEs.

Figure 19. Distribution of academic staff by country and HEI



There are systematic differences across countries in the staff/student ratio, reflecting different institutional settings but also different levels of investment in higher education.

Looking at the distribution of HEIs in classes based on the size of academic staff, we find that in several countries there is a prevalence of small and very small institutions, which in ten countries represents 60% or more of total HEIs (CY, HR, HU, IS, LI, LT, LV, MK, NO, PL, PT). Very large institutions are only in the UK, DE and in BE, CH, HR with one giant institution each. As expected, the share of students enrolled in HEIs with small or a very small faculty size is generally lower than their respective share in the sample. Only in Latvia is it above 50% of enrolled students, while in BG, GR, HR, HU, IS, LT, MK, NO, PL, PT it is above 15% of total students.

How significant are private HEIs in European Higher Education?

The distinction between public and private organizations is fundamental in most fields of social life, as it marks a profound difference in the mission, governance and activities. This is frequently expressed by the idea that public organizations are steered by the State and oriented towards social goals, whereas private organizations strive for profit (Arellano-Gault, Demortain, Rouillard and Thoenig 2013). In higher education, the situation is more complex (Bozeman and Bretschneider 1994). On the one hand, all HEIs are subject to national policy goals independent of their legal status; on the other hand, with the emergence of New Public Management, public organizations have become more autonomous and are increasingly requested to orient themselves to "customers," (Deiaco, Holmén and McKelvey 2010). Finally, legal status is a poor indicator of the relationships with the State, since HEIs might be legally private (for example owned by foundations), but *de facto* part of the public higher education system.

Many expectations have been put on the expansion of private higher education, especially to cope with the increasing number of students without requiring additional State funds. Moreover, there were expectations on the contribution of private HEIs for research, following the US example where most top-ranked universities are private.

Public and private HEIs

HEIs in ETER are classified in three groups, i.e. *public*, *private independent* and *private government-dependent*.

This definition is the one adopted by EUROSTAT and does not refer to legal status, but to whether a public agency or a private entity has ultimate control over the HEI and has the power to determine the policies and activities of the institution. Therefore, some HEIs might have a private legal status, but nevertheless be considered as public when they are under State jurisdiction.

Private HEIs are divided between government dependent – which either receive more than half of their core funding from government agencies or whose staff are paid by the government – and independent private.

In ETER, the National Statistical Authorities mostly provided this classification.

ETER variable: "legal status".

Variable codes: "0" public, "1" private, "2" private government dependent.

Completeness: 2290 out of 2293 cases available.

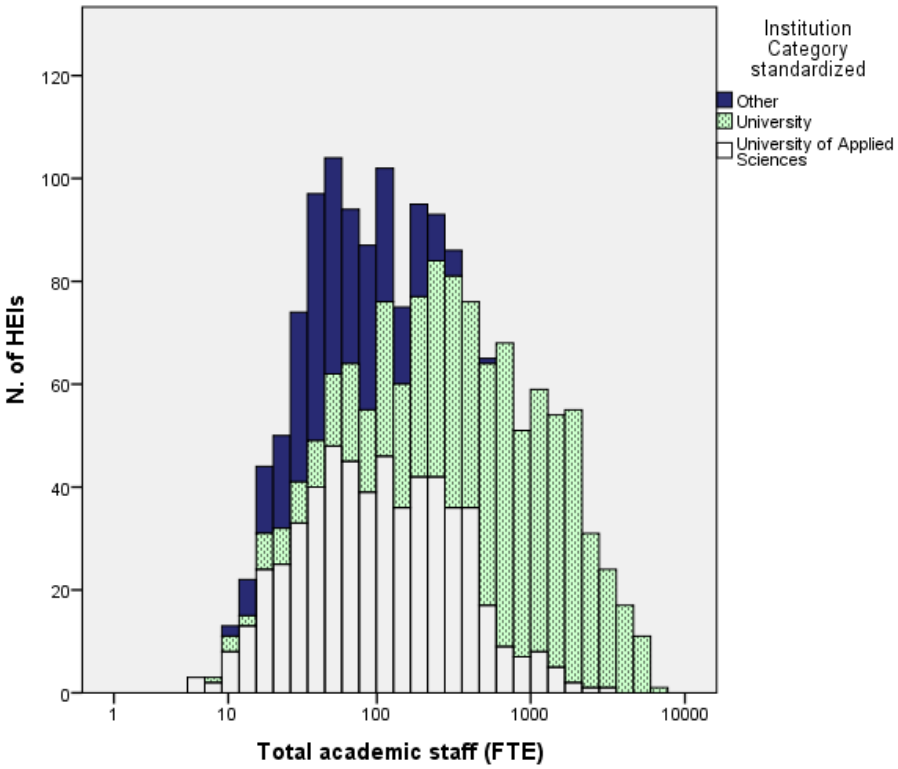
Many private HEIs, but accounting for a small share of educational and research activities

The ETER database includes 1,530 public HEIs, 613 private HEIs and 154 private government-dependent HEIs. Therefore, in Europe, more than one HEI in four is fully private, in terms of control and funding.

When weighted by the number of students, private HEIs account however for less than 8% of undergraduate students (ISCED 5-6) and even less for 2% of the PhD students (ISCED 8). As shown by figure 4, most private HEIs are very small, with less than 100 full-time equivalents of staff (and less than 1,000 undergraduate students).

The private government-dependent HEIs are more similar to public HEIs, reflecting that they are financed by the public sector, but owned by foundations or charities. This group is mainly found in BE, EE and NL and includes both old and reputed universities like Free University in Amsterdam and Catholic University in Leuven.

Figure 20. Distribution of HEIs by their size



Public and private HEIs have different profiles

The indicators included in ETER allow for comparisons between public and private HEIs for some basic dimensions of their activities.

Table 5. Characteristics of HEIs by legal status (median by type)

	Number of HEIs	Total academic staff (FTE)	Total students enrolled ISCED 5-7	Total students enrolled at ISCED 8	PhD intensity	Tuition fees / total budget	Subject concentration education
Public	1526	309	4903	309	.03	.04	.35
Private	613	50	919	37	.02	.57	.60
Private government-dependent	151	150	2455	123	.02	.12	.34

Private HEIs are much smaller, younger (half of them were founded after 1997), more oriented towards teaching and much less research intensive. They are mostly funded by student fees and most are focused on a single educational sector, as demonstrated by the high specialization index (). Finally, they are less internationalized. In other words, private HEIs are mostly niche players in fields where students are willing to pay for their education. The lack of private research-oriented HEIs can partly be explained by the fact that, in most European countries, the largest portion of research funds are allocated through a core State allocation to public HEIs and only a small share from competitive grants.

Private HEIs are more significant in Central and Eastern Europe

Private HEIs play a more important role in Central and Eastern Europe, as a specific outcome of the transformation process, which took place after the end of the Communist regimes (see Figure 21). In Cyprus, private HEIs account for 60% of enrolment of undergraduate students, as explained by the geographical position, which makes the country a privileged place for foreign campuses. The share exceeds 20% in Latvia and Poland, and 10% in Bulgaria, the Czech Republic, Estonia, the former Yugoslav Republic of Macedonia and Slovakia. In Western Europe, only in three countries – Portugal, Spain and Norway – does the share of students in private HEIs exceed 10%. More than half of the undergraduate students in Belgium, Estonia and the Netherlands are enrolled in private government-dependent HEIs, displaying that this model is rooted in specific national traditions.

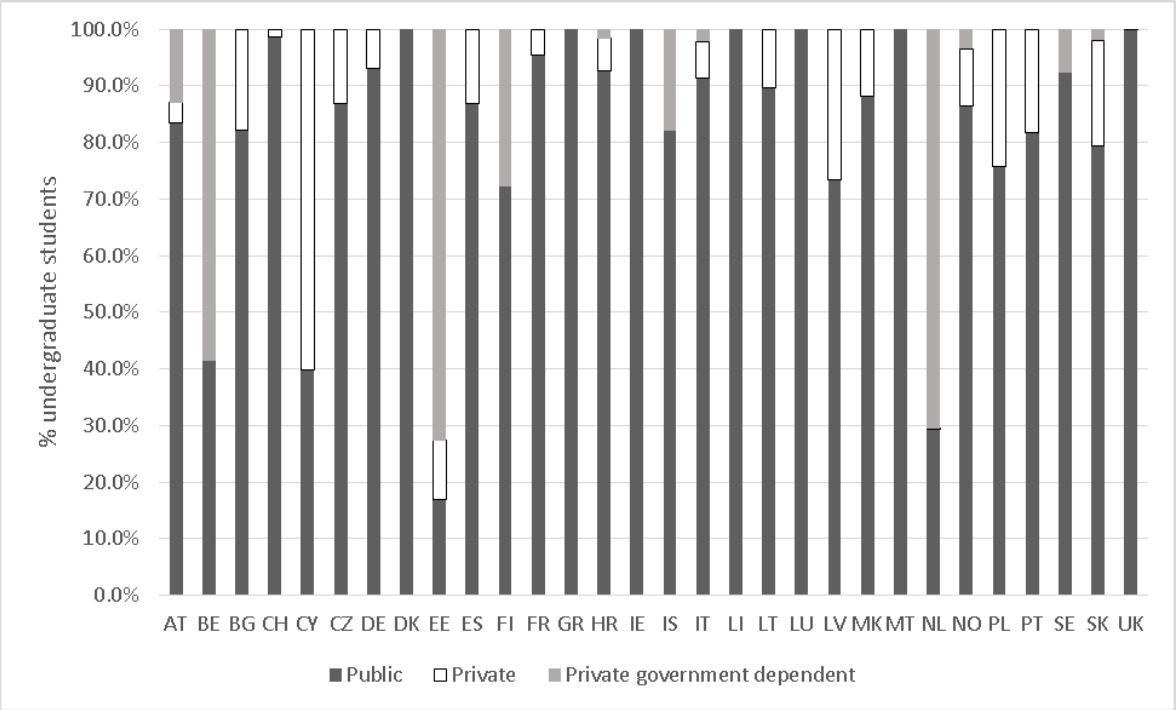
Highlights

Private HEIs account for a limited proportion of European Higher Education, with the exception of Central and Eastern Europe.

They are smaller, more teaching-oriented and more specialized than public HEIs.

HEIs owned by private foundations and charities are an important component of public HEs in Belgium and the Netherlands.

Figure 21. Undergraduate students by HEIs legal status by country



Which HEI types? Unitary and binary systems in Europe

Comparative studies of higher education display strong variations between countries and over time in the structure of national systems and in the "types" of HEIs in each system (Kyvik 2009). While there are obviously many national specificities and categories, the major divide in current higher education is between *unitary systems*, where in principle all HEIs have the same regulatory status, and *binary systems (*de Lourdes Machado, Brites Ferreira, Santiago and Taylor 2008, Lepori and Kyvik 2010). In the latter, there are two official types of HEIs, universities (mostly PhD-awarding) and universities of applied sciences (UAS, mostly non PhD awarding and oriented towards professional education and, sometimes, applied research).

Binary systems have been created from the '60s to respond to a growing demand for education, starting in countries like Germany and the UK. In most countries, the UAS sector was created through consolidation and mergers with pre-existing professional schools, which in this way became formally part of tertiary education (Kyvik 2006). Examples of binary systems are Germany (Fachhochschulen), Switzerland (Fachhochschulen), Netherlands (Hogescholen), and Finland (Polytechnics). This distinction between unitary and binary systems is a dynamic one: The UK established a binary system already in the '60s, which became unitary in 1992 when the Polytechnics were awarded university status (so-called 1992-universities). Conversely, binary systems were created as late as in the '90s in countries like Finland and Switzerland. From the '90s, most countries' UASs also received a research mandate, so the distinction with the university sector became more blurred (Lepori and Kyvik 2010). As a matter of fact, out of the 676 universities of applied sciences included in ETER, two-thirds are classified as research active and 46 have the legal right to award a doctorate, most of them in Ireland, Norway and Slovakia.

The distinction by type is highly relevant as it can be argued that it strongly contributes to internal diversity of higher education systems.

To analyse this aspect, ETER provides a classification of HEIs in three categories, namely universities, universities of applied sciences (reserved to countries, which have a formally binary system) and other HEIs, like colleges, technological institutes, etc. (see box).

Types of HEIs

HEIs in ETER are classified in three groups:

Universities displaying a largely academic orientation (without excluding some focus on applied research) have the right to award the doctorate and can bear the full name of "university" (including variants like technological university, etc.).

Universities of applied sciences have a focus on professional education. In most cases they do not have the right to award a doctorate. This category applies only to countries that have a binary HE system, where these HEIs are given a specific legal status.

Other. All institutions that do not fit the other two types. This includes art schools or private HEIs in some countries, as well as non—university HEIs in countries that don't have a second HE sector (like France and Italy).

ETER variable: "Institutional category standardized".

Variable codes: "0" other, "1" University, "2" University of applied sciences.

Completeness: 2292 out of 2293 cases available.

Types show very different characteristics

As shown by Table 6, ETER includes a large number of non-university type HEIs: out of 2,300 HEIs, only 1,002 are universities, 677 universities of applied sciences and 602 other institutions.

Their characteristics are deeply different, as an outcome of different historical evolutions, missions and public regulations. Other HEIs are mostly very small-scale specialized providers in a single subject field, typical examples being art and music schools. Universities of applied sciences are significantly larger; the median number of students is above 2,000, but some UAS approach 50,000 students. Their focus on education is reflected by the low number of PhD students (most UAS do not have PhD students at all) and by the high share of funding from tuition fees.

On the contrary, universities are older and larger, both in terms of students and staff, cover a larger set of subject domains, as shown by the subject specialization index and are more research-intensive, as shown by the number of PhD students and by the higher share of third-party funds (mostly for research).

We conclude that the typology is not just a political and regulatory distinction, but it is associated to systematically different patterns of activities and HEI characteristics.

Highlights

Non-university HEIs account for 60% of the ETER sample.

Universities of applied sciences play an important role especially for bachelor education.

There is a clear-cut distinction in Europe between systems dominated by universities and binary systems, where UAS enrol a substantial share of the students.

Table 6. Median characteristics of HEI types

	N. of HEIs	Foundation year	Total academic staff (FTE)	Students ISCED 5-7	Students ISCED 8	share third party funds	Share tuition fees	Subject specialization
Other	602	1973	54	635	0	.04	.03	1.00
University	995	1968	575	10216	338	.13	.06	0.27
University of Applied Sciences	677	1994	101	2131	0	.07	.11	0.45

UAS play an important role especially in bachelor education

As shown by Figure 22, more than half of the HEIs in ETER do not belong to the university type. However, patterns are clearly different when looking at the distribution of students, PhD graduates and academic staff. Universities cover the largest part of activities both in education and in research, while other HEIs account for a very small portion of activities. Universities of applied sciences have become an important factor in the European HE system, especially concerning education at the bachelor level, where UAS enrol more than 20% of students.

This picture however conceals deep differences between countries (Figure 22). Consistent with the literature on higher education, we can basically distinguish between two types of systems: the university-dominated system, which includes all large European countries except Germany, and binary systems like Belgium, Germany, Switzerland, Denmark, Ireland, the Netherlands and Norway, where more than one-third of undergraduate students (and most students at the bachelor level) are enrolled in universities of applied sciences. The extreme cases are represented by Belgium and the Netherlands where UAS enrol more than half of undergraduate students.

Figure 22. HEIs by type and activity

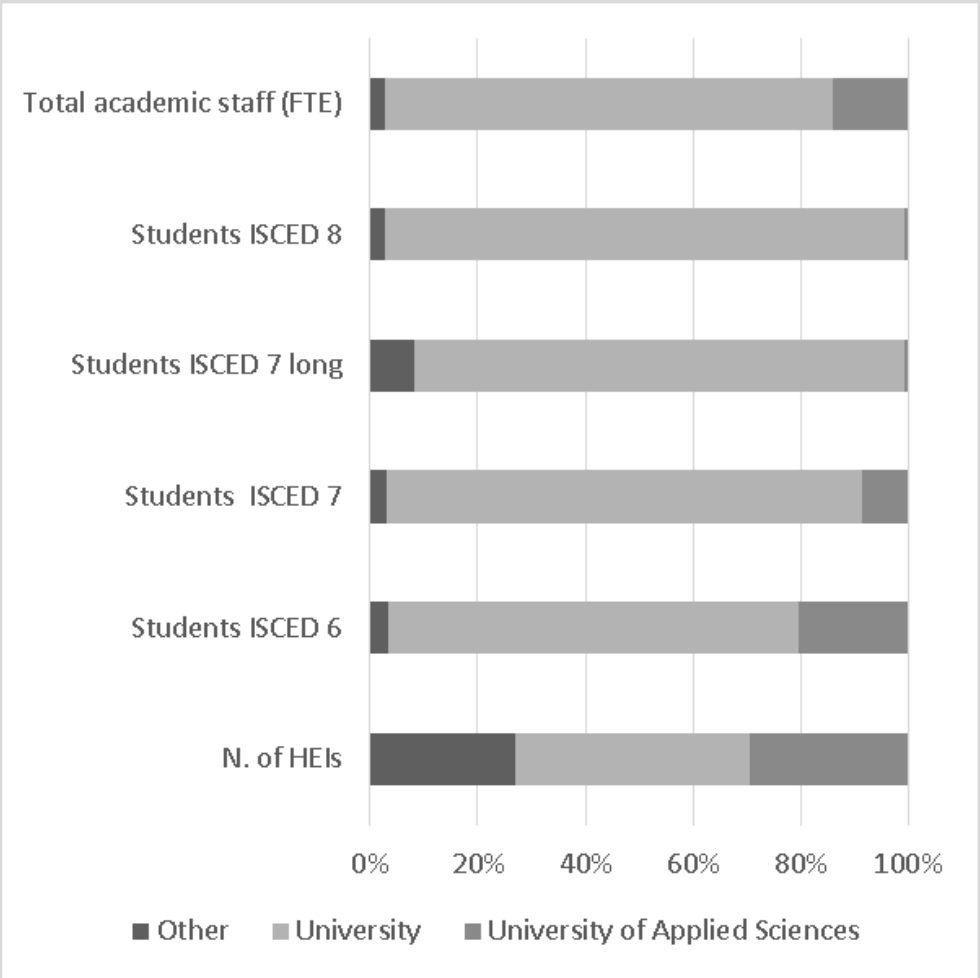
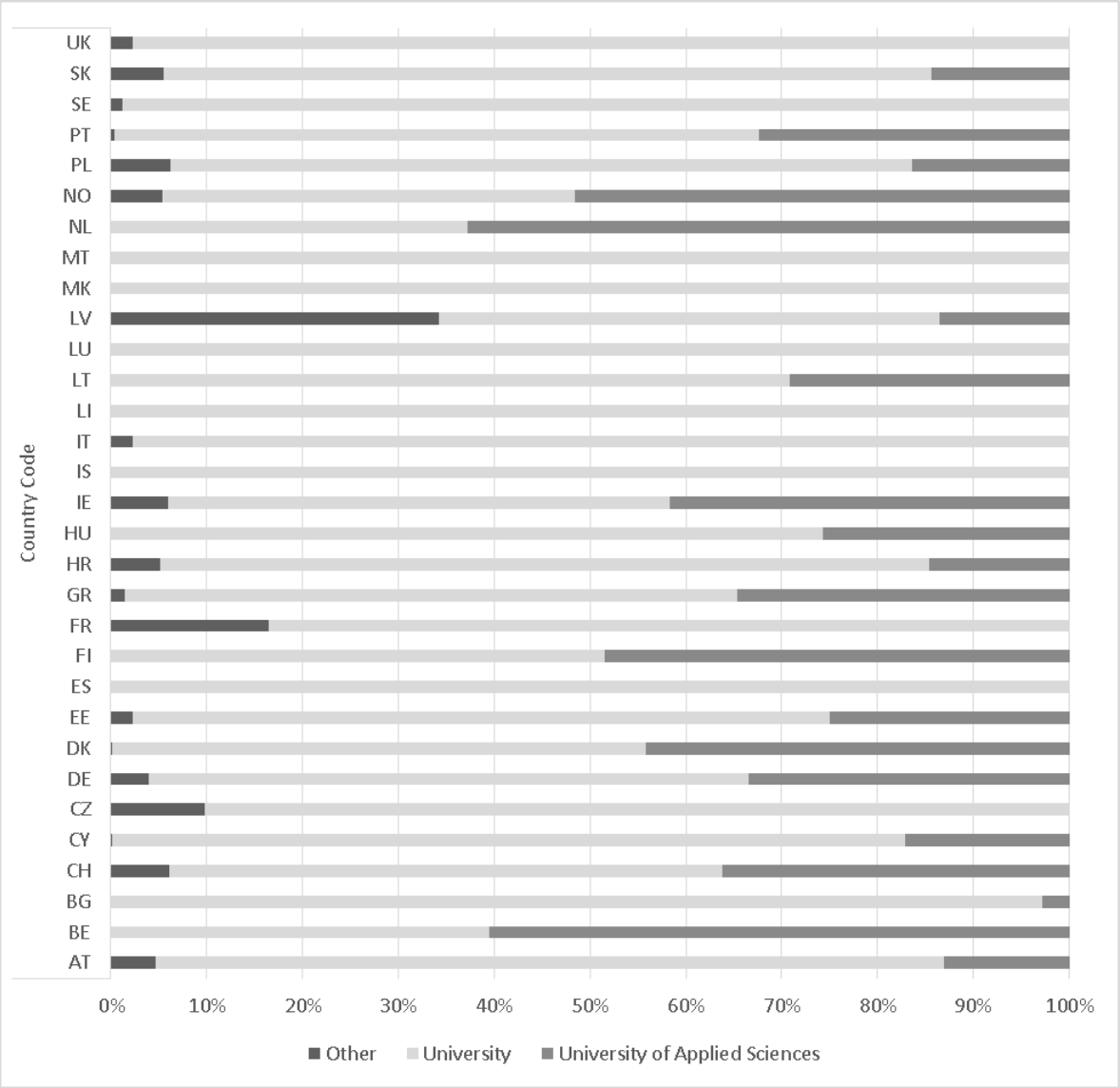


Figure 23. Distribution of undergraduate students by type of HEIs



How are European HEIs funded?

The level and composition of HEI revenues is a central concern for research and educational policies, but also for the HEIs themselves (Jongbloed 2008; Jongbloed and Lepori 2015). Since the '90s, with the introduction of New Public Management (Ferlie, Ashburner, FitzGerald and Pettigrew 1996), many countries in Europe attempted to reform the way higher education is funded, by introducing more competition in the allocation of public funds and by requiring public HEIs to acquire more funds from private companies and students (Teixeira, Jongbloed, Dill and Amaral 2004; Geuna 2001). However, comparative studies display that change in most European countries has been rather gradual, while the UK, with its highly competitive funding system, largely remains an exception (CHEPS 2010; Nieminen and Auranen 2010). In this respect, ETER provides significantly better information than official statistics. Not only are data on revenues for individual HEIs available, but ETER also provides a breakdown of revenues in three categories, i.e. the core budget provided to the HEI for its normal functioning, third-party funds acquired for specific activities, and tuition fees (Lepori, Benninghoff, Jongbloed, Salerno and Slipersaeter 2007). Additionally, data are provided on private funding in the form of contracts, separately from private funding through tuition fees; this is an important measure of the ability of HEIs to finance themselves through the service provision.

Core public allocation is still dominant, except for private HEIs

Despite policy efforts to differentiate HEI's sources of revenues, most European HEIs are essentially funded from the States' core contribution, as shown by Figure 24. Among the 849 HEIs for which data are available, in only 120 does the core contribution correspond to less than half of total revenue. 70 of them are private HEIs, which are funded mostly through student fees. In only three countries is there a sizeable number of public (or private government HEIs) funded mostly by other sources, i.e. Hungary,

Breakdown of revenues

HEI revenues are divided into three categories:

Core budget is defined as funding available for the operations of the whole institution (for example salaries of permanent employees), which are not earmarked to specific activities. In most institutions, the main component of the core budget is the government base grant (either from the national or regional government).

Third-party funding is funding earmarked to specific activities and institutional units, in most cases also limited in time. It specifically includes grants from national and international funding agencies for research activities, funds from charities and non-profit organizations, contracts from public bodies, non-profit organizations and private companies.

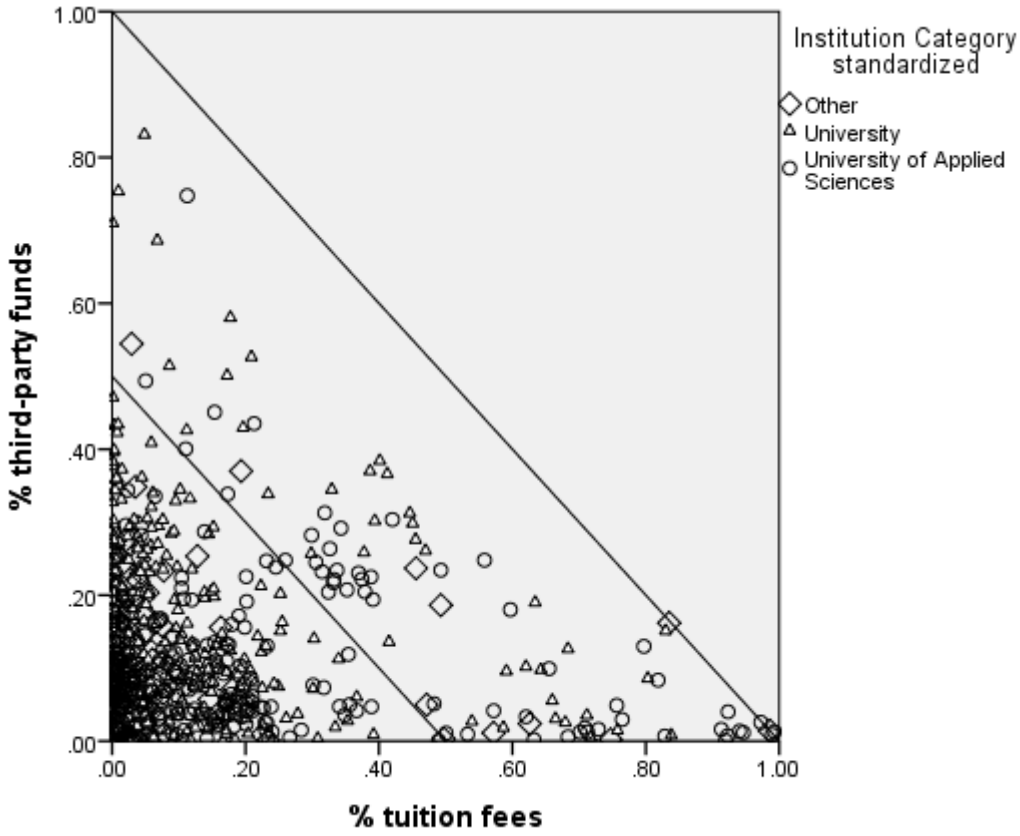
Fees paid by households and students to higher education institutions for participation in educational programs.
Amounts are provided in national currency, in euros at official exchange rates and in Purchasing Power Parities.

Variables. Core budget, Third party funding, Student fees funding.

Completeness. Data available for 1143 HEIs (core budget), 918 HEIs (third-party funds) and 957 HEIS (student fees) over 2293 cases.

Ireland and Lithuania (no data are currently available for the UK).
While private HEIs have a high share of tuition fees funding, HEIs with a large share of third-party funds are more diverse, given that these funds both include public and private contributions. Among the 80 HEIs for which third-party funds constitute more than 30% of their revenue there is a prevalence of medical schools and technical universities, including some highly-reputed international HEIs like Karolinska in Sweden, TU Technische Universität in München, Trinity College in Dublin and many Dutch universities (Leiden, Twente, TU (technical university) Eindhoven). Disciplinary orientation in fields where public and private research funds are more abundant largely influence the ability of HEIs to acquire third-party funds.

Figure 24. Composition of HEI revenues.



The two axes display the percentage of revenues for third-party funds and from tuition fees. The remainder is represented by the core State contribution. Therefore, HEIs on the left-bottom of the chart are totally funded from the core allocation, HEIs along the first line are funded 50% by the core budget, the remaining from tuition fees or third-party funds, and HEIs on the second line have no core allocation.

Finally, data on revenues from the private economy (excluding student fees) display that, despite the emphasis of national research policies on acquiring funds from this source, these remain at most a small complement to public funds; in fact most third-party funds actually come from the public sector. Among the 829 HEIs for which ETER provides data on private funding, only 56 had a share of private funds in the total budget exceeding 10% – some extreme cases might be due to data problems as well – and only 20 exceeded 15%. Expectedly, some universities specialized in technology (TU Delft) or medicine (Karolisnka Instituut) belong to this group. This shows how the

ability to acquire private funds is associated with specializations in engineering and technology.

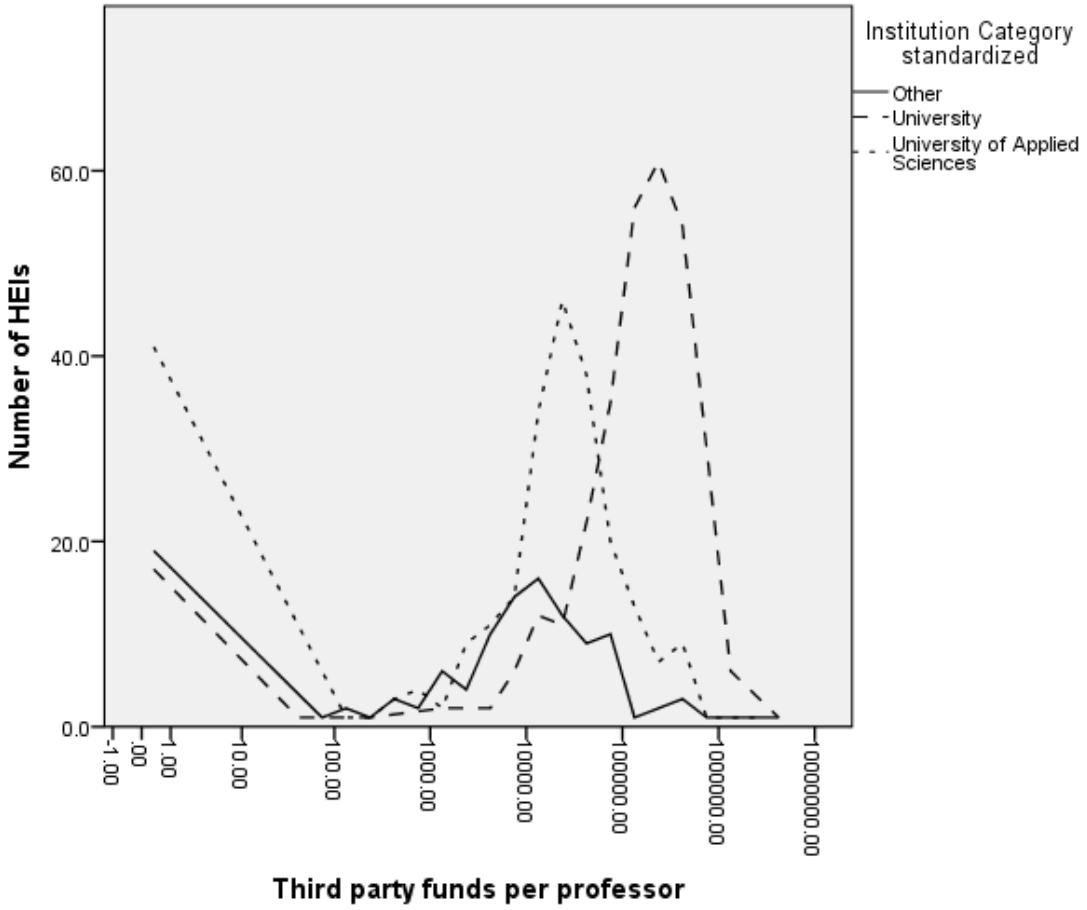
Large differences in the ability to acquire external funds

Differences between HEIs in their ability to acquire third-party funds can be conveniently normalized by the number of professors, as these funds are largely acquired by professors themselves for their research activities. As demonstrated by Figure 25, differences are indeed extremely large. Non-university HEIs have a very low level of such funds; consistent with their lower research orientation. Even between universities, differences are very large. In other words, while core funding is spread across the whole system in order to finance educational activities, third-party funds are more concentrated in a small number of (research-oriented) universities.

Highlights

European HEIs are mostly funded through a core allocation from the State.
Only private HEIs are largely funded through student contributions.
Third-party funds are strongly concentrated in research-oriented universities.
Private funding is quite limited.

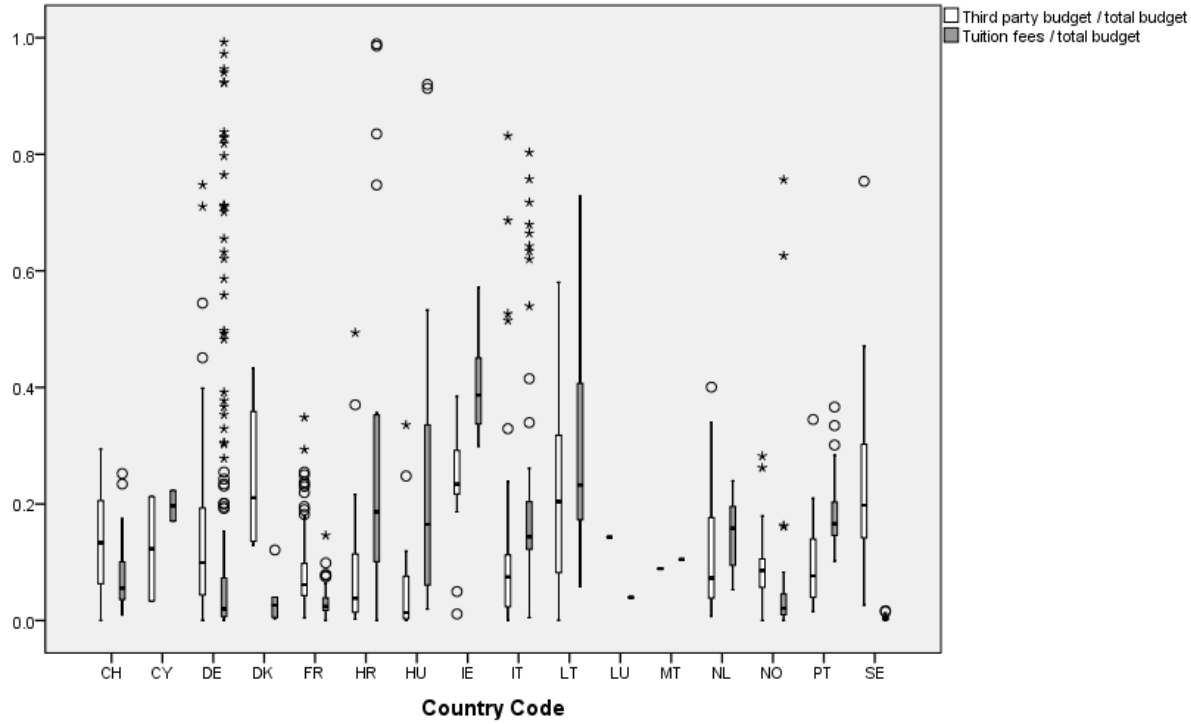
Figure 25. Third party funds per professor in Purchasing Power Parities



Are there significant differences between countries in their provision of external funds?

Figure 26 displays systematic differences between countries in the role of third-party funds and tuition fees in funding higher education.
In some countries, so-called project funds attributed through public funding agencies have a more important role in the distribution of funding to HEIs, particularly for research (Lepori, Dinges, Reale, Slipersaeter, Theves and Van den Besselaar 2007). Among the countries that provided data to ETER, this is the case in Denmark, Ireland, Sweden and Lithuania. In other countries, like Cyprus, Italy and Croatia, HEIs are mostly financed through a core State allocation. The low share of third-party funds in France reflects a system where public-sector research is largely managed and funded through the Centre National de la Recherche Scientifique (CNRS) and its joint units with universities (Theves and Esterle 2005).
The role of tuition fees tends to be much larger in Central and Eastern European countries, see for example in Cyprus, Croatia, Hungary and Lithuania (most other Central and Eastern European countries did not deliver data). Among Western countries, Ireland is the only one where tuition fees are a central source of HEI revenues (ETER does not currently include financial data on the UK). The figure also shows how countries like Germany and Italy are characterized by a number of private HEIs, largely funded through tuition fees, alongside public HEIs mostly funded by the State.

Figure 26. Share of third-party funds and tuition fees over total revenues



Education and research: complementary or segregated?

Education represents, by definition, the central activity of most HEIs within the ETER database. Research on the other hand is present only in the so-called research-active HEIs, which are defined as HEIs having an *institutionalized research mission*.

Most HEIs covered in ETER are research active

Nearly 70% of all HEIs covered in ETER are also research active, while 22% are not and the information for the rest is missing. In several countries, all included HEIs are research active (AT, BE, CH, DE, ES, FI, IE, LI, LU, MT, NL, NO) however in three countries, more than 75% of all covered HEIs are not research active (EE, HR, PT). The research active institutions are also the ones covering most of the academic staff (96%) and students (95% for undergraduate students, 100% for PhD students). There are clear patterns regarding the institution category: while there are very few non-research active universities, the opposite is true for nearly 40% of the universities of applied sciences and nearly half of the other institutions.

The research mission

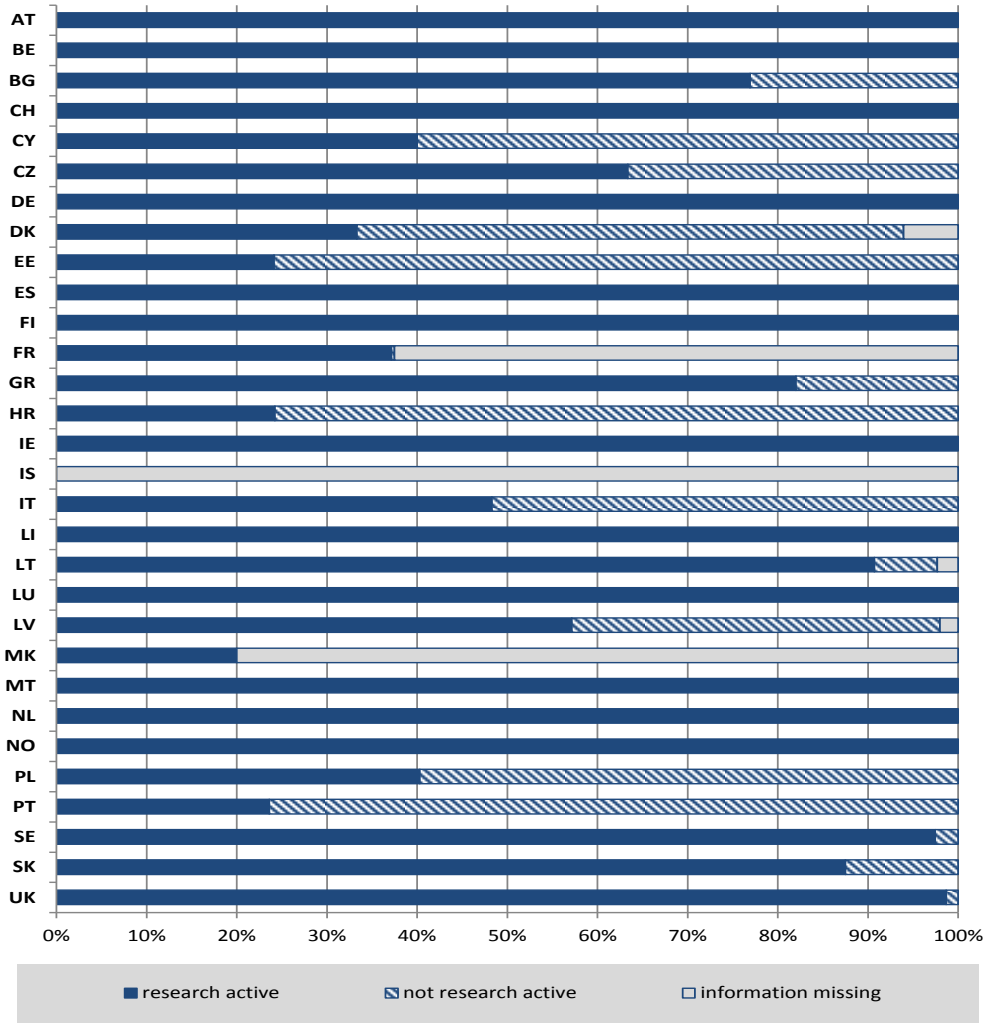
All institutions in the dataset have an education provision in common, therefore, using the variable *Research active institution* allows one to have a look at the relationship between education and research in European HEIs.

ETER variable Research active institution.
Research-active institutions are those having an institutionalised research activity. Criteria for inclusion are the following (at least 3 have to be fulfilled):

- The existence of an official research mandate.
- The existence of research units institutionally recognised (for example on the institutional website).
- Inclusion in the R&D statistics (availability of R&D expenditure data), as a sign of institutionalised research activity.
- Awarding doctorates (ISCED 8 degrees).
- Consideration of research in the institution's strategic objectives and plans.
- Regular funding for research projects either from public agencies or from private companies.

Variable codes:
0 = non-research active, 1 = research active
Completeness:
Available for 2213 over 2293 HEIs.

Figure 27. Distribution of HEIs by research activity and country



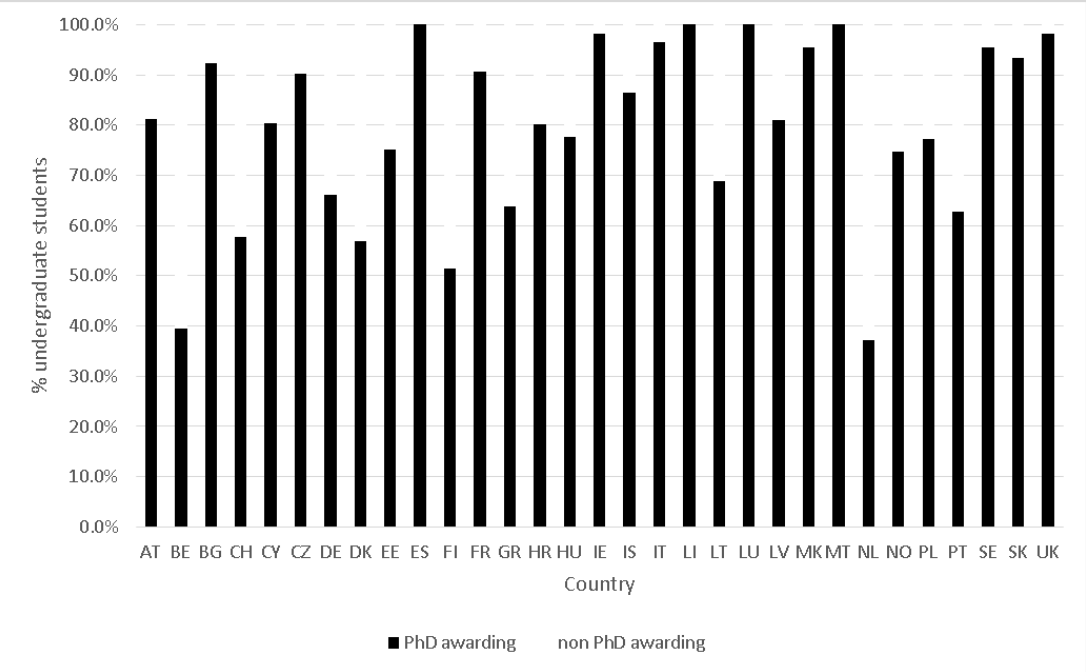
The research mission extended beyond doctorate-awarding universities

Research orientation in Higher Education Institutions is often associated with HEIs offering PhD degrees. Over the whole sample, 47.1% of all HEIs are awarding ISCED 8 degrees, while 49.5% are not. The number of institutions offering PhD degrees is considerably lower than the number of research active institutions, showing that the research mission extends beyond doctorate-awarding universities to also include other types of institutions.

In the UK, SK, IE and ES, most of the covered HEIs award PhD degrees.

The picture is slightly different when considering where undergraduate students are enrolled. Two groups of countries stand out, i.e. those countries where almost all undergraduate students are enrolled in PhD awarding HEIs, like France, Italy, Spain and the UK and the countries where a substantial share of students are enrolled in HEIs which do not award the PhD, particularly universities of applied sciences. These include Belgium, Switzerland, Germany, Denmark, Greece, Lithuania, the Netherlands and Portugal. Separating the education and research mission of an HEI is perceived as positive as it allows research active HEIs to provide advanced training and research for graduate students. On the other hand, a concentration of undergraduates in non-research active HEIs allows for a focus on education and its quality aspects (Bonaccorsi 2009).

Figure 28. Distribution of undergraduate students by HEI level of degree



Large differences in research intensity

The ratio between the number of PhD graduates and undergraduate graduates is an important indicator of the research orientation of PhD-awarding HEIs, as PhDs constitute a large part of the workforce in research (as well as an important research output). It is well known that this indicator is strongly correlated with other indicators of research orientation, like the number of international publications, acquisition of third-party funds and participation in EU framework programmes (Lepori, Heller-Schuh, Scherngell and Barber 2014).

As shown by Figure 29, there are systematic differences between countries in this respect, reflecting the level of national research investment, but also the role of PhD students as a research workforce, which is larger in university-dominated systems than in systems traditionally characterized by strong public-sector research like France and Italy. Most outliers are either graduate schools or research institutes with some educational activities, as well as some medical schools. However, the top-ranked European research universities, like the two Federal Institutes of technology in Zurich and Lausanne or

Highlights

All institutions covered by ETER offer education and nearly 70% are also research active.

In many countries, all included institutions are research active.

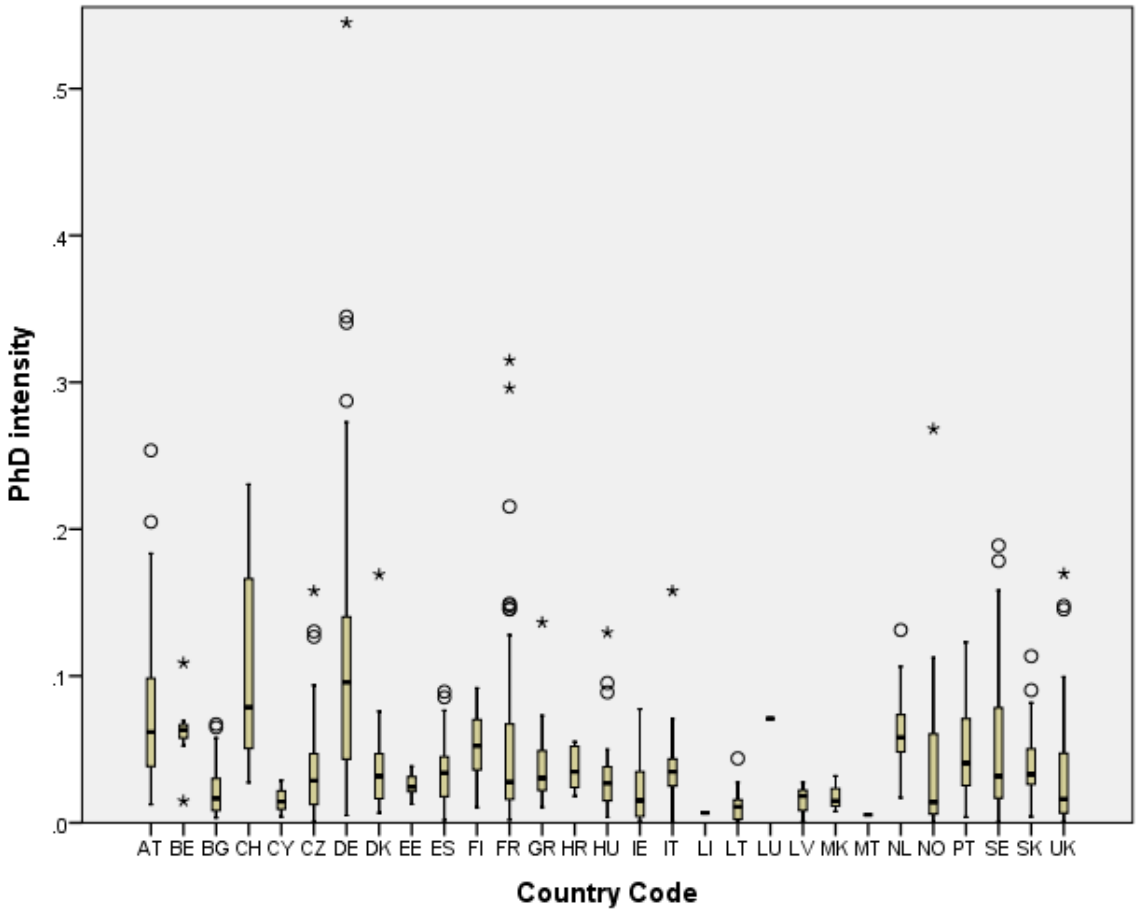
Research active institutions cover most of the staff and undergraduate students and all PhD students.

While few universities are not research active, 40% of universities of applied sciences and half of other institutions are not research active.

The number of research active institutions is considerably larger than PhD awarding HEIs, showing that the research mission extends beyond doctorate

Karolinska and Cambridge, have more than 15 PhD degrees for 100 undergraduate degrees, showing how central graduate education is to their activities.

Figure 29. PhD intensity by country and HEI



Mobility of students and academics in the European Research Area

The international dimension of HEIs is an important concern for European policies. International mobility at the student level is expected to improve educational quality and foster cultural exchanges. International mobility is an increasingly important characteristic of the academic profession (Enders and Musselin 2008) and there is evidence that it is closely related to research productivity, both at the individual (Cruz-Castro and Sanz-Menéndez 2010) and institutional level (Horta 2009).

ETER provides rich data on mobility at the student level, which are disaggregated by educational level, therefore allowing the investigation of changing levels of mobility by educational level. Further, HEI-level data allows for the examination of the extent to which specific characteristics of HEIs are responsible for their internationalization patterns, as well as the interaction with country characteristics. Unfortunately, the availability of data is more limited concerning the internationalization of academic staff.

Mobility and nationality indicators

Foreign Citizenship. The share of students that do not have the nationality of the country in which they study (foreigners).

Data available by ISCED level for students, graduates and for academic staff.

Availability. Data are available for 1,740 HEIs (ISCED 6 students), 1,623 HEIs (ISCED 7 students), 744 HEIs (ISCED 8 students) and for 786 HEIs (academic staff).

Mobility. The share of foreign students that have physically crossed a national border for the purpose of studying. The country of origin is defined as the country of prior education, i.e. the country where upper secondary diploma was obtained.

Data available by ISCED level for students and graduates.

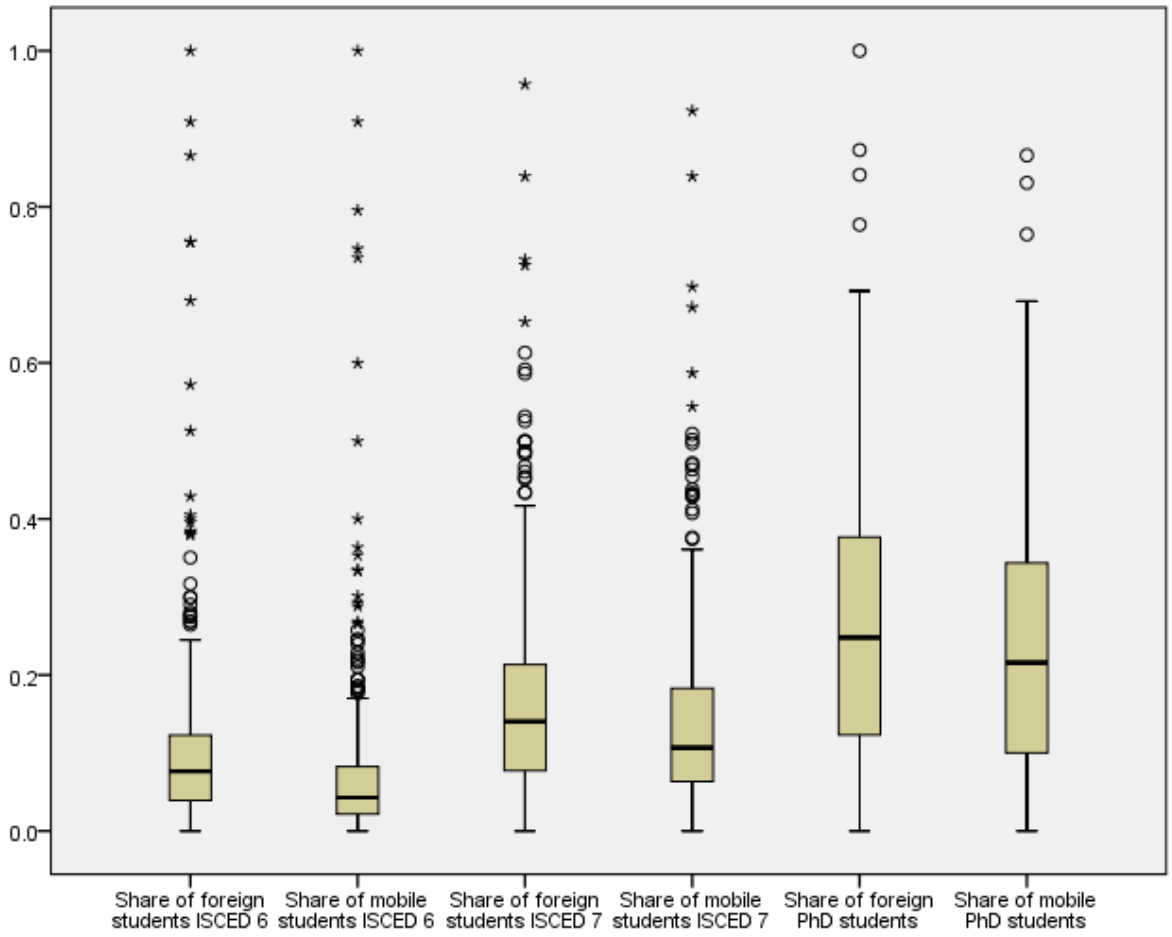
Availability. Data are available for 1,164 HEIs (ISCED 6 students), 1,177 HEIs (ISCED 7 students), 493 HEIs (ISCED 8 students).

Students' mobility increases with educational level

Data on students confirm the expectation that student mobility increases with the level of education (Figure 30); the median share of foreign students is 6.5% at the bachelor level, 11.5% at the master level and 16% for PhD graduates.

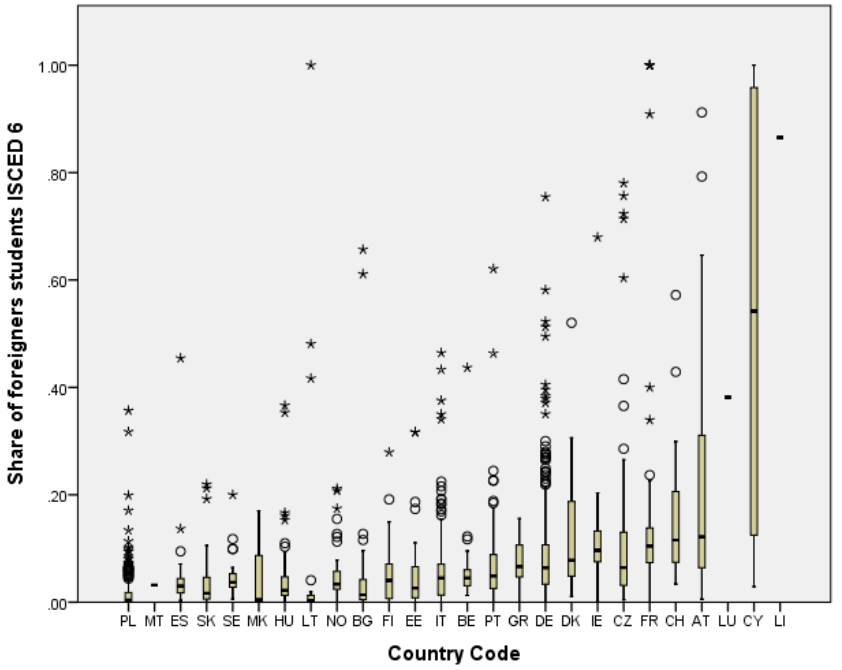
Differences in the level of internationalization between HEIs also increases by educational level and is particularly large for PhD students, suggesting that at this level, mobility is indeed based on quality. The increase from the bachelor to the master level indicates that the Bologna reform has the expected effect of favouring student mobility at the interface between bachelor and master. Data for mobile students and graduates are expectedly lower (median 4% for bachelor and 9.6% for master); for PhD graduates, data are not comparable since the data coverage is different.

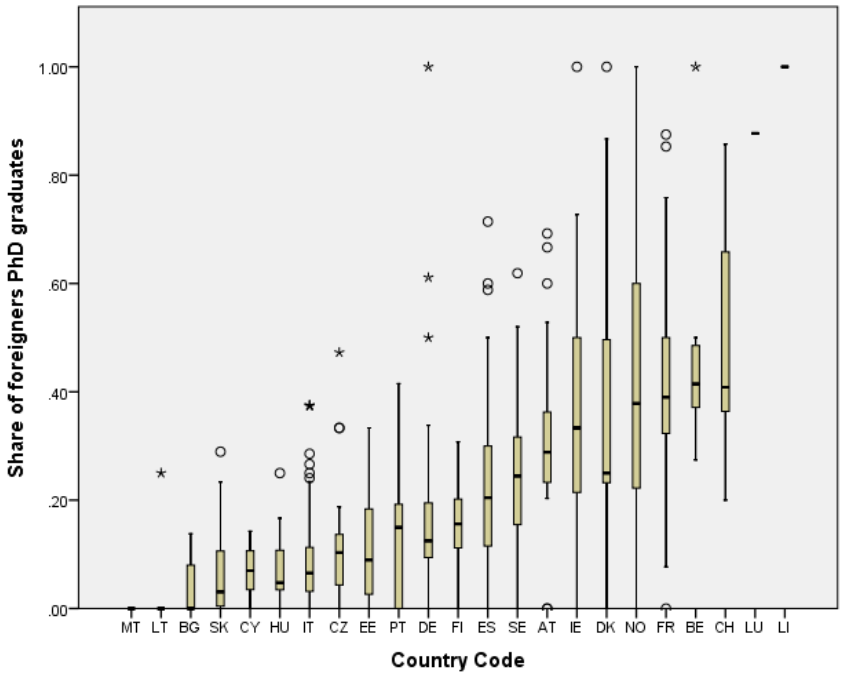
Figure 30. Share of foreign students by degree level



Country comparisons display similar patterns (Figure 31). For undergraduate students, differences in internationality are quite limited both between and within countries; very international countries are either very small (Luxembourg and Liechtenstein), strongly focused on international education (Cyprus), or share a language with neighbouring countries (Austria, Belgium and Switzerland).

Figure 31. Share of foreign undergraduate students (top) and of foreign PhD students (bottom)





Patterns for PhD graduates (on the right in the figure) are very different. The share of foreign PhD graduates exceeds 40% in Switzerland, Belgium and Norway, but goes down to a few per cent in Eastern Europe and in Italy. National differences are associated with research-intensive countries, but also with countries with past colonies like France. Differences between HEIs in the same country are also rather large, especially for highly internationalized countries like Ireland, Norway and Switzerland.

Large variations in the internationalization of academic staff

Data on the internationalization of academic staff are somewhat more limited, as only 11 countries provided this information (including very small countries like Malta, Luxembourg and Liechtenstein; Figure 32).

However, since these data are not provided by EUROSTAT, they represent an important advance in the understanding of the internationalization of European HEIs.

Data are consistent with previous works based on EUMIDA data (Lepori, Seeber and Bonaccorsi 2014). There are large differences in the internationalization of academic staff between countries, with those European countries that are wealthier and have higher research investment (like Switzerland, Sweden and Finland) being more international than Mediterranean countries like Spain, Portugal and Italy. Further, in internationalized countries there are large differences between HEIs, driven by their international reputation and research orientation, whereas all HEIs in the less internationalized countries have few international staff. This displays the extent to which internationally reputed HEIs in these countries have difficulties in internationalizing, as shown by Italian and Spanish universities.

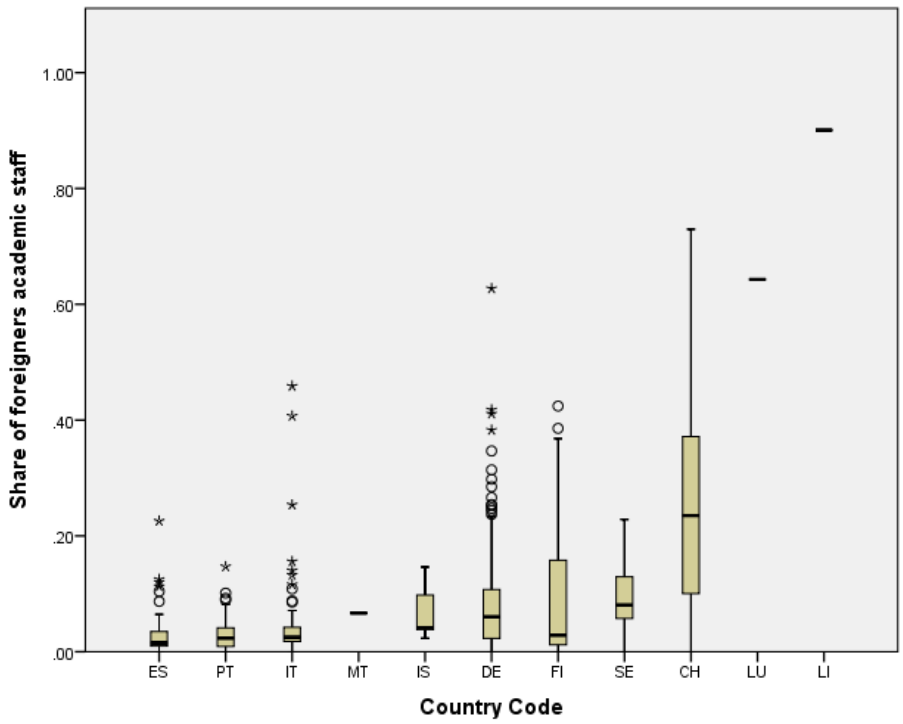
Highlights

Mobility of students increases strongly with the educational level from the bachelor to the master to the PhD.

Country differences in internationalization of undergraduate students are limited, while for PhDs they are much larger.

There are large differences in the internationalization of academic staff, driven by international reputation and national investment in R&D.

Figure 32. Share of foreign academic staff



Gender equality at European higher education institutions

The objective of increasing gender equality in academia has been an important political goal for quite a while, both at the European Union level, at the country level and in most Higher Education Institutions. However, cross-country comparative data on gender in higher education have, until ETER was launched, only been available at the national level through She Figures[2]. These figures have repeatedly shown that women's careers in academia are characterized by vertical segregation, with a majority of females among students and graduates, while men are still dominating the top positions in academia.

These patterns are remarkably stable over time, and they exist across countries. Common metaphors used to describe these patterns are "glass ceiling" and "leaking pipeline", and these two concepts describe two ways of interpreting the finding. The glass ceiling illustrates the fact that women to a lesser extent than men occupy the top positions in academia. According to Bain and Cummings 2000, the glass ceiling in academia is embedded in the cultural and economic contexts, which are different from country to country. In addition to this, organizational structures and traditions that are specific to a certain type of institution, as well as in different disciplines, may also have an impact on the various shapes and forms the glass ceilings can take. The leaking pipeline can be seen as a way to understand the gender patterns of academia (White 2004, Wolfinger, Mason and Goulden 2008, Xu 2008), while tracking women and men's careers in higher education, from student to a successful academic. The principal argument in this metaphor is that more women than men leave academia while working their way up the career ladder.

However, a Swedish study indicates that men are leaving higher education at the same or at an even higher pace than women at each level they reach beyond recruitment to doctoral studies. Nevertheless, women have a slower career development than men, and this is the assumed reason why it takes longer for women to receive the credentials that will give them access to full professorship. Similar findings were found in a Norwegian study in 2008 (Gunnes and Hovdhaugen 2008),

Gender in ETER

ETER collects data on gender of students, graduates, doctoral students, doctoral graduates, academic staff, as well as among professors at the level of individual HEIs.

Calculation of share of women in HEI = (number of women)/(number of men+number of women).

Unclassified cases are excluded from the comparison.

Completeness. Data are available for 1856 of the HEIs and 26 countries for ISCED 6 students, 1719 and 29 countries for ISCED 7, 829 HEIs and 29 countries for ISCED 8, 1364 of HEIs and 21 countries for academic staff and 1206 of the HEIs and 21 countries for full professors.

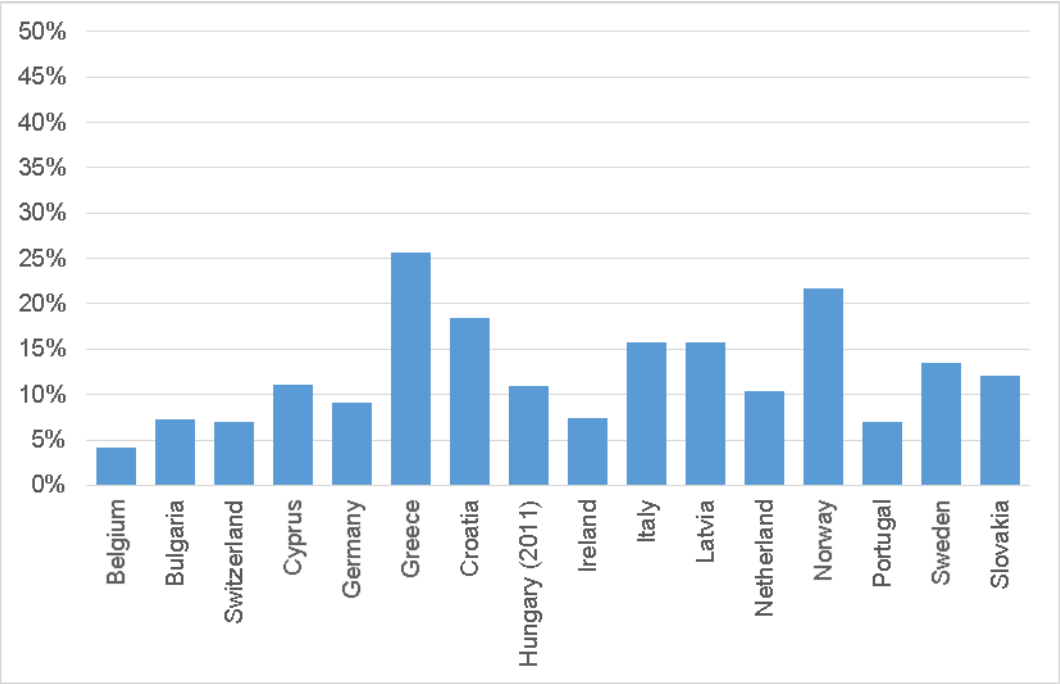
[2] She Figures is a publication of a set of indicators on women in science and research. This data set has been collected and published every three years from 2003, and the forth publication was made public in 2012. The data collection is undertaken by the Directorate-General for Research and Innovation of the European Commission, in cooperation with the Helsinki Group and its sub-group of Statistical Correspondents (European Commission 2012). See: http://open-data.europa.eu/data/dataset/she-figures-2013-gender-in-research-and-innovation.

and both studies indicate that there are large differences between disciplines, especially at the level of full professorship.
Hence, when analysing gender differences in the recruitment to different positions at European higher education institutions, it is important to take the composition of disciplines at an institution into account as well as the varying employment structures and how easy/hard it is to obtain a position as a full professor (Vabø et al. 2012). There are large variations between countries and institutions in their share of full professors out of total academic staff.

Is the share of female professors related to the share of professors among academic staff?

In this analysis, we explore the hypothesis that females are more likely to become professors in countries where professors constitute a large share of academic staff. Hence, as a point of departure, we will look at differences in the composition of academic staff at universities in countries where we have information on gender related to staff in general and professors. In this analysis we only use data on universities as the share of professors varies widely among other types of institutions.
Figure 33 shows that Croatia, Greece, Italy, Latvia and Norway are among the countries in Europe where professors constitute a relatively high share of all academic staff, over 15 per cent. At the other end of the scale, Belgium has less than 5 per cent of academic staff holding a professorship, while Bulgaria, Switzerland, Ireland and Portugal have 6-7 per cent. Hence, there are very different countries that fall in the same category, which indicates that this is related to the historical development of the higher education system in that specific country or that it is related to the career structure in academia in that country.

Figure 33. Share of full professors among total academic staff at universities in selected countries: 2012.



However, when turning to the share of females among academic staff and full professors at universities in European countries, we do not find the same pattern. Among countries where professors constitute a larger share of academic staff, Croatia and Latvia are the only two countries that also have a high rate of female full

professors (30%). The other three countries that have relatively high shares of professors among academic staff have a share that is on par with the average for women: 24 per cent for Norway, 21 per cent for Italy and 20 per cent for Greece. At the other end of the scale, we find that Belgium and Switzerland have relatively few female professors, and professors also constitute a relatively small share of all academic staff in these two countries. However, Bulgaria, Ireland and Portugal do not follow this pattern, as their share of female professors is close to or above average. Hence, it does not look as if the share of professors among academics in general can explain the share of female professors in a country. However, it may contribute to the explanation in some countries, but certainly not in all.

Figure 34 displays the difference in percentage points between the share of females among academic staff and full professors within a country.

Highlights

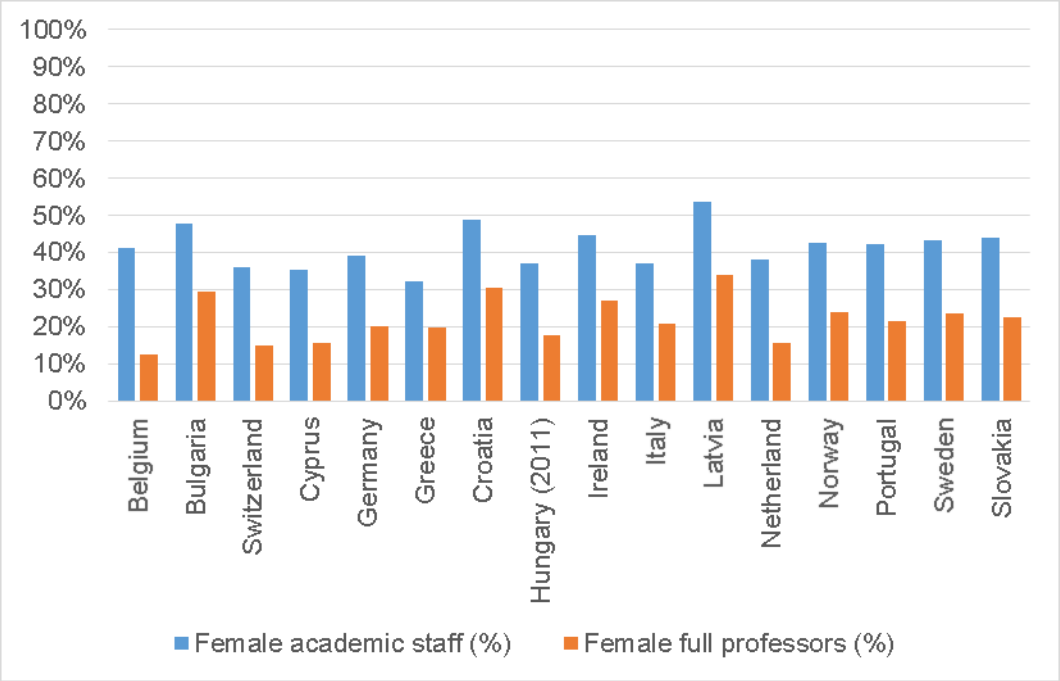
Gender equality has been reached in most European HEIs for undergraduate students and PhD students.

The median share of females among academic staff is now 40%.

The share of female professors in European higher education is very low (median 20%), even if there are large differences between countries and HEIs in this respect.

Time series data should be used in order to fully understand and explain differences in the share of female professors among European universities and how this has changed over time. In addition, there are, as mentioned earlier, many other historical and contextual factors as well as discipline differences, which contribute to explaining differences both in the share of women among academics and the share of women among professors.

Figure 34. Share of women among academic staff and full professors at universities in selected countries: 2012.



Subject domains: specialized vs. generalist HEIs?

The heterogeneity of higher education systems in Europe is a well-known phenomenon and has therefore been addressed in many studies. Specialization by subject domain in individual HEIs has a strong impact on heterogeneity, not only at the European level, but also on differences between institutions within countries. The impact of different subject compositions are manifold. The subject mix of a Higher Education Institution for example, affects the resources and the interaction between institutions and the environment (Lepori, Probst and Baschung 2010). Also, the internal organization and the production process of research and education strongly depend on the subject domains of an HEI (Jongbloed, Salerno and Kaiser 2003).

Generalist institutions vs. specialized HEIs

In this analysis, the Herfindahl index, calculated by the distribution of undergraduate students, is used to measure the concentration of subject specialization in HEIs.
Based on this distribution, we distinguish three groups of HEIs:

- *Generalist HEIs* with a Herfindal Index below 0.3, which implies that a single field cannot enrol more than half of all students (636 HEIs).
- *Focused HEIs* with a Herfindal Index between 0.3 and 0.7; this implies that there is one dominant field, constituting at least half of all students, but other fields account for a substantial share (633 HEIs).
- *Specialist HEIs,* with a Herfindal Index above 0.7, which implies that a single field comprises at least 80% of all students (628 HEIs).

These groups of HEIs have very different characteristics. Expectedly, generalist HEIs are much larger and enrol more students and PhD students, while the specialist HEIs are mostly very small-scale.
As a matter of fact, generalist HEIs, which constitute only one-third of the whole sample, account for about 70% of total staff and enrolled students (see Table 3).

Subject specialization

The ***Herfindahl index*** can be used to measure concentration of subject specialization within HEIs:

$$Herfindahl = \frac{1}{n^2} * \sum_{j=1}^{N} n\, n_j^2$$

n_j = number of students in subject j
N = number of fields of education.

ETER variable. Students ISCED 5-7 by field of education (undergraduate students)
ISCED fields of education (FoE 2011):

- 00: General programmes and qualifications
- 01: Education
- 02: Humanities and Arts
- 03: Social Sciences
- 04: Business and law
- 05: Natural Science, mathematics and statistics
- 06: Information and communication technologies
- 07: Engineering, manufacturing and construction
- 08: Agriculture, forestry, fisheries and veterinary
- 09: Health and welfare
- 10: Services

Completeness. Subject specialization for undergraduate students (ISCED5-7) is available for 1,897 out of 2,293 HEIs in ETER.

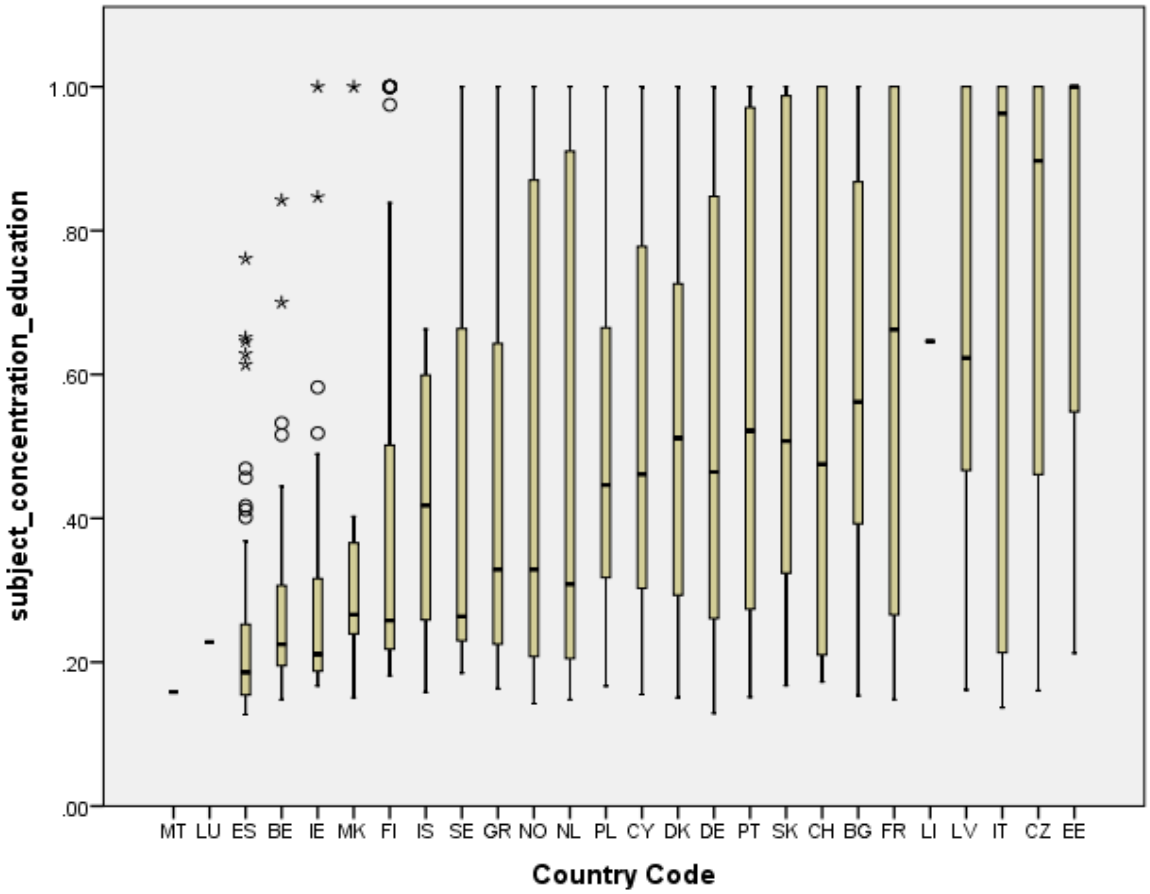
Table 7. Characteristics of HEIs by level of specialization (median)

	N. of HEIs	Total academic staff (FTE)	Total students enrolled ISCED 5-7	Total students enrolled at ISCED 8	PhD intensity	Tuition fees / total budget	Subject specialization
Generalist	633	606	10482	482	0.04	0.06	0.21
Focused	629	115	2391	151	0.03	0.05	0.46
Specialist	628	57	622	50	0.05	0.05	1.00

Generalist vs. specialized HEIs: A country comparison

A comparison of the distribution of HEIs by specialization and countries shows that some countries like Italy, Estonia and the Czech Republic have a large number of specialized HEIs, which means that these institutions have a high concentration of students in a few subjects. On the contrary, Spain, Belgium and Ireland have many institutions where students are divided between many disciplines (Figure 35).

Figure 35. Distribution of subject specialization by countries



Specialization in universities, universities of applied sciences and other institutions

The ETER data also allows for a distinction by institutional category, which means universities, universities of applied sciences and other institutions. While many universities are generalist institutions, there also exists a remarkable group of specialized ones. Universities of applied sciences are more likely to be specialized than universities, while other institutions, which include very specialized schools in arts, music, theology etc., are mostly focused on one single discipline.

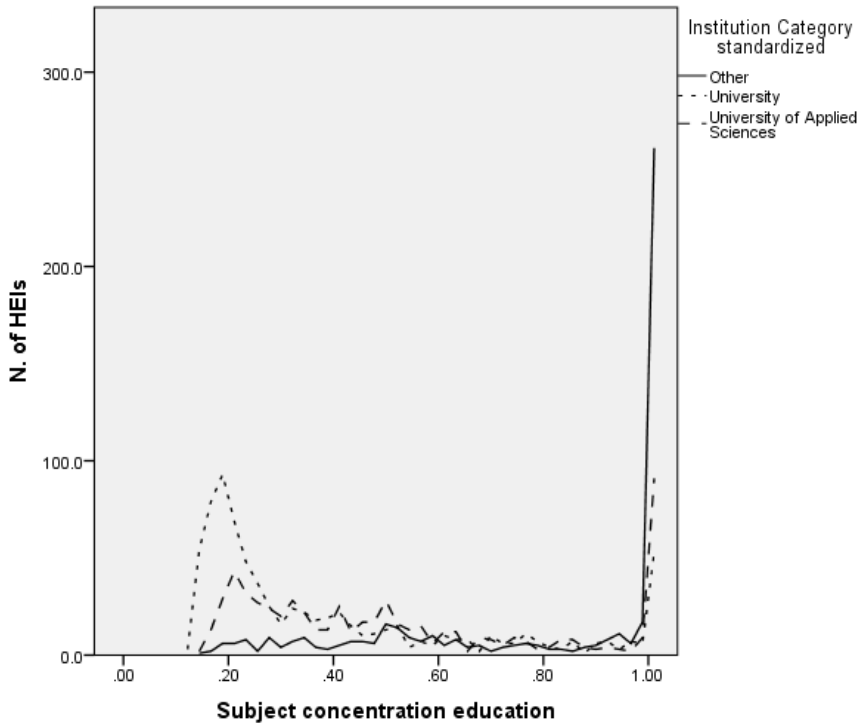
Highlights

A classification of institutions covered in ETER into three groups of HEIs (generalist institutions, focused HEIs, specialized HEIs and institutions between both groups) showed that the numbers of institutions within these groups are equally distributed in the dataset.

While general institutions dominate some countries, other countries have large numbers of specialized HEIs.

While universities of applied sciences are far more likely to be specialized than universities, most "other" institutions (e.g. schools of arts, music, theology etc.) are mono-disciplinary.

Figure 36. Frequency distribution of the Herfindahl index by institution category



The way ahead. Establishing ETER

In the past two years, the ETER project has provided significant advances in the establishment of a database of European Higher Education Institutions, which provide basic data on European HEIs with a reasonable level of quality and comparability. It moved from the EUMIDA project, which demonstrated the feasibility of such a database, towards the establishment of a regular data collection, which can be repeated every year. Systematic standards for data validation and quality control have also been introduced, thus increasing the quality and trust of the data. Even more importantly, data have been made public under the same usage conditions as Eurostat statistics, i.e. users can freely download and use data for their own purposes. Therefore, ETER breaks with a long tradition of private databases on universities, where only some indicators are available to users, but not the individual micro-data.
The importance of this achievement has rapidly been recognized by the European Commission, the National Statistical Authorities, and by users. A new contract began in August 2015: it will ensure the continuity of data collection for the next two years, addressing a number of methodological problems identified in the first phase and focusing on the exploitation and dissemination of the dataset, in order to also make policy-makers and other potential users aware of its potential.
Despite its achievements, the study also identified a number of challenges that need to be addressed in the next phase in order to build a sustainable long-term instrument for the transparency of European higher education.

a) *Extending the coverage of countries*. Among the 36 ERA countries covered by ETER, the following countries/systems did not provide data: the French part of Belgium, Romania, Slovenia, Montenegro, Serbia and Turkey.
Reasons for non-delivery are different depending on the country. In the French part of Belgium, the governance of higher education was subject to a major reform in 2012/2013, and therefore no suitable contact point for ETER existed; however attempts at contact resumed at the end of 2014, with the expectation that they will join the new ETER data collection. In the two other EU countries, the main issues are represented by confidentiality problems and by the lack of NSA resources. Contact with the three non-EU countries yet to deliver data have been more difficult and did not lead to a positive outcome beyond the delivery of a list of HEIs.
The stabilization of ETER as a long-term data collection project and its broader usage are likely to push some of these countries to join the project. Targeted action by the European Commission to address not only the National Statistical Authorities, but also higher education and research ministries, will be important as well.

b) *Providing more information on professional tertiary education*. ETER is expected to cover all tertiary education, i.e. the ISCED-2011 levels 5 (short-cycle diplomas), 6 (bachelor), 7 (master) and 8 (PhD). Overall, for the countries that delivered data, ETER included 87% of total student numbers at the tertiary level provided by EUROSTAT in 2012. In fact, while coverage in ETER at the bachelor, master and PhD level is very good, the coverage of short diplomas is quite limited. This is largely due to a different structure of professional tertiary education as explained in section 0.
These observations suggest that, while it would indeed be important to provide more information on professional tertiary education, simply extending the perimeter of ETER by including additional HEIs is not a feasible option. The identification of groups of institutions, to be characterized collectively, is suggested as a more feasible approach, which should be further tested.

c) *Low data availability and comparability problems for financial data and staff data.* A major outcome of the current ETER contract has been to consolidate and formalize the methodological approach developed in EUMIDA and to be able to collect most of the requested variables. The ETER handbook has been progressively extended and made more precise thanks to the feedback received from the NSAs, which constitutes a solid basis for the long-term development of ETER.
In terms of completeness, the current ETER database reaches a satisfactory level of 75%, meaning that three-quarters of the requested data and breakdowns are available for the HEIs included in the data collection. However, there are some clear issues concerning staff data (availability around 60%) and of financial data, where availability is below 50%.
Information collected by the ETER project shows that limited availability of staff and financial data is not due to the fact that these figures do not exist: at least for public HEIs, numbers of personnel and budgets are routinely reported to the State and, in most countries, they are even made public. However, there are considerable differences between countries in how these figures are produced. This also implied that the effort for NSAs to map data on staff and finances to the ETER definitions was and could be substantial. The quality analysis performed on the ETER data also highlighted a number of comparability problems for these variables.
The consortium therefore considers that a key condition to improve financial and staff data in ETER will be the development of specific definitions and methodological guidelines, beyond those currently provided by the UOE manual for education statistics, also taking into account the specific characteristics of higher education. Given the fact that national classification systems for staff and finances differ widely, the establishment of concordance schemes with the ETER categories will be highly important to improve comparability and to reduce the burden for data collection.
d) *Improving the usability of the ETER dataset and disseminating results*. The ETER database raised substantial interest, as shown by the number of visitors and number of dataset downloads, particularly thanks to the fact that data can be downloaded freely. There are also signs that ETER is becoming a reference dataset on European higher education and is starting to be used in different analyses and projects as a source of data on European Higher Education.
At the same time, the visibility of ETER showed that access to the data could be made more user friendly, particularly for the policy-relevant audience. Of course, ETER is mostly a statistical database and the main usage of such data will remain for the purposes of statistical analysis. However, access to the data can be made easier through a consequent redesign of the Website and access pathways from the data. At the same time the current structure of the database would allow, with a reasonable effort, the delivery of some ready-made analyses and visualizations on European higher education for a more general audience, like policymakers and journalists. This is likely to strongly boost the visibility and impact of ETER.
Beyond these advances, a long-term issue will be represented by the development of a sustainable business model for ETER. ETER clearly represents a public infrastructure, which should be made available to the broadest possible range of users and where access to micro-data is essential for exploitation. At the same time, continuity will be important as well, since the availability of the time series in ETER will boost its analytical value.

References

Aghion, P., Dewatripont, M., Hoxby, C., Mas-Colell, A. & Sapir, A. (2010). The governance and performance of universities: evidence from Europe and the US. Economic Policy, 25(61), 7-59.

Albarrán, P., Crespo, J. A., Ortuno, I. & Ruiz-Castillo, J. (2010). A comparison of the scientific performance of the US and the European Union at the turn of the 21st century. Scientometrics, 85(1), 329-344.

Arellano-Gault, D., Demortain, D., Rouillard, C. & Thoenig, J. (2013). Bringing Public Organization and Organizing Back In. Organization Studies, 34(2), 145-167.

Bain, O. & Cummings, W. (2000). Academe's Glass Ceiling: Societal, Professional-Organizational, and Institutional Barriers to the Career Advancement of Academic Women. Comparative Education Review, 44(4), 493-514.

Barré, R. (2001). Sense and nonsense of S&T productivity indicators. The Contribution of European Socio-Economic Research to the Benchmarking of RTD Policies in Europe. Proceedings of a Conference Organised by the European Commission Directorate General for Research, Brussels, March 15-16, 2001.

Bogetoft, P., Fried, H. O. & Vanden Eeckaut, P. (2007). The university benchmarker: An interactive computer approach. In A. Bonaccorsi & C. Daraio(Eds.) Universities and Strategic Knowledge Creation. Specialization and Performance in Europe (pp. 443-462). Bodmin, Cornwall: MPG Books Limited.

Bonaccorsi, A. (2009). Division of academic labour is limited by the size of the market. strategy and differentiation of european universities in doctoral education. In M. McKelvey & M. Holmén(Eds.) Learning to compete in European universities (pp. 90-127). Cheltenham: Edward Elgar.

Bonaccorsi, A., Daraio, C., & Simar, L. (2013). Scale and scope using directional distances with an application on European universities data. Paper Presented at the Workshop ASE Bucharest, 4 April 2013, DIAG Technical Report to Appear.

Bonaccorsi, A. & Daraio, C. (2007). Universities and Strategic Knowledge Creation. Specialization and Performance in Europe Cheltenham: Edwar Elgar.

Bozeman, B. & Bretschneider, S. (1994). The "publicness puzzle" in organization theory: A test of alternative explanations of differences between public and private organizations. Journal of Public Administration Research and Theory, 4(2), 197-224.

Brinkman, P. T. & Leslie, L. L. (1986). Economies of Scale in Higher Education: Sixty Years of Research. Review of Higher Education, 10(1), 1-28.

CHEPS (2010). Progress in Higher Education Reform in Europe. Funding Reform Brussels: European Commission.

Clark, B. R. (1983). The Higher Education System. Academic Organization in Cross-National Perspective. Berkeley: University of California Press.

Commission of the European communities (2000). Towards a European research area - Communication from the Commission to the Council, the European Parliament, the Economic and Social Committee and the Committee of the Regions. Brussels: European Commission.

Cruz-Castro, L. & Sanz-Menéndez, L. (2010). Mobility versus job stability: Assessing tenure and productivity outcomes. 39, 27-38.

Daraio, C., Bonaccorsi, A. & Simar, L. (2015a). Efficiency and economies of scale and specialization in European universities: A directional distance approach. Journal of Informetrics, 9(3), 430-448.

Daraio, C., Bonaccorsi, A. & Simar, L. (2015b). Rankings and university performance: a conditional multidimensional approach. European Journal of Operational Research, 244(3), 918-930.

Daraio, C., Bonaccorsi, A., Geuna, A., Lepori, B. & et. al. (2011). The European university landscape: a micro characterization based on evidence from the Aquameth project. Research Policy, 40(1), 148-164.

de Lourdes Machado, M., Brites Ferreira, J., Santiago, R. & Taylor, J. (2008). Reframing the non-university sector in europe: Convergence or diversity? In J. Taylor, J. Brites Ferreira, M. de Lourdes Machado & R. Santiago(Eds.) Non-university higher education in Europe (pp. 243-259). Dordrecht: Springer.

Deiaco, E., Holmén, M. & McKelvey, M. (2010). What does it mean conceptually that universities compete? In M. McKelvey & M. Holmén(Eds.) Learning to compete in European Universities (pp. 300-328). Cheltenam: Edward Elgar.

Dosi, G., Llerena, P. & Labini, M. S. (2006). The relationships between science, technologies and their industrial exploitation: An illustration through the myths and realities of the so-called 'European Paradox'. Research Policy, 35(10), 1450-1464.

Enders, J. & Musselin, C. (2008). Back to the future? the academic professions in the 21st century. In OECD(Ed.) Higher Education to 2030 - Volume 1: Demography (pp. 125-150). Paris: OECD.

European Commission (2012). She Figures 2012. Women and Science. Statistics and Indicators. Office for Official Publications of the European Communities.

European Commission (2011a). Innovation Union Competitiveness Report. Brussels: European Commission.

European Commission (2011b). Supporting growth and jobs – an agenda for the modernisation of Europe's higher education systems. Brussels: European Commission, SEC(2011) 1063 final.

European Commission (2010). Europe 2020. A European strategy for smart, sustainable and inclusive growth. Brussels: European Commission, COM(2010) 2020.

EUROSTAT (2010). Business Registers. Recommendation manual Luxembourg: EUROSTAT.

Ferlie, E., Ashburner, L., FitzGerald, L. & Pettigrew, A. (1996). The New Public Management in Action. Oxford: Oxford University Press.

Geuna, A. (2001). The changing rationale for European university research funding: are there negative unintended consequences? Journal of Economic Issues, XXXV(3), 607-632.

Godin, B. (2005). Measurement and Statistics on Science and Technology. London: Routledge.

Gulbrandsen, M. & Slipersaeter, S. (2007). The third mission and the entrepreneurial university model. In A. Bonaccorsi & C. Daraio (Eds.) Universities and Strategic Knowledge Creation. Specialization and Performance in Europe (pp. 112-143). Cheltenham: Edwar Elgar.

Gunnes, H. & Hovdhaugen, E. (2008). Karriereløp i akademia. Oslo: NIFU STEP-rapport 19/2008.

Hazelkorn, E. (2009). Rankings and the battle for world-class excellence: institutional strategies and policy choices. Higher Education Management and Policy, 21(1).

Hazelkorn, E. (2012). European "transparency instruments": Driving the modernisation of european higher education. In Anonymous European Higher Education at the Crossroads (pp. 339-360). Springer.

Horta, H. (2009). Global and national prominent universities: internationalization, competitiveness and the role of the State. Higher Education, 58(3), 387-405.

Huisman, J., Meek, V. L. & Wood, F. (2007). Institutional Diversity in Higher Education: a Cross-National and Longitudinal Analysis. Higher Education Quarterly, 61(4), 563-577.

Jongbloed, B. & Lepori, B. (2015). The funding of research in higher education: Mixed models and mixed results. In Anonymous Handbook of Higher Education Policy and Governance. Palgrave.

Jongbloed, B. (2008). Creating public-private dynamics in higher education funding. A discussion of three options. In J. Enders & B. Jongbloed(Eds.) Public-Private Dynamics in Higher Education Funding (pp. 113-138). Bielefeld: Transcript.

Jongbloed, B., Salerno & Kaiser (2003). Kosten per student. Methodologie, schattingen en een internationale vergelijking.

Kyvik, S. (2009). The Dynamics of Change in Higher Education. Springer.

Kyvik, S. (2006). Change processes in non-university higher education in Western Europe. Paper for the CHER 19th Annual Conference, University of Kassel, 2006.

Kyvik, S. & Lepori, B. (2010). Research in the non-university higher education sector in Europe. Dordrecht: Springer.

Larédo, P. (2003). University research activities: on-going transformations and new challenges. Higher Education Management and Policy, 15(1), 105-123.

Lepori, B. & Bonaccorsi, A. (2013). The Socio-Political Construction of a European Census of Higher Education Institutions: Design, Methodological and Comparability Issues Minerva, 51(3), 271-293.

Lepori, B. & Kyvik, S. (2010). The research mission of Universities of Applied Science and the future configuration of Higher Education systems in Europe. Higher Education Policy, 23, 295-316.

Lepori, B., Probst, C. & Baschung, L. (2010). Patterns of subject mix of higher education institutions: a first empirical analysis from the AQUAMETH database. Minerva, 48(1), 73-99.

Lepori, B., Seeber, M. & Bonaccorsi, A. (2014). Competition for talent. Country and organizational-level effects in the internationalization of European higher education institutions. Research Policy.

Lepori, B., Benninghoff, M., Jongbloed, B., Salerno, C. & Slipersaeter, S. (2007). Changing models and patterns of higher education funding: Some empirical evidence. In A. Bonaccorsi & C. Daraio(Eds.) Universities and Strategic Knowledge Creation. Specialization and Performance in Europe (pp. 85-111). Bodmin, Cornwall: MPG Books Limited.

Lepori, B., Dinges, M., Reale, E., Slipersaeter, S., Theves, J. & Van den Besselaar, P. (2007). Comparing the evolution of national research policies: what patterns of change? Science and Public Policy, 34(6), 372-388.

Lepori, B., Heller-Schuh, Scherngell & Barber (2014). Understanding Factors Influencing Participation to European Programs of Higher Education Institutions. STI 2014, Leiden.

McCormick, A. C. & Zhao, C. M. (2005). Rethinking and reframing the Carnegie classification. Change, 37(5), 50-57.

Meek, V. L., Goedegebuure, Kivinen & Rinne (1996). The Mockers and Mocked: Comparative Perspectives on Differentiation, Convergence and Diversity in Higher Education. London: Emerald.

Musselin, C. (2013). Long March of French Universities. London: Routledge.

Mustar, P., Renault, M., Colombo, M. G., Piva, E., Fontes, M., Lockett, A., Whright, M., Clarysse, B. & Moray, N. (2006). Conceptualising the heterogeneity of research-based spin-offs. A mutidimensional taxonomy. Research Policy, 35, 289-308.

Nieminen, M. & Auranen, O. (2010). University research funding and publication performance - an international comparison. 39, 822-834.

OECD (2002). Frascati Manual. Proposed Standard Practice for Surveys on Research and Experimental Development Paris: OECD.

Paradeise, C., Reale, E., Bleiklie, I. & Ferlie, E. (2009). University Governance. Western European Comparative Perspectives. Dordrecht: Springer.

Porter, T. (1995). Trust in Numbers: The Pursuit of Objectivity in Science and Public Life. Princeton: Princeton University Press.

Schubert, T., Bonaccorsi, A., Brandt, T., De Filippo, D., Lepori, B., Niederl, A., Schmoch, U., Slipersaeter, S. & NIFU STEP, O. (2014). Is there a European university model? New evidence on national path dependence and structural conver-gence. Knowledge, Diversity and Performance in European Higher Education: A Changing Landscape, 47.

Teixeira, P., Jongbloed, B., Dill, D. & Amaral, A. (2004). Markets in Higher Education. Rhetoric or Reality? Dordrecht: Kluwer Academic Publishers.

Theves, J. & Esterle (2005). National reports on data/indicators production. Country report France.

UOE (2013). UOE data collection on education systems. Volume 1. Manual. Concepts, definitions, classifications Montreal, Paris, Luxembourg: UNESCO, OECD, Eurostat.

van Raan, A. F. J. (2008). Bibliometric statistical properties of the 100 largest European universities: prevalent scaling rules in the science system. Journal of the American Society for Information Science and Technology, 59(3), 461-475.

van Vught, F. A., Kaiser, File, Gaethgens, Peter & Westerheijden (2010). U-MAP The European Classification of Higher Education Institutions.

Van Vught, F. (2009). Mapping the higher education landscape. Towards a european classification of higher education. 28.

Waltman, L., Calero-Medina, C., Kosten, J., Noyons, E., Tijssen, R. J., Eck, N. J., Leeuwen, T. N., Raan, A. F., Visser, M. S. & Wouters, P. (2012). The Leiden Ranking 2011/2012: Data collection, indicators, and interpretation. Journal of the American Society for Information Science and Technology, 63(12), 2419-2432.

Weingart, P. & Maasen, S. (2007). Elite through rankings - the emergence of enterprising university. In R. Whitley & J. Gläser(Eds.) The Changing Governance of the Sciences (pp. 75-1011). Dordrecht: Springer.

White, K. (2004). The leaking pipeline: Women postgraduate and early career researchers in Australia. Tertiary Education & Management, 10(3), 227-241.

Wolfinger, N. H., Mason, M. A. & Goulden, M. (2008). Problems in the pipeline: Gender, marriage, and fertility in the ivory tower. The Journal of Higher Education, 79(4), 388-405.

Xu, Y. J. (2008). Gender disparity in STEM disciplines: A study of faculty attrition and turnover intentions. Research in Higher Education, 49(7), 607-624.

HOW TO OBTAIN EU PUBLICATIONS

Free publications:

- one copy:
  via EU Bookshop (http://bookshop.europa.eu);
- more than one copy or posters/maps:
  from the European Union's representations (http://ec.europa.eu/represent_en.htm);
  from the delegations in non-EU countries (http://eeas.europa.eu/delegations/index_en.htm);
  by contacting the Europe Direct service (http://europa.eu/europedirect/index_en.htm) or calling 00 800 6 7 8 9 10 11 (freephone number from anywhere in the EU) (*).

  (*) The information given is free, as are most calls (though some operators, phone boxes or hotels may charge you).

Priced publications:

- via EU Bookshop (http://bookshop.europa.eu).

NC-01-15-791-EN-N

ISBN 978-92-79-52368-7
DOI 10.2766/755061