

University Systems in Europe: A Multi-Dimensional Efficiency Comparison

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The paper undertakes an examination of university systems of selected European countries from the perspective of the Austrian higher education system. The challenge of implementing higher institutional autonomy, accountability, and controllability in the Austrian higher education system is discussed with respect to recent experience in selected national university systems in Europe. Two major challenges were identified, first, the high diversity of the Austrian university system, and second, the implementation of considerable reorganization in a comparatively short period and under conditions of relatively high uncertainty. Data envelopment analysis (DEA) was used to compare the performance of universities of five European countries and to take account of the multidimensionality of both input and output. The technical efficiency of these universities was then calculated. In contrast to analysis employing only one output dimension, the technical efficiency of individual universities using the new measure was found to be very high. Country averages only differ marginally.

Keywords: university systems in Europe, comparative university performance, multidimensionality, data envelopment analysis (DEA), technical efficiency of universities

Higher Education Systems and Institutions: Challenges and Strategies

Changing expectations with respect to the link between a knowledge driven economy and economic growth have significantly altered the demands placed on higher education institutions (HEIs) and have kicked off a phase of rapid changes.

Such changes concern new patterns of knowledge production, the demand for greater interaction with national innovation systems and the service function of higher education, as well as related questions of scientific capacity and infrastructure.

The role of HEIs in educational systems is also a focus of debate, e.g., the ongoing “massification” of higher education and its increasing internationalization. Questions concerning the availability of public funds have also gained significance throughout the last few decades.

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Despite the very different historical backgrounds, traditions, and institutional varieties existing across Europe, higher education policies and the repertoire of policy instruments have begun to converge across the continent.

Common trends now emerging include changes in government funding, with increasing importance being given to competitive funding (IPTS, 2008). National governments are trying to decouple HEIs from traditional cameralistic models and to provide a framework for increasing institutional autonomy on one hand, and for greater accountability and reliance on performance agreements on the other. The last decade showed that the traditional linear model of knowledge production and the emphasis on the “science push effect” in creating innovations are no longer suitable as a theoretical and strategic framework in modern science and technology policies. As a consequence, pro-active fostering of collaboration with business and so-called “third mission” projects have gained significantly importance.

Other relevant trends include increasing differentiation in higher education systems in terms of a mass-education vs. a research approach, together with the promotion of centers of excellence focusing on top-level thematic strengths.

The academic world has changed significantly throughout the last few decades and has become increasingly output and performance-oriented. Both national governments and HEIs have realized the need for concrete measures to increase the attractiveness of academic careers.

Concrete strategies for HEIs in Europe comprise (Jongbloed et al., 2006):

- Achieving focus and mass by rationalizing research activity (selectivity, critical mass, profiling);
- The creation of “centers of excellence” as a result of university rationalization and profiling policies. Such centers often function as inter-disciplinary institutes;
 - Using financial/budgetary instruments as a means of attaining research goals and enhancing quality;
 - Strengthening the steering capacity of the university’s central management (e.g., by adjusting the internal planning, budgeting and control cycle);
 - The setting up of a support facility (or office) to help researchers apply for funds or commercialize their research findings;
 - Decentralization (devolving responsibility and making departments more autonomous when it comes to their management and resourcing) as a means to increasing research performance and research income;
 - Employing human resource management (HRM) as an instrument in helping institutions achieve the right composition of academic staff. For instance, vocational HEIs may encourage staff to engage more in research as this also helps improve teaching;
 - Improving research training (Doctor of Philosophy (Ph.D.) track; graduate schools);
 - Engaging in linkages with the outside world (region, industry, small and medium enterprises(SME)).

Despite the existence of a common set of challenges and strategies in higher education systems at a European level, the relevant financial and regulatory frameworks are still shaped within a national context and thus considerable differences still exist across national higher education systems.

In order to make a useful comparison of different HEIs and to learn from the experience of those in other countries, it is essential that specific national contexts be taken into account.

This paper discusses the historic background and current challenges faced by European higher education systems from an Austrian perspective. The aim of the paper therefore—based on recent contributions concerning changes in selected national higher education systems and on the discussion of relevant, comparable

statistical data—is to gain greater insight into the feasibility of a performance-driven approach in steering higher education systems and to assess related pre-conditions for such a change in Austria. Starting with the historical background and recent changes in the higher education system in Austria, the paper presents selected national cases in order to illustrate the complexity, multidimensionality, and respective temporal horizons as the higher education systems move towards becoming competitive, more flexible, but controllable entities exhibiting greater institutional autonomy and accountability.

The last section of the paper attempts to quantify the technical efficiency of universities. The database used include information on different inputs and outputs, and by means of data envelopment analysis (DEA), the efficiency of selected universities in five countries is compared.

The Development of the Austrian University System

The Austrian academic system has a very long tradition. The first university was established in 1365, and up to 1993, public universities (for both scientific and arts programs) were the only HEIs available in Austria. From a structural point of view, the higher education system remained very static despite the high increases in student numbers beginning in the 1970s. In the past 15 years, however, the higher education system has changed dramatically and the number of institutions increased from 19 in 1993 to 69 in 2009. This was mainly due to the establishment of various and new types of HEIs (e.g., The Institute of Science and Technology (I.S.T.) Austria, private universities, Universities of Applied Science, University for Further Education Krems, University colleges of teacher education) and to the establishment of three distinct public medical universities (which emerged from former positions as faculties of large general universities).

The Austrian higher education system is characterized by small and medium sized universities, high diversity, and a relatively high degree of specialization at several institutions.

The following paragraphs provide a short introduction to the five major types of institutions in the Austrian higher education sector:

- Public universities remain the dominant form of institution in the higher education system in Austria. Up to 2004 two main types of universities could be distinguished within the Austrian public university sector—“science universities” and “colleges of arts and music” (nowadays called “universities for the arts”). Even in recent decades, the influence of Humboldt’s initial vision concerning the role of universities in public life remained strong, and the university landscape in Austria faced relatively little pressure to change. However, towards the end of the last millennium several developments finally set the ball rolling. The Universities Act 2002 created a common legal basis for science and arts universities by eliminating the legal distinction between the two types. The act gained full power on January 1st, 2004 and also changed the status of public universities to that of full legal bodies under public law (Kottmann, 2008);

- A feature of the Austrian science university sector is its diversity. This is also a result of the Universities Act 2002. The sector now includes three autonomous medical universities, one university of veterinary medicine, one university of economics and business administration, two universities of technology, one university of mining, and one university of natural resources. In addition, universities for applied life sciences and “general” science universities can also be distinguished. The University for Further Education Krems is a public university of a special kind, having its own legal basis, as established by the Danube University Krems Act 1994. It is a corporation under public law with far-reaching powers of self-administration, serves the goal of providing post-graduate training and further training, and only offers non-regular study programs. The

relatively high diversity of the Austrian public university landscape is thus a major challenge with respect to the establishment of a system of performance-oriented coordination and pro-active structural change in the higher education system;

- Private universities are very common in other European countries but were non-existent in Austria until quite recently. The University Accreditation Act 1999 paved the way for the establishment of private universities in Austria. The first private university was accredited in 2000 by the Accreditation Council. Today 12 private universities exist in Austria. However, Austrian private universities only cover a relatively small part of the student population. Some of the private universities also receive strong support from regional governments;

- Universities of Applied Sciences (UASs) are relatively new in the Austrian higher education system. The first program started in the academic year 1994/1995. This new type of tertiary education provided an alternative to existing university studies in Austria and was based on the Fachhochschule Studies Act 1993 (Kottmann, 2008). UASs offer degree programs at university level and serve the needs of those seeking vocational training with a scientific basis or practical orientation. They also have a mandate for applied research. A considerable share of study programs offered by UASs consists of part-time professional development programs. twenty UASs now exist in Austria;

- A large part of the programs offered by colleges for medico-technical occupations and by colleges for midwifery (on level International Standard Classification of Education (ISCED) 5B) has already been incorporated in UASs programs. However, this is still an ongoing process as there is no legal obligation to shift. UASs provide bachelor and master degrees, but they do not have the right to award doctorates or PhDs. Nevertheless graduates of University of Applied Sciences master programs (or pre-Bologna-diploma programs) are allowed to pursue doctoral studies at a university (sometimes additional requirements have to be fulfilled before they may enter university doctoral programs);

- University colleges of teacher education represent a new type of higher education institution resulting from the upgrading of existing educational structures. They started operating in the study year 2007/08. The Federal Act on the Organization of University Colleges of Teacher Education 2005 called for the transfer of the training of compulsory school teachers as well as of the continuing and in-service training of all teachers from the former teacher training colleges (ISCED 5B) to the new university colleges of teacher education (ISCED 5A). The shift from ISCED level 5B to 5A means that the previous vocational nature of the training has been upgraded and that completion of the program now results in the award of a bachelor degree (Bachelor of Education). In Austria, there are nine public, and five private university colleges of teacher education;

- The I.S.T. Austria, located in Klosterneuburg (close to Vienna), is a relatively recent establishment. It is a post-graduate academic institution, with an emphasis on basic research in scientific fields such as life sciences, physics, mathematics, chemistry, computer science, and multidisciplinary areas. The institution is committed to becoming a world-class research centre, and aims at providing an international, state-of-the-art environment for approximately 500 scientists and doctoral students by 2016. The legal basis for the institute is the Federal Law on the Establishment of the I.S.T. 2006.

In addition to the HEIs described above, several schools of theology also exist. These are run by the church and are mainly responsible for the education of priests and those working within the realm of church affairs. They will not be considered in this paper.

Hence, in contrast to conditions prevailing in the recent past, it can now be said that Austria has a highly

diversified higher education system that is characterized not only by several different types of higher education institution but also by considerable differences within a specific type.

In addition to this massive increase in the diversity and number of HEIs, the nature of governance at public universities, which still represent the majority of students and are the most important research actors, has also changed radically in recent years. A move from direct control by the public authorities to complete autonomy was introduced in 2004. The major aim of this shift was to improve the public universities' research profile (IPTS, 2008). The direction and steering of public universities are now based on performance agreements. This is intended to allow universities to focus on specific areas of interest, but also to ensure that synergies are exploited. So far, the level of differentiation prevailing within the university sector with regard to status, prestige and the role of research remain relatively low.

The establishment of Universities of Applied Science and of private universities also gave federal regions in Austria the opportunity to take a more active role in higher education policy. Governments in regions lacking a public university have become very active in supporting the establishment of Universities of Applied Science (and to a lesser extent private universities).

The functions of the different types of HEIs vary considerably. However, there are numerous areas of overlap. For example, Universities of Applied Science are undertaking a particular effort to increase their research activities and thus become more similar to traditional universities.

A Comparison of Developments in Austria to Developments in Other Selected Countries

The developments presented for Austria in the previous section lie in stark contrast to those found in other European countries. Outside Austria, a major long-range effort has often been undertaken not to increase but to reduce the number of HEIs, e.g., via the merging of various HEIs as in Denmark or Finland. Based on selected national cases, the following paragraphs show how these developments have been part of a long-term strategy which is still ongoing.

The Case of the Netherlands—Towards Institutional Autonomy, Market Orientation, and Accountability

The higher education system of the Netherlands is composed of 14 public universities, 40 “hogescholen” (these are comparable to Universities of Applied Science in Austria, but started in the Netherlands in the mid-1960s), and five private universities.

While in many countries higher education reform only began in the last decade, in the Netherlands reforms started in the beginning of the 1980s.

Beginning in the 1980s the view of the role of government in the higher education system changed. Universities were granted more autonomy and the government was meant to steer or guide from a distance (from government to governance). At that time the sector of universities of applied science (hogescholen) was consolidated: Mergers took place that reduced the number of universities of applied science from 375 in 1983 to 40 in 2009 (Westerheijden, de Boer, & Enders, 2009).

In the decades since the 1980s substantial reforms have continued to take place in the Netherlands. Several waves of reforms, all with a common objective, have been implemented. Such reforms have been primarily dedicated to creating more institutional autonomy, greater market orientation, and enhanced accountability. While overall these forms can be considered successful, they did take a considerable amount of time. The respective roles of stakeholders in the higher education system have been changed significantly. The government is now considered as a “market engineer”, universities as entrepreneurs, and students as customers

(Enders et al., 2006). Reforms are still taking place, and frequently they are first tested on a small scale.

Apart from the different time frame involved in the Netherlands, the consolidation of the universities of applied science also offers an interesting contrast to developments in Austria. In addition, closer cooperation between traditional universities and universities of applied science is also being discussed. In fact one university of applied science has already merged with a university (the Free University Amsterdam and the “hogeschool” in Zwolle, Windesheim).

Switzerland—Successful Change Against a Background of Strong Federal and Regional Interests in a Highly Diversified Academic System

The Swiss higher education system consists of two Federal Institutes of Technology, 10 cantonal universities, eight UASs, and 14 teacher training institutions. The UASs were established from 1995 to 1997 on the basis of the existing professional schools. They represent roughly one third of students and 50% of 1st year enrolments.

Apart from the Federal Institutes of Technology in Zurich and Lausanne, the governance of HEIs in Switzerland is organized at the cantonal level. Hence, great differences exist in legal status, rules, etc., and governance tends to be very complex. Irrespective of these differences, the funding of universities has become increasingly competitive in almost all cantons (Lepori, 2007).

Due to the fact that for the most part responsibility for higher education governance is in the hands of the cantons, overall national coordination proves very challenging since in effect it has to be based on various bottom-up initiatives and on achieving consensus. Although this implies that the reforms implemented thus far have tended to be of a gradual nature, they have nonetheless had a substantial impact. The strong local stakeholder interests within the system mean that mechanisms for change remain bottom-up in character. (Lepori & Fumasoli, 2009).

The Swiss higher education system is unique in terms of governance structure, although it is possible to discern similarities to the Austrian system in that due to the growing engagement of federal regions in Austria, governance is also becoming increasingly complex.

Owing to the excellent performance of the Swiss higher education system pressure for reform was never very high, and, as indicated above, any improvements that were made, were normally driven by bottom-up processes.

Italy—Long Ranging Change in a Highly Differentiated “University” System

The Italian higher education system consists of approximately 100 public and private universities, more than 100 Institutions for Arts and Music and a few universities specialised in postgraduate studies only. The universities represent the vast majority of students, however.

In line with other European countries, reforms have been implemented in Italy over the past 20 years in order to increase university autonomy and to initiate change in university curricula.

Over the last 15 years specific changes have been carried out in university regulation which basically dates back to the system based on the Gentile reform of 1923. Study programs and the allocation of responsibilities in university management have been redrawn, and there has been a progressive and wide transfer of responsibilities from the central government to the individual universities. The overall legal autonomy of universities has increased, as has their autonomy with respect to funding, teaching, and the recruitment of university teaching staff (Reale & Poti, 2009).

Finland—Radical Change Borne by Considerable Bottom-up Dynamics

The Finnish higher education system is binary: It consists of roughly 20 universities and 30 polytechnics. The polytechnics were established in the 1990s in order to deal with increasing student numbers. In addition, there is also a National Defence University and a Police College. Compared to other HEIs, the latter two institutions differ considerably in terms of governance and functions and will thus not be considered in this paper.

University autonomy was increased in 1997, and modifications to governance have continued ever since. Full autonomy has only been possible since 2010 (the implementation process will be finalised in 2012). Other changes in the past decade have included the establishment of a graduate school system. This has led to a considerable increase in the number of doctorates (Aarrevaara, Dobson, & Elander, 2009).

In Finland higher education policy is discussed mainly within the context of innovation policy, and currently, several university mergers are taking place or are under discussion. The aim of the merger process is to decrease the number of universities to 15 (Aarrevaara et al., 2009).

In addition to mergers, various institutes are in the process of relocation or of becoming integrated into other institutes. Such changes are normally the result of years of discussion and fine-tuning and are frequently driven by bottom-up initiatives.

The Finnish higher education system is similar to the Austrian system. However, changes in governance have been implemented over a much longer time period. It seems that this longer time frame has made it easier to take bottom-up initiatives into account.

Comparing Performance—Possible Approaches in the Face of Different Academic Systems and Institutions

Compared to other Western European countries, changes in the Austrian higher education system appear to have been relatively slow in coming. It was only after the 1990s that structural change or changes in governance started to gain speed and become more comprehensive. However, a drawback remains in that the changes implemented so far, may also be partly responsible for the challenges that remain in steering the overall system. Such challenges are also more severe than they need be due to the relatively high diversity of Austrian higher education (particularly universities). This not only makes direct comparisons within Austria relatively difficult, it also tends to hinder comparison of Austrian HEIs with those of other countries. Any meaningful comparison of educational performance in the tertiary sector thus requires the development of a suitable methodology.

Multi-dimensionality of Input and Output

University activities may be considered multi-dimensional since they encompass both the generation and dissemination of knowledge using several avenues, i.e., research, teaching, and the so-called “third mission”, including interaction with economic and social sectors. Thus, to be worthwhile, any overall comparison of university systems needs to take account of the diverse nature of the various activities. This represents a considerable challenge. The quality of the different university inputs and outputs is far from being homogenous, making direct comparison extremely difficult. In addition, the time periods needed before the various outputs become observable may not be definable. A further problem resides in the fact that no generally acceptable weightings are available with respect to the numerous activities, i.e., the relative importance of teaching, research, co-operation with agents in the external economy, etc. remain unclear (Dundar & Lewis, 1998;

Bonaccorsi, Daraio, & Lepori, 2007).

This rules out the use of an assessment based on a simple weighted sum of the various outputs (such as number of publications, graduates, patents etc.) since it does not allow for the multi-dimensionality of the various activities to be simultaneously taken into account. Simple statistical ratios, e.g., the number of publications per researcher, etc. are also inadequate for purposes of overall comparison since they fail to take account of complementarities, substitution effects, and joint production among outputs (Bonaccorsi & Daraio, 2003).

However, more advanced statistical techniques are available, which are capable of coping with the above problems. The use of such techniques means that input and output behaviour of very diverse bodies may be adequately compared. One relevant method, DEA, is described below.

Methods and Data

DEA is a highly flexible statistical method enabling simultaneous consideration of very diverse inputs and outputs. It is thus applicable in the context of university comparison where factors exhibiting a high degree of heterogeneity and non-determinability are common. To be more specific, DEA may be used to calculate the technical efficiency of university productivity, i.e., how much more output may be obtained from the use of a given set of inputs (or the obverse, how a certain output might be achievable using fewer inputs). Although attempting an assessment of university performance on the basis of technical efficiency is likely to appear highly suspect to many observers, one has to remember that there is nevertheless a great deal of consensus concerning the need to avoid inefficiencies or waste of public resources in times of general scarcity.

Data envelopment analysis allows for the simultaneous consideration of diverse inputs and outputs without requiring any (implicit or explicit) prior knowledge concerning factor interrelationships. The method is used to calculate the technical efficiency of a specific unit, in our case a university, with respect to a hypothetical input-output efficiency frontier. The technical efficiency is the relative input-output correlation compared to the best institution in the group under consideration, the highest efficiency score is one. The frontier is drawn up with respect to units of comparison suitable for the entity under observation. It is thus clearly important that the basis for comparison contains institutions which are truly comparable. Given the present relatively high level of diversity within the higher education system, attempting such a comparative analysis at the Austrian level is unlikely to be very fruitful. To be useful, any such overall assessment requires a much broader basis for comparison (even though this also means that a certain amount of detail will have to be sacrificed owing to the more limited comparability of international data).

The origins of DEA can be traced back to the work of Farrell (1957) and its first applications to Charnes, Cooper, and Rhodes (1978) and Färe, Grosskopf, and Lovell (1985). The technique is often employed by industrial engineers when undertaking productivity analysis. DEA efficiency units always need to be interpreted with respect to the relevant units of comparison, and represent relative, not absolute values. Confidence intervals for DEA units, developed on the basis of the work by Simar and Wilson (1998; 2000), may be employed to help interpret the explanatory power of the efficiency values derived. Using such work as a starting point, an input-oriented DEA analysis was carried out (under the assumption of variable returns to scale) in an attempt at an international comparison of the Austrian university system.

The availability of suitable data is a key point in carrying out any DEA. As part of the European project Advanced Quantitative Methods for the Evaluation of the Performance of Public Sector Research

(AQUAMETH) under the Network of Excellence PRIME, a harmonised database was developed on HEIs in 12 countries. Ideally, all inputs and outputs arising as part of university activities (which are subject to university control or direction) should be considered in the analysis. In practice, however, owing to the diverse nature of the university activities and data available under AQUAMETH, which is not realistic. Nevertheless, as a considerable share of university activity is dedicated to research and/or teaching, at least these two dimensions need to be taken account of in any attempt on overall assessment and comparison. University employees represent the most important resource in teaching and research activity. However, as it could clearly be seen in previous sections, such activities may vary considerably depending on the scientific discipline in question. This makes it necessary to distinguish between the various scientific or academic objectives of university staff. Considerable differences also exist with respect to the funding and resources needed across research and teaching activities. On the basis of such considerations and given the nature of the international comparative data, the following indicators were chosen for use in attempting an overall comparison of Austrian and non-Austrian universities (see Table 1).

Table 1

Indicators Used in International Comparison

Outputs (3), Inputs (7)	Indicator
Output 1	No. of graduates ("diploma" and/ or master's program)
Output 2	No. of doctorates (including PhDs)
Output 3	ISI-Publications
Input 1	Financial resources (in Euros)
Input 2	No. of academic staff employed in engineering and technical sciences, agriculture and forestry, veterinary medicine
Input 3	No. of academic staff employed in human medicine
Input 4	No. of academic staff employed in natural sciences
Input 5	No. of academic staff employed in social sciences
Input 6	No. of academic staff employed in other scientific fields
Input 7	No. of non-academic staff

Note. Source: Based on AQUAMETH database 4.2.

The model specifications chosen allowed for an overall assessment of Austrian university performance and its international comparison, and took account of the diverse nature of structural and resource factors. The specifications chosen also mean that only five (those described in section three above) of the 12 university systems available in AQUAMETH could be used in the comparison calculated. Various gaps and incomparabilities in data and university systems (e.g., the relatively high significance of bachelor programs in Great Britain) rule out a more comprehensive approach. Furthermore, the scheme used for allocation of academic staff is not capable of taking proper account of those employed in Austrian universities of arts. These universities are thus not considered in the analysis. This means that the comparison of Austrian university technical efficiencies is based on a dataset comprising 133 universities from Switzerland, Holland, Italy, Finland, and Austria.

Results

A comparison of university systems from Switzerland, Holland, Italy, Finland, and Austria, taking both structural and resource differences into account, shows that most of the institutions observed, come out very well in terms of the relationship between inputs employed and output achieved in teaching and research, i.e.,

they appear to attain a very high level in terms of technical efficiency with respect to these two fields of activity. The average values obtained for the universities observed do not differ from each other to any significant extent.

Figure 1 shows that once the necessary structural adjustments are taken into consideration, differences between Austrian universities are very small (as is also the case for Holland). In contrast, university systems in Switzerland, Italy, and Finland exhibit a far larger proportion of institutions achieving below average levels of technical efficiency in teaching and research.

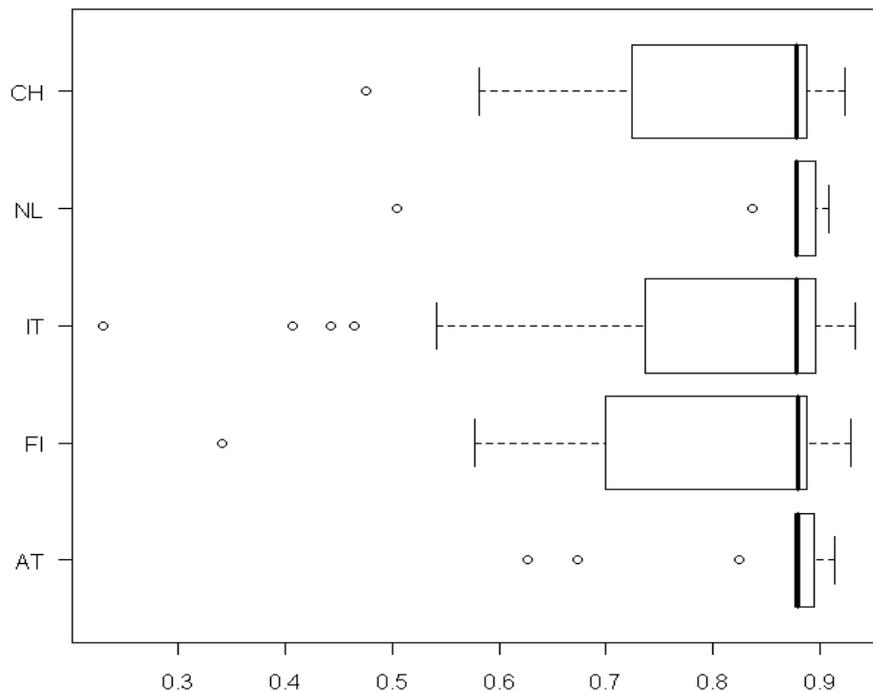


Figure 1. National differences in university technical efficiencies for teaching and research (DEA-VRS).

On taking the different inputs and outputs simultaneously into account, and given the large differences among universities, it is interesting to find that the technical efficiency of individual universities in the set considered is in general very high. Country averages also only differ marginally. This is in stark contrast to pictures that arise when only single dimensions are taken into account (e.g., research measured in terms of publications). This highlights how important it is to take the multidimensionality of HEIs into account.

Hence a truly comparative, comprehensive assessment of individual academic institutions:

- should not be limited to analysis of individual dimensions alone, e.g., research only;
- must take differences in scientific orientation and availability of resources into consideration;
- must be able to do justice to the complexity of the correlations between the various inputs and outputs;
- must be flexible enough to address the differences in these correlations between individual universities.

Conclusions and Further Challenges

The Austrian higher education system is characterized by a very long tradition of small and medium sized universities, high diversity, and a relatively high degree of specialization among several institutions. The higher education system in Austria long remained very static from a structural point of view despite the high increases

in student numbers, beginning in the 1970s. Even in more recent decades, the influence of Humboldt's initial vision concerning the role of universities in public life remained strong, and the university landscape in Austria faced relatively little pressure to change.

However, during the last decade, the higher education system has been increasingly confronted with demands for institutional change. Higher education policy and institutions need to rise to the new challenges and establish the more robust mechanisms, greater accountability, and comprehensive databases required for the more efficient steering of the higher education system. This is all the more relevant given the relatively high heterogeneity of the Austrian system (direct university comparisons are thus difficult). A database and adequate methods of structural analysis and performance measurement have to consider multiple dimensions. As argued above, multidimensional analyses allow for a much better comparison of selected universities across countries. Using DEA, it proved possible to take a number of different outputs (graduates, publications etc.) and inputs (financial resources, academic staff by field, etc.), i.e., a number of different structural settings into account. Interestingly—and surprisingly (given the very different institutional backgrounds examined)—the technical efficiency of the individual universities considered was found to be quite high. Values for country averages also showed only small deviations from each other.

The approach described above means that universities with similar financial resources, academic staff, research specializations etc. can be compared in terms of their output, and hence, their technical efficiency with respect to inputs and outputs can also be assessed. Thus, inadequate or misleading one-dimensional comparisons, for example, those based on the number of publications only (e.g., used to compare Harvard with small universities), whereby differences in inputs are totally neglected, can now be avoided.

However, despite the use of technical and statistical instruments in providing a more valuable basis for the introduction of greater flexibility and accountability in a diversified higher education system, such as that found in Austria, existing institutional reality throw up several more challenges.

Two major challenges were identified. First, the relatively high diversity of the Austrian higher education systems seems to act to prevent the development of a more uniform system of coordination and steering. It also seems to hinder the comprehensive redeployment of resources. Second, there is a need to accomplish considerable reorganization in a comparatively short period of time, and to do this under conditions of high uncertainty.

The national cases discussed above serve to provide an interesting starting point when considering further development of the higher education system, particularly concerning questions relating to endogenous dynamics. Bottom-up stimulation in itself is inadequate. For several higher education systems, it seems to be essential that more long-term and incremental processes are undertaken in order to avoid the irritations caused by what is often erratic top-down intervention.

While higher education policy has long been a matter of national policy, broad discussion of higher education system reforms on a European level is slowly emerging, but still wanting. At the moment initial steps are being undertaken to create a common understanding of the heterogeneous landscape of higher education in Europe and, as a consequence, to develop more comparable and refined databases at the institutional level.

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