

How to Measure Institutional Diversity in Higher Education Using Revenue Data

Silvia Salini · Matteo Turri

Received: date / Accepted: date

Abstract This article suggests the use of statistical analysis, based on revenue data, to measure institutional diversity. The financial statements of universities in Italy and in England are thoroughly examined in order to emphasize the levels of diversity within these two different university systems; to understand the causes of the variations; and to verify, from a longitudinal perspective, the behaviour of the universities in terms of differentiation. The aim of this paper is mainly methodological; that is, to demonstrate the potential of revenue data analysis for investigating institutional diversity. For exploratory purposes, this paper will also introduce additional considerations to the ongoing debate on institutional diversity.

Keywords Institutional Diversity · Higher Education · Revenue data · Multidimensional Scaling · Data reduction

1 Introduction

Institutional diversity, or differentiation, is one of the most intensely debated topics of higher education studies. However, currently, there is neither a shared conceptualisation nor (most importantly) a theoretical consensus on its determinants [50, 39, 42]. A fairly positive meaning of this notion is commonly associated with the concept of institutional diversity. University systems that are more differentiated are likely to have a more pronounced tendency to meet the numerous requirements of society; to

S. Salini
Department of Economics, Management and Quantitative Methods - Università di Milano
Tel.: +39-02-50321538
Fax: +39-02-50321505
E-mail: silvia.salini@unimi.it

M. Turri
Department of Economics, Management and Quantitative Methods - Università di Milano
Tel.: +39-02-50321189
Fax: +39-02-50321505
E-mail: matteo.turri@unimi.it

have a more developed attention to their students' learning needs; to develop better ways to promote social mobility and cultural pluralism; to promote and test higher degrees of innovation; to be less likely to be exploited by a centralized government to indoctrinate people; and to apply a more developed specialization and attention to local needs [45, 3, 28, 8, 57, 4].

Despite the strong attention in this issue, empirical studies on institutional diversity are still far from being fully satisfactory and comprehensive [21, 22, 52]. This paper engages in the debate about diversity and, in particular, how to measure it. The aim is to illustrate how revenue data can be used to measure diversity within an higher education system. Revenue data are relevant elements in understanding institutional diversity; they measure a university's ability to attract financial resources from the external organizational environment and how these resources are acquired. Organizational studies correlate the characteristics and behaviour of an organization with the resources that it draws from [35]. Thus revenues, in particular their composition and differentiation, do not only represent how an organization obtains its resources, but also significantly display how that organization works. Appreciate the degree of diversification of revenue of universities within the same university system thus allows to have a robust indicator of the actual difference in the existing institutional university system. In addition the analysis of the revenues that more markedly impact on diversity allows to understand how diversity is connected with public funding or policies and vice versa how it is linked to universities revenues from the market. In this way the analysis of revenue data makes a contribution to the ongoing debate on institutional diversity.

Methodologically, the use of revenue data provides important opportunities because the data is quantitative and contain information about various activities, which are annually updated and homogeneously collected at national level. These features make these data particularly suitable for descriptive and exploratory research aimed at identifying regularities and studying their progress over time.

The article considers the revenues of the Italian and English universities along almost a decade through the three-way multidimensional-scaling (MDS) technique that will be employed to acquire multidimensional and longitudinal perspectives. This approach combines the classification approach (cluster) and the dimensional reduction approach (ordination). MDS is a technique frequently employed to graphically show the differences and similarities of some units of a group. Section 2 addresses the notion of institutional diversity and how the revenue data can play a relevant role to measure institutional diversity. Section 3 highlights the weakness of the previous empirical studies and present the proposed approach. Section 4 presents the revenue data in Italian and English universities. Section 5 reports the results in particular Section 5.1 presents a first simple analysis based on univariate statistical indexes and Section 5.2 shows the analysis in a multidimensional and longitudinal point of view. Finally, Section 6 draws conclusion and future perspectives.

2 Revenue data contribution to institutional diversity studies in higher education

2.1 Institutional diversity

According to Huisman et al. [22], the variety of institutions within a national higher education system defines the notion of institutional diversity, which is a topic of great relevance to European political and research debate.

The very origin of the first reflections on institutional diversity can be traced back to the second post-war period in the United States. Since the seventies, Carnegie Classification's main goal has been to try to recognize and describe institutional diversity in US higher education. Trow's analysis [55] of transition to higher education considers institutional diversity as one of the main points of the whole analysis. Elite universities tend to be highly homogeneous systems, whereas mass higher education institutions are more comprehensive and boast a higher degree of diversity. Finally, universal access for universities is certainly characterized by remarkable levels of diversity.

More recently, the very concept of diversity has been rooted in European studies, where traditionally, at least in some countries, a high level of homogenization among universities had been pursued to promote equality through a strong centralization of the university system [31, 34, 47, 38]. Regarding the link between the strengthening of market mechanisms and diversity, it is possible to observe that there are bivalent relationships. Universities are encouraged to adopt strategical behaviours and to seek new market niches; but also, competition promotes the imitation of the most successful competitors [40, 18, 1, 7, 41, 42, 52]. It appears that there is a need to identify not just a single cause but deeper causal links to determine the presence of combined different and contrasting forces that impact diversity and homogeneity in a university system. Geiger [17] links the effects of competition in terms of diversity to the abundance of available resources (encouraging imitation), or the scarcity of resources (stimulating universities to specialise to survive). Teixeira et al. [52], when considering the link between competition and diversity in the Portuguese university system, conclude that although competition is a powerful force in determining the behaviour of universities, its effects are influenced by other factors. These include a conservative disposition, hostile behaviours against risk in the universities, obligations arising from the past in terms of path dependency and the availability of economic resources.

Similarly, the impact of government regulation is not always linked to a reduction in the scope for developing autonomous institutional strategies and a subsequent reduction in diversity, as one might intuitively think. Huisman et al. [22] established that high levels of diversity can precisely be triggered and preserved through governmental decisions in a university system, such as by promoting a binary system or concentrating public funding in few institutions. Moreover, the understanding of the determinants of diversity can be enhanced by considering how universities strategically respond to governmental policies and how useful the notion of institutional positioning can be in this approach [16]. In this respect, it is possible to understand how universities do not only react to the changes brought upon them by the envi-

ronment, but are also influenced by how the other actors involved in the university system respond to the same events.

Nonetheless it is important to take into consideration that not only the different governmental strategies but also the different grade of institutional autonomy and the different national regulations on services delivery and production are able to condition the behaviour of the universities and thus the level of differentiation within an university system.

2.2 Use of revenue data to measure institutional diversity

Classic organizational theory has traditionally associated the characteristics of an organization with internal elements, such as size and complexity [49]. Since the 1970s, other studies have highlighted that behaviour, organizational structure and performance are influenced and shaped by the requirements and pressures from organizations and groups operating in their environments [15, 32]. In particular, according to resource dependency theory, “*Administrative structure reflects efforts to ensure a stable flow of resources and to manage problems and uncertainties associated with exchange transactions*” [53] (p. 2). The intensity of the dependence is related to both the magnitude of the exchange and the criticality of the resources for the organization [35]. In this respect, it is even possible to conclude that a great deal of the organizational behaviour of the universities is driven by the search for scarce resources [27].

Generally, revenue data can be used to measure institutional diversity on the basis of triple-information potential.

Firstly, revenue data provide a representation of the ways in which an organization receives resources to operate, and also measure the ability of a university to attract external funding. Revenue data contain reliable and comparable data, even longitudinally, in relation to the amount of attracted resources and their origins. The most immediate and direct informational dimension linked to revenue data can easily be compared on a larger scale (even between different university systems), and that mainly includes the concentration of the available resources of a university and their revenue. It is thus possible to assess the impact of revenue that is linked to research activities, the weight of government funding, or the ability to attract research resources through public tendering procedures and collaborations with companies.

Secondly, on the basis of resource dependency theory, revenue data can produce a reliable representation of the organisational structure and behaviours of a university. As explained above, the ways in which universities attract resources determine their behaviour. A university acquiring a high amount of research revenue from international competitive tendering must develop strategies and must mainly focus on international research. However, a university receiving most of its revenue from undergraduate teaching must look for a close interaction with the surrounding environment and the local community in which it operates, with a particular focus on students. As Pfeffer and Salancik state [35] state (p. 53), “*The potential for one organization influencing another derives from its discretionary control over resources needed by the other and the other’s dependence on the resources and lack of countervailing resources and access to alternative sources.*” A particularly consequential element to

take into account is the analysis of the dependence of universities on third-party entities. As confirmed by the existing literature, a university chiefly depending on state resources has characteristics and behaviours that differ from those of a university that derives most of its revenue through market competition [17, 43, 54, 14].

Thirdly, another important informational contribution of revenue data is that they provide complete information about all university activities (for example, teaching, research, third-stream activities, student services and management of real estate assets). This characteristic is difficult to find in other indicators, but is nevertheless linked to the simultaneous analysis of various types of data. Indeed, the quantitative nature of revenue data allows calculating differences and ratios; it is not limited to profile frequency analysis. Moreover, revenue data are values calculated using standard procedures; they are measured without error, and they are not latent variables or indicators computed through aggregations. This greatly reduces uncertainties and thus statistical errors.

Like any other methodology, the use of revenue data needs to be based on some caveats [22]. On the one hand, as this methodology is focused on one specific aspect (revenue data), the resultant information is more limited than in reality. This shortcoming can partially be overcome by combining the analysis with other characteristics of the university. Nevertheless, it is still present by definition since taking full account of all the diversities might lead to consider all institutions as unique. The availability of data usually is not a problem because the budgets of universities, or their summarised versions, are easily available from a longitudinal perspective. On the other hand, an element that needs to be carefully considered is the comparability of the data, which is certainly ensured within a national context but requires not always easy reclassification procedures in international comparisons.

3 Methods

Despite the lively debate on the notion of institutional diversity and its determinants, empirical studies on institutional diversity are not widespread and there are various limits [21, 22].

A good review of methods that measure diversity is provided by Huisman [21], who identifies three techniques: (a) diversity indices, (b) group (or cluster) analysis and (c) the reduction of data dimension (ordination).

The use of diversity indices (a) needs the preventive identification of the profiles. It carries out a comparison between various years by analysing the number of profiles present in each individual year. The first author to use this approach was Birnbaum [3]. Morphew [33], as well, when analysing the American system, followed Birnbaum's approach [3] quite closely by comparing two different time-periods: 1972 and 2002. Huisman [21] used this method in 2007 to perform both a cross-national study and a longitudinal analysis. This kind of analysis is not suited to revenue diversification data, which are quantitative by nature and hard to discretise without losing information.

Another technique employed in literature to study diversity is cluster analysis (b). Cluster analysis does not allow performing longitudinal analysis, but, at best, allows

some descriptive comparisons between classifications obtained in different periods of time. However, it answers an important question: which is more similar to which? This reveals groups of institutions within a university system that may be considered similar; hence, this technique answers the question on diversity in an indirect way.

Even the method of data-reduction techniques (c)—employed by by Andrews et al. [2], and called ordination by by Huisman [21]—does not look the most suited to achieving the goals of this study. This approach is based on dimensional reduction via the analysis of the principal components, and the subsequent representation of the institutions in the new dimensional space. Again, this kind of analysis does not consider the time dimension; it is not a longitudinal analysis. It allows, at best, a descriptive comparison of two different periods of time. As Huisman underlines [21], reduction methods can apply if they provide interpretable dimensions that hold a good percentage of explained variance. But this requirement might not count when financial statement items are considered. These cannot necessarily be reduced to a lesser number of dimensions and yet simultaneously lose little information and remain interpretable.

For these reasons, the multidimensional-scaling (MDS) technique will be employed to acquire multidimensional and longitudinal perspectives while overcoming the limitations of comparing different university systems from different countries. It combines the classification approach (cluster) and the dimensional reduction approach (ordination). MDS is a technique frequently employed to graphically show the differences and similarities of some units of a group. It is a generalization of the ordination concept. From a square matrix that includes the “similarity” or “distance” of every unit on each line and every unit on each column, the multidimensional-scaling algorithm assigns to each unit a certain position in an n -dimensional space, with n being fixed beforehand. If n is sufficiently small, this space may be represented by a graph or a 3D plot. This technique basically starts with a system having an equal number of dimensions and units, and then reduces the dimensions to a specified number n .

On the other hand, MDS may be seen as a way to graphically determine if there are any clusters. The hierarchical cluster analysis covered by Huisman [21] basically starts from the same square matrix from which the MDS algorithm starts.

MDS has been extended to more complex analysis models [25, 10]. One of these intends to simultaneously analyze matrixes of distances: each matrix has the same structure and is made up of the same objects. The matrix analyzed is unique but three-dimensional (a three-way MDS). This method can be employed to detect and study the presence of some latent structures within a considered group in different times (longitudinal analysis) or in different conditions (experimental researches). The output of this procedure is represented by both the matrix of the coordinates of the objects and the matrix of the different cases.

In our instance, the third row of the matrix shows the period of time considered, and the cases are the universities; hence, this is a longitudinal analysis. From an operational point of view, the multi-way MDS algorithm that we have used is called SMACOF (Scaling by MAjorizing a COMplicated Function) and we will use the R library **Smacof** [12].

SMACOF is an elegant algorithm for computing a MDS solution. The main problem in MDS is the minimization of the deviance of the distances between points in a geometric space and their corresponding dissimilarities, the minimization of the so-called *stress* function. The *stress* function σ is a cost or loss function that measures the squared differences between ideal (n -dimensional) distances and actual distances in r -dimensional space ($r \ll n$). Usually r is 2 or 3, i.e. the ($r \times n$) matrix X lists points in 2- or 3-dimensional euclidean space so that the result may be visualized (i.e. an MDS plot). the *stress* function is defined as:

$$\sigma(X) = \sum_{i < j \leq n} w_{ij} (d_{ij}(X) - \delta_{ij})^2$$

where $w_{ij} \geq 0$ is a weight for the measurement between a pair of points (i, j) , $d_{ij}(X)$ is the Euclidean distance between i and j and δ_{ij} is the ideal distance between the points (their separation) in the n -dimensional data space.

A configuration X which minimizes $\sigma(X)$ gives a plot in which points that are close together correspond to points that are also close together in the original n -dimensional data space.

There are many ways that $\sigma(X)$ could be minimized. For example, [24] recommended an iterative steepest descent approach. However, a significantly better (in terms of guarantees on, and rate of, convergence) method for minimizing stress was introduced by [11]. De Leeuw's iterative majorization method at each step minimizes a simple convex function which both bounds σ from above and touches the surface of σ at a point Z , called the *supporting point*. In convex analysis such a function is called a majorizing function. This iterative majorization process is also referred to as the SMACOF algorithm. For major details see [6].

4 The data

The analysis will be accomplished by focusing on two different national case studies: Italy and England. These have been deliberately selected to verify how our methods can describe institutional diversity within two dissimilar university systems and, therefore, they are not comparable with each other. Italy and England share similar demographics and student population sizes (about 60 million inhabitants in Italy vs. 53 million in England, and 1.8 million university students in Italy vs. 2 million in England); however, they have very different historical backgrounds and characteristics [37]. The English university system [9] is traditionally characterized by a high degree of institutional autonomy in its universities. For years, it has been transitioning from a state-funding system based on historical expense to a more competitive system; for instance, in 2013–2014, out of 115 financed institutions 50% of research resources were allocated to only 10 universities. Conversely, Italian universities have always been characterised by a low level of institutional autonomy. Although they have transitioned to a state-funding system based on lump-sum budgets since 1994, in 2000–2010 the government tried to correlate funding with university performance, but these provisions yielded only a limited practical effect [41, 37].

For Italy, the time period considered is the nine years from 2001 to 2009. Only those universities that have not changed their names during a period of time have been included. Moreover, for the longitudinal analysis (Section 5.2), only public universities (50) have been considered because the data regarding private universities could not correctly be compared over time (the number of students enrolled in public universities is 93.4%).

The financial data used in this paper were collected by the *Comitato Nazionale per la Valutazione del Sistema Universitario (CNVSU)*, National Committee for the Evaluation of the University System). They have been reclassified following a homogeneous scheme supervised by the Italian Finance Ministry. Table 1 illustrates the entries of the revenues. Revenues generated through clearing entries have been excluded because of the financial nature of this accounting system.

Table 1 Italy, balance revenues structure

V1	Tuition fees
V2	Grants and transfers from non-state actors (UE or regions, for example) in the absence of performance
V3	Revenues regarding the sale of commercial goods and services
V4	Property or patrimony revenues (e.g. rents and bank interests)
V5	FFO (block grant assigned by the government to universities for their correct running)
V6	Transfer of patrimony goods (generated by the sale of goods)
V7	Revenues from other actors (both private and public) after an agreement on the destination of these revenues (in these cases a performance from universities is expected)
V8	Funds coming from the central government (research funds allocated after evaluation of specific projects by groups of academics)

The data regarding the universities in England (Wales, Scotland and Northern Ireland are not included) come from the Higher Education Statistics Agency (HESA). For each institution, the budget entries for the eight academic years (corresponding to the fiscal years from 2002-03 to 2009-10) have been considered. A total of 91 institutions have been examined. Universities running for just a few academic years or who have changed their names have been excluded. The sources of income listed in Table 2 have been considered. The total amount of sources for each university matches the total income indicated by HESA.

Given the nature of the data, the most appropriate model would allow a proper treatment of quantitative variables with the aim of summarizing data and highlighting possible similarities and trends.

5 Results

5.1 A first aggregate analysis

The use of diversity indices (a) needs the pre-emptive identification of the profiles and carries out a comparison between various years by analyzing the number of profiles in

Table 2 England, balance revenues structure

V1	Block grant for teaching coming from funding body grants (Higher Education Funding Council for England – HEFCE, mainly)
V2	Block grant for research coming from funding body grants (Higher Education Funding Council for England – HEFCE, mainly - assigned on an RAE basis)
V3	Other incomes from Funding body grants not included in the block grant for teaching and research.
V4	Course fees for non EU-domiciled students (includes fees for every degree, diplomas and similar award-bearing courses for non-home and non EU-domiciled students)
V5	Tuition fees and education contracts (except for non-EU course fees)
V6	Research grants & contracts (This includes all incomes in respect of externally sponsored research carried out by the institution or its subsidiary undertaking for which directly related expenditure has been incurred)
V7	Other incomes - other services rendered (This includes all incomes in respect of services rendered to outside bodies, including the supply of goods and consultancies)
V8	Other incomes (residences & catering operations, Grants from local authorities, incomes from health & hospital authorities, release of deferred capital grants, incomes from intellectual property, other operating incomes)
V9	Endowment and investment incomes

each individual year. This kind of analysis is not suited to revenue diversification data that are quantitative by nature, and which can hardly be considered “discrete” in order to be classified. Besides, there are too many variables to be considered. Nonetheless, to compare different countries or years, it is possible to use the aggregate and normalized indices of the quantitative variables.

A synthetic measure that can be useful to study institutional diversity among different university systems is the ratio between the total income and the total number of students enrolled in a certain year. Figure 1 show the distribution of the ratio in the two countries. The strength of this analysis is that the index allows the behaviour comparison of university systems from many different countries.

Table 3 reports the mean, the standard deviation and the coefficient of variation, $CV = Std.Dev/Mean$.

Table 3 Ratio between the total amount of income and the total number of students enrolled (last year – 2009), Coefficient of Variation

		Mean	Std. Dev	CV
IT	Income	188252654	200147731	1.06
	Student enrolled	23362	23496	1.01
	Ratio	9965	11289	1.13
ENG	Income	192950215	208405327	1.08
	Student enrolled	16375	19979	1.22
	Ratio	19767	45198	2.29

In relation to the university systems analysed here, some glaring differences clearly show up: in Italy the coefficient of quartile variation is 1.13, whereas in England it is 2.29, with respect to the non-diversity concerning the total income amounts.

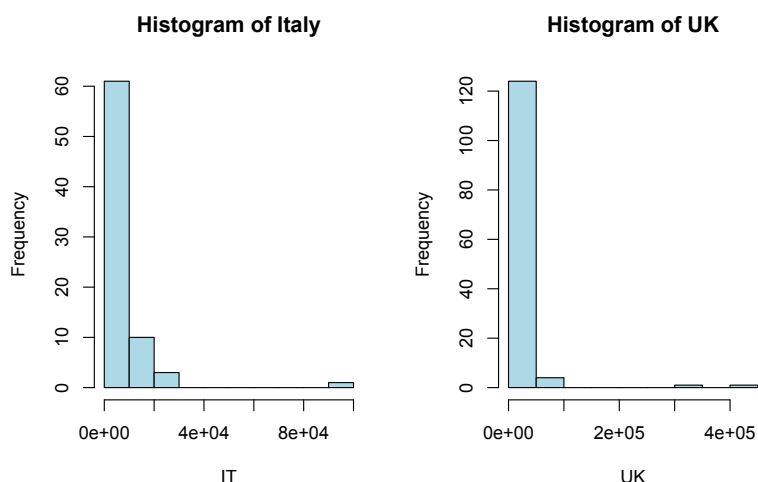


Fig. 1 Histogram of the ratio income-students enrolled in Italy and England

The fact that the English university system shows a coefficient of variation that doubles the Italian one reveals a higher level of diversity in the distribution of revenues amongst its universities. The descriptive analysis shows that the English mean value is markedly higher than the Italian. This demonstrates a major lack of heterogeneity in the ratio between the total amount of income and the students enrolled in Italian universities.

This observation can be improved by focusing on a particular group of universities. In Italy, for example, about 6% of students enrolled in private universities. If we exclude these universities from our examination, we notice that the coefficient of variation falls from 1.13 to 0.44, and the mean value is just slightly over the median. It is therefore possible to state that the weak revenue diversification of the Italian system (if compared to the English one) is related to a small number of private universities. Without them, the Italian system appears to be extremely homogeneous in terms of the ratio between the total income amounts and the students enrolled (in contrast to the situation in England).

The question that arises looking to these results and to Figure 1 is if the difference in the ratio CV depends on the presence of outliers in the two university systems, for the fact that the CV is a not robust measure of variability.

Figure 2 shows the box plot of the ratio in the two countries considering (left part) all the universities and (right part) excluding the universities with ratio higher than 50000. It is even more evident in UK a major diversification than in Italy in terms of income-per-student, regardless of the presence of outliers.

Table 3 shows the *coefficient of quartile variation* [5] $cqv = (Q3 - Q1)/(Q3 + Q1)$, a more robust measure of variability.

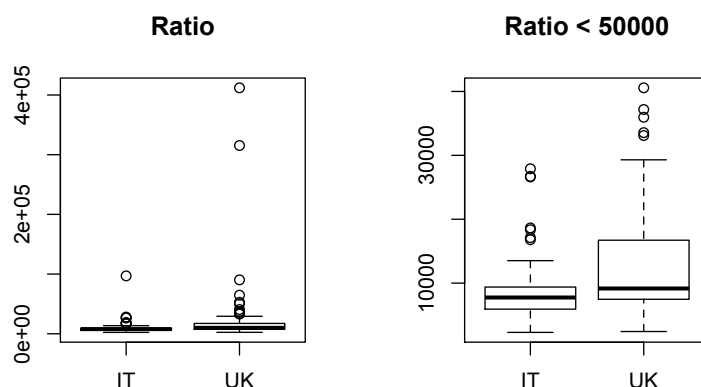


Fig. 2 Box-plot of the ratio income-students enrolled in Italy and England

Table 4 Ratio between the total amount of income and the total number of students enrolled (last year – 2009), Coefficient of quartile variation

		Q1	Q2	Q3	cqv
IT	Income	53209726	135372957	236005188	0.63
	Student enrolled	7777	15558	31688	0.61
	Ratio	5924	7776	9404	0.23
ENG	Income	56736661	150136573	233053051	0.61
	Student enrolled	5031	15065	23187	0.64
	Ratio	7490	9943	17341	0.40

In Italy the coefficient of quartile variation is 0.23, whereas in England it is 0.40. The index for England, also in this case, is double with respect Italy and, moreover, the total income amounts have the same variability.

This analysis could also be enhanced by determining (in relation to each single university system, thus losing any chance to compare it to other systems) which entries contribute most to diversity in a university system. It is now possible to verify which revenue entries, in each one of the two systems, mostly contribute to increase revenue diversification.

In England, the variable that has the highest coefficient of variation is the one regarding *other incomes – other services rendered*, followed by *endowment and investment* and *research grants and contracts*. The first two entries appear to relate to diversity in universities and the way in which they apply funding policies and receive funds from enterprises. The difference between the coefficients of variation of the recurrent grants for teaching and research is quite remarkable; it highlights the English government's will to assign research funds with different criteria to the ones dedicated to teaching. Actually, since the 1980s, research funds have mostly been

Table 5 Italy – Coefficient of variation of each budget entry

IT		
V1	Tuition fees	1.16
V2	Grants and transfers from non-state actors	3.27
V3	Revenues regarding the sale of commercial goods and services	1.54
V4	Property or patrimony revenues	2.83
V5	FFO	1.09
V6	Transfer of patrimony goods	6.52
V7	Revenues from other actors	1.25
V8	Other funds coming from the central government	1.06

Table 6 England - Coefficient of variation of each budget entry

England		
V1	Block grant for teaching	0.80
V2	Block grant for research	1.82
V3	Other incomes from funding body grants	0.81
V4	Course fees for non EU-domiciled students	1.11
V5	Tuition fees and education contracts (except for non-EU course fees)	0.75
V6	Research grants & contracts	2.20
V7	Other incomes - other services rendered	4.16
V8	Other incomes	1.17
V9	Endowment and investment income	2.37

based on the RAE (Research Assessment Exercise) results with the declared aim of allocating resources to universities in a fair but not egalitarian way [29].

Conversely, in Italy, the level of university diversification is particularly high for the *transfer of patrimony goods*; that is, the revenues coming from the sale of assets (extraordinary operations involving a very high amount of money that take place only in certain universities). Also, the *grants and transfers from non-state actors* are greatly affected by the way in which some regions support the universities (this support is traditionally higher in Southern Italy because of the allocation of specific European funds). The diversity of university budgets does not seem to be influenced by national policies, but is related to temporary events (such as transfer of real estates) and certain environmental conditions (such as regional funds for universities). Similarly the market is not a factor inducing diversification in the Italian university system.

5.2 Longitudinal and multidimensional analysis of budget entries

As previously mentioned, another technique employed in literature to study diversity is cluster analysis (b). Cluster analysis does not allow us to perform longitudinal analysis, but, at best, allows some descriptive comparisons between classifications obtained in different periods of time.

In this section, diversity is examined not in relation to the individual variables but to the overall budget structure in various years. This allows considering diversity in relation to the behaviour of the individual universities.

First of all, the progress of the confidence intervals of the means of the distances between all the variables that appear in the budget entries is examined. Through this longitudinal analysis, it is possible to understand whether diversity among institutions has changed through time. But instead, if we observe the configuration map, it is possible to identify the existence of universities having more similar budget structures. The analysis has been carried out separately for Italy and England because the statistical method employed does not allow comparisons between universities (Italian and English universities in this case) with different budget structures.

As far as Italy is concerned, we immediately observe that the mean of the distances among universities (as previously stated) is a synthetic measure for diversity. It is important to stress that the upper triangular matrix of the squared Euclidean distances of the percentages of the individual budget entries in relation to the total amount of incomes for each university has been calculated. Then, it has been compared with all the others and a new mean has been obtained. The use of the percentages, as already underlined, explores the effect that the dimension of the university could have on the absolute values. To take a squared distance for the same universities every year makes it possible to use means as a comparative measure. The confidence interval also takes into account the variability of the distances. Figure 2 displays the confidence intervals regarding the means of the distances for each year in Italy. This observation shows the absence of significant changes in diversity among universities. Surely there have not been any increasing or decreasing trends. We can see a slight increase between 2003 and 2004 and a subsequent decrease of global diversity in the years 2005 and 2006, but then we notice that these data settle back to the initial levels between 2007 and 2009.

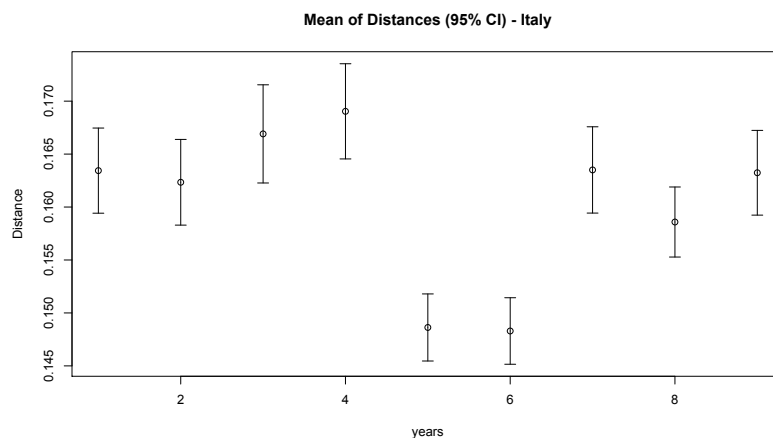


Fig. 3 Mean of Distances (95% Confidence interval) for Italy

In Figure 3, the left hand graphic shows the group configurations plot, which is the bidimensional representation of the distances for each university and each year. Looking at the map, it is possible to answer, first of all, the question on diversity: as universities become more scattered on the map, diversity becomes higher. It is also possible to conjecture if homogeneous groups of universities exist and which university is more similar to which. The graphic on the right helps interpret the clusters and the positions of the universities. The universities on the left of this graphic are characterized by a low percentage of FFO (P5 variable); those on the top right corner by a remarkable percentage of revenues from other actors (P7); those on the bottom right corner by a low percentage of funds from non-state actors (P2); and those below the horizontal zero by a high percentage of tuition fees (P1) on the total number of entries.

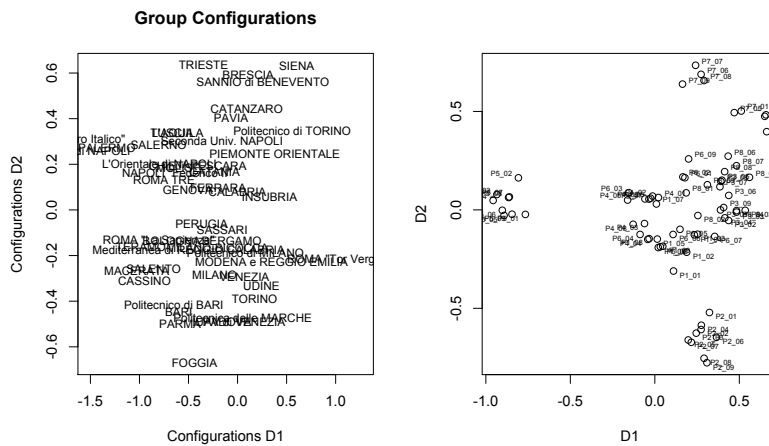


Fig. 4 Group configuration for Italy, plot of cases and plot of variables

In Figure 3, in the right graphic, variables are shown along with their reference year. Figure 4 gives a clearer idea of the time trends of the variables, where the correlations between the final configurations and the original variables for each year have been plotted. Judging by this graph, it is even clearer that the P7 (revenues from other services) variable is positively correlated to both the D1 coordinate on the x-axis and the D2 coordinate on the y-axis. It is also possible to observe that such correlation decreases over the years for D1 and increases for D2. The other two variables characterize the dimensions D1 and D2; but, due to negative correlations, they are P5 (FFO) and P2 (revenues from other subject) respectively. In this case, the progress is more or less constant in time, even though we record a slightly decreasing trend for P2 in the D2 configuration.

For England, the graph of the means that constitute the upper triangular matrix for one year (Figure 5) shows that diversity among institutions decreased in 2002–2003 and 2009–2010, and then levelled off from 2006–2007 on.

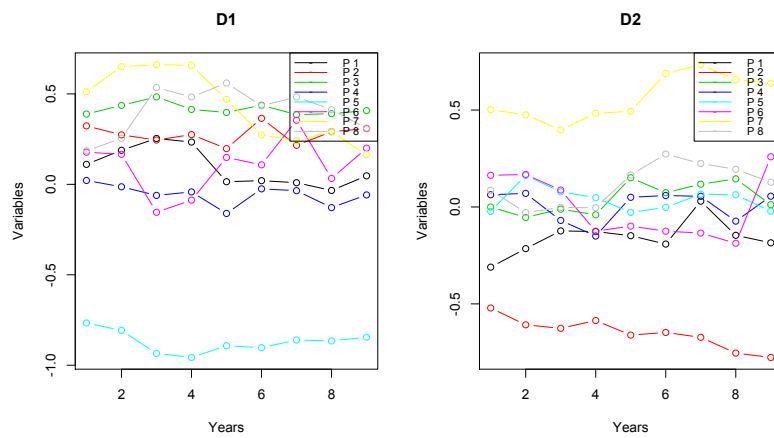


Fig. 5 Correlations between coordinates and original variables over years in Italy

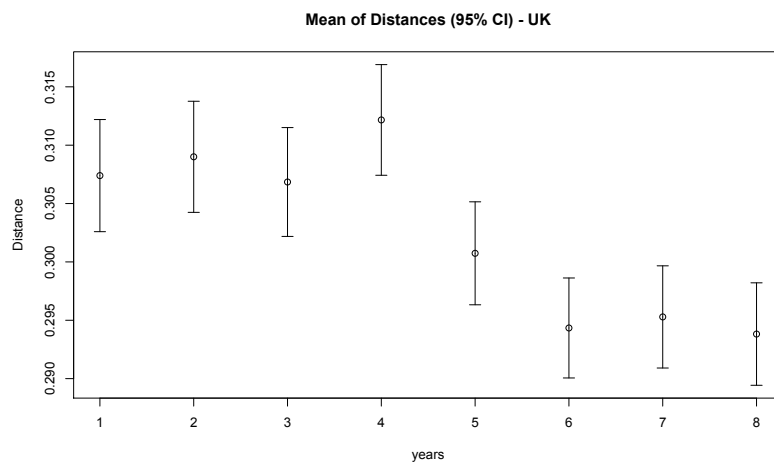


Fig. 6 Mean of Distances (95% Confidence interval) for England

The general map for England shows a quite dense and wide cloud of points in the middle. It is surrounded by some isolated points; that is, universities considered abnormal compared to the rest (Figure 6). Clearly, among English universities there is a structural variability in the budget entries, as the width of the cloud and the magnitude of the means of the distances illustrate.

Looking at Figures 6 and 7, it is possible to point out the variables that mainly characterize the final coordinates of the English map. P2 (block grant for research) and P6 (research grants and contracts) are the variables positively correlated to D1, and the correlation is stable over time. In a less effective way, it is also positively correlated to P8 (other income). However, P3 (other entries from funding body grants),

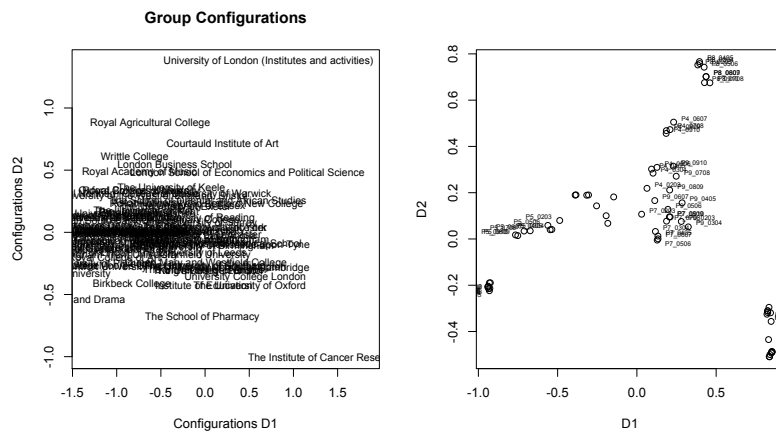


Fig. 7 Group configuration for England, plot of cases and plot of variables

P5 (tuition fees and education contracts) and P9 (endowment and investment income) are negatively correlated. P9 is even more correlated than the other two, and with a constant correlation over time. For P3 and P5, from 2006 on it is possible to notice a decrease and an increase respectively.

Hence, to be placed in the bottom left corner of the graph means to have high-percentage values for P2 (block grant for research) and P6 (research grants and contracts), and low-percentage values for P5 (tuition fees and education contracts) and P4 (course fees for non-EU students).

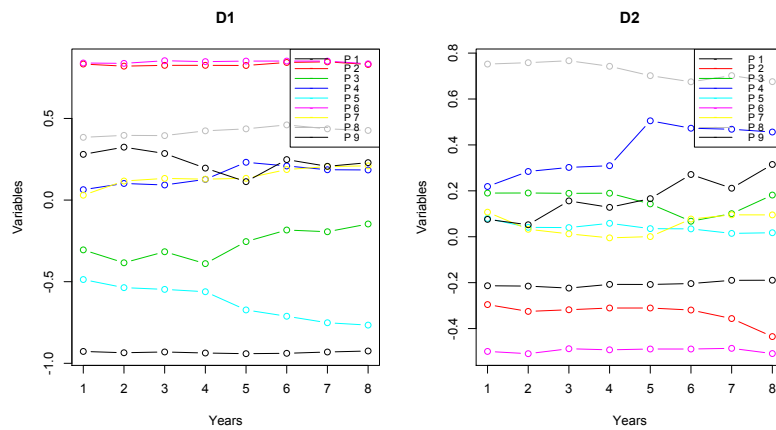


Fig. 8 Correlations between coordinates and original variables over time for England

The analysis carried out with MDS allows us to conclude that, in terms of budget composition, Italian universities are quite similar, but with some differences observable in a longer time frame. These differences are mainly due to P2 (transfers from grants and non-state actors) and P7 (revenues from other entities). So, the ability of a university to be different is related to entries that are other than state funds; they are linked to the entrepreneurial skills of the universities themselves.

Conversely, in England, it is not possible to identify homogeneous groups of universities with similar features, but in some way a constant differentiation through time emerges. This differentiation is structural. It is related to such a variety of budget entries that it suggests the presence of diversified budget strategies in these universities.

6 Conclusion

In this paper the national case studies are discussed in order to measure institutional diversity and to examine the causes and the determinants of diversity. A thorough examination of the institutional differentiations in Italy and England would actually require an analysis of the historical and institutional backgrounds of their university systems, and a consideration of the complex interactions between the universities and their environments at the institutional and systemic levels [50, 16]. The objective of this article is instead mainly methodological; that is, to show the high potential of revenue data for measuring the level of institutional differentiation underlying a university system and how this differentiation changes over time. This approach does not deny the fact that, while measuring diversity through revenue data, there may arise useful elements in understanding the determinants of diversity in Italy and England and (more generally) in contributing to the debate on institutional diversity. Furthermore, the analysis helps identify what are the most significant revenue in terms of differentiation among universities allowing to verify if the variation is therefore function of system elements, reward mechanisms related to the allocation of government resources, or the behavior of single university, ability to attract non-governmental resources.

From the methodological point of view, the first analysis produced a simple and aggregate index - the ratio income and number of students enrolled, which allows to compare, only with regard to that index, the two different countries. The second analysis is rather multidimensional and longitudinal. The aim of the work was to study the diversity over time; the two statistical techniques described by Huisman [21], cluster analysis and dimensional reduction could be applied only to a few years with a cross-section approach. The panel nature of the data is instead analyzed using the algorithm SMACOF to minimize the *stress* function of the MDS adapted by de Leeuw and Mair [12]. This approach make possible to obtain both the group analysis that the dimensional reduction proposed by Huisman [21] but taking into account the longitudinal nature of the data.

The implementation of methodologies permits to contribute to the debate on diversity. In particular it is possible see a weak differentiation among revenue data in Italian universities. The main differentiations are induced by transfers from non-state actors and revenue from other actors. The longitudinal analysis has indicated that

the entries connected to the sale of property (extraordinary by nature) is not relevant (in a longitudinal perspective they have a small impact), whereas the entries from non-state actors remain far more relevant, which means local actors tend to support universities. Besides, MDS highlights the role of the income from other actors; that is, the ability of a university to attract public and private revenues in exchange for performances. In terms of differentiation, the non-relevance of all the entries from the state and from the sale of commercial services confirms respectively the absence of government policies about differentiation and the weak role of the market. In England a constant differentiation over time emerges. This confirms what was ascertained through the first analysis: the plurality of budget entries correlated to diversity indicates that the diversity of the English revenue is a structural phenomenon stemming from the joint efforts of government policies (block grant for research); actions improving didactics promoted by the universities (tuition fees and education contracts); research (research grants and contracts); and entrepreneurial projects for universities (endowment and investment income).

On the basis of resource dependency theory which suggests a close and continuous correlation between an organization and its environment based on a reciprocal adaptation between the behaviours of an organization and the critical resources for its survival the results can be interpreted on two levels.

The first interpretation regards the determinants of differentiation. The Italian data do not highlight differentiation-inducing actions from either the government or the market. Conversely, in England, an active role in introducing differentiation is shown by the governments research policies and the competition of the universities to obtain resources. The ways in which a government funds universities impacts their behaviours and thus the level of diversity in a university system, which is practically a prerequisite to trigger differentiation of universities. This consideration has relevant operational implications. Governments, when establishing the mix of state funding, should first reflect on the level of diversity within a university system. Besides the role of the state is not limited to the definition of allocation mechanisms of public funding but it is important also in relation to differentiation by establishing the degree of institutional autonomy the universities can have (for instance with reference to the possibility to differentiate or increase in tuition fees). At the same time, the English case shows that market opening and competition among universities promotes diversity among universities. This element can be very clearly highlighted by revenue data analysis, which also points out a strong concentration of resources in a few top universities. As shown by Jongbloed [23] and Teixeira et al. [52], the collected data confirm that the combination of the effects of state regulation and market forces impact the level of diversity in a university system on the basis of non-automatic interactions.

The second interpretation of the data, regarding the time trend of diversity, provides a second level of analysis. The decreasing differentiation trend in England revives the debate as to whether more competition to obtain resources could lead to more [44] or less specialization [20]. Although in the English university system there are conditions structurally triggering competition (such as competitive mechanisms to distribute the governments research funds and competition for tuition fees), there is indeed a decrease, or at least a mitigation of differentiation. Italys continued trend,

however, suggests that when there are no external stimuli organizations do not tend to differentiate their behaviours. At least in respect of the two national case studies examined in this paper, we can conclude that there are significant forces opposing differentiation and promoting imitation of behaviours among universities and homogeneity among university systems [33]. Furthermore, these forces have a very relevant impetus in that universities strategically respond to governmental policies as well as to the actions of other universities [16]. The collected data, especially in the English case, suggests the assumption that the stronger ones are stimuli in terms of government regulation and competition among universities, where the stronger is the tendency to imitate behaviours of other universities and also to adopt strategic behaviours. However, this is a hypothesis which needs to be discussed and tested by further studies.

The complexity of the determinants of institutional diversity and the absence of automatic mechanisms [46] stress the importance of taking into account revenue data when studying institutional diversity. It does not imply that tried-and-tested approaches need to be replaced, but they can be supported and integrated by the range of information and methods of statistical analysis deriving from the use of revenue data. Future studies may move in this direction as well as to verify the possibility for adopting reclassifications that allow comparing the budgets of different countries (thus favouring broader comparability). Another future line of research could be the analysis of the outcome of the variation of the composition of budgetary revenues in terms of diversity. The two university systems in this study show recent changes (subsequent to the data examined in this paper and thus not taken into consideration), which can be the subject of useful examinations: in England, the reduced state funding for teaching in the face of increased tuition fees [19]; and in Italy, the reduction in government funding (FFO) and the increased share of FFO distributed on the basis of university performance [56].

Acknowledgements We are grateful for the financial support of the project MIUR PRIN MISURA - Multivariate models for risk assessment.

References

1. Aldersley, S.F. (1995). 'Upward drift' is alive and well. Research/doctoral model still attractive to institutions. *Change* 27, no. 5: 50–56.
2. Andrews, L., Aungles, P., Baker, S., & Sarris, A. (1998). Characteristics and performance of higher education institutions (A preliminary investigation). Canberra: DEETYA.
3. Birnbaum, R. (1983). *Maintaining institutional diversity*. San Francisco: Jossey-Bass.
4. Bohmert, D. (2010). Mapping (classification): new higher education transparency tool. Paper presented at the ENQA seminar Quality and Transparency in Higher Education: Expectations, Tools and the Link to Institutional Autonomy, Bologna, Italy

5. Bonett, D. G. (2006). Confidence interval for a coefficient of quartile variation. *Computational statistics & data analysis*, 50-11: 2953-2957.
6. Borg, I., & Groenen, P. (1997). *Modern multidimensional scaling: theory and applications*. New York: Springer.
7. Codling, A. & Meek, L. (2006). Twelve Propositions on Diversity in Higher Education, *Higher Education Management and Policy*, 18 (3), 23-47.
8. Conceição, P. & Heitor, M. V. (1999). On the Role of the University in the Knowledge Economy, *Science and Public Policy*, 26(1): 37-51
9. Capano, G., (2011). Government continues to do its job. A comparative study of governance shifts in the higher education sector. *Public Administration* 89: 1622–1642
10. Cox, T. F & Cox, M. A. A. (2001). *Multidimensional scaling*. CRC press.
11. de Leeuw, J. (1977), *Applications of convex analysis to multidimensional scaling*, in Barra, J. R.; Brodeau, F.; Romie, G. et al., *Recent developments in statistics*, pp. 133-145 .
12. de Leeuw, J. & Mair, P. (2009). *Multidimensional Scaling Using Majorization: SMACOF in R*, *Journal of Statistical Software*, No. 31-3.
13. Dill, D. D., & Teixeira, P. (2000). Program diversity in higher education: An economic perspective. *Higher Education Policy*, 13(2), 99–117.
14. Eastman, J.A. (2006) Revenue Generation and Organisational Change in Higher Education: Insights from Canada. *Higher Education Management and Policy*, 18(3): 55 - 81
15. Freeman, J. (1973) Environment, technology and the administrative intensity of manufacturing organizations. *American Sociological Review*, 38: 750-763.
16. Fumasoli, T. & Huisman, J. (2013) Strategic Agency and System Diversity: Conceptualizing Institutional Positioning in Higher Education. *Minerva* 51 (2): 155-169.
17. Geiger, R.L. (1996). *Diversification in US higher education: Historical patterns and current trends*. In V.L. Meek, L. Goedegebuure, O. Kivinen, & R. Rinne (eds.) *The mockers and the mocked: Comparative perspectives on differentiation, convergence and diversity in higher education* (188–203). Oxford: Pergamon.
18. Hannan, M.T., & Freeman, J. (1977). The population ecology of organizations. *American Journal of Sociology* 82: 929–64.
19. HEFCE – Higher Education Funding Council for England (2013) Guide to funding and student number control 2013-14. How HEFCE allocates its funds and controls student numbers. <http://www.hefce.ac.uk>
20. Huisman, J. & Mophew, C. C. (1998). Centralization and Diversity: Evaluating the Effects of Governmental Policies in U.S.A. and Dutch Higher Education. *Higher Education Policy*, 11 (4), 3–13.
21. Huisman, J. (2000). Higher Education Institutions: as Different as Chalk and Cheese? *Higher Education Policy*, 13 (1), 41–53.
22. Huisman, J., Meek, L. & Wood, F. (2007) Institutional Diversity in Higher Education: a Cross-National and Longitudinal Analysis. *Higher Education Quarterly*, 61(4): 563-577

23. Jongbloed B., de Boer H., Enders J., File J. (2010), Progress in Higher Education Reform Across Europe: Funding Reform. Cheps: http://ec.europa.eu/education/news/news2259_en.htm
24. Kruskal, J. B. (1964). Multidimensional scaling by optimizing goodness of fit to a nonmetric hypothesis. *Psychometrika*, 29, 1-27.
25. Kruskal, J. B. & Wish M. (1978). *Multidimensional scaling*. SAGE press.
26. Lawrence, P. & Lorsch, J. (1967). Differentiation and Integration in Complex Organizations. *Administrative Science Quarterly*, 12, 1-30.
27. Lepori, B., Usher, J. & Montauti, M. (2013) Budgetary allocation and organizational characteristics of higher education institutions: a review of existing studies and a framework for future research. *Higher Education* 65:59–78
28. Maassen P. & Potman, H. (1990) Strategic decision making in higher education. An analysis of the new planning system in Dutch higher education. *Higher Education*, 20: 393-410
29. Martin, B.R. & Whitley, R. (2010). The UK Research Assessment Exercise: a case of regulatory capture? In R. Whitley, J. Gläser & L. Engwall (Eds), *Reconfiguring Knowledge Production: Changing Authority Relationships in the Sciences and Their Consequences for Intellectual Innovation* (pp. 51-80) Oxford: Oxford University Press
30. Meek, V. L. (1991). The transformation of Australia higher education from binary to unitary system. *Higher Education*, 21(4), 461-494
31. Meek, V. L., Goedegebuure, L. & Huisman, J. (2000). Editorial: Diversity, Differentiation and the Market. *Higher Education Policy*, 13(4), 1–6.
32. Meyer, J. and Brian R. (1977) Institutionalized organizations: Formal structure as myth and ceremony. *American Journal of Sociology*, 83: 340-363.
33. Morphew, C. (2009). Conceptualizing Change in the Institutional Diversity of U.S. Colleges and Universities *The Journal of Higher Education*, 80(3), 243-269
34. Moscati, R. (2001). Italian university professors in transition. *Higher Education* 41(1): 103-129.
35. Pfeffer, J. & G. R. Salancik (1978). *The External Control of Organizations: A Resource Dependence Perspective*. New York, NY: Harper and Row.
36. Reborá G. & Turri M. (2011). Critical Factors in the Use of Evaluation in Italian Universities. *Higher Education*, 61 (5), 531-544.
37. Reborá, G. & Turri, M. (2013). The UK and Italian research assessment exercises face to face. *Research Policy* 42: 1657– 1666
38. Regini, M. (2011) *European Universities and the Challenge of the Market. A comparative analysis*. Cheltenham: Edward Elgar
39. Reichert, S. (2009) *Institutional diversity in European higher education. Tensions and challenges for policy makers and institutional leaders*. European University Association <http://www.eua.be>. Accessed 15 June 2013.
40. Riesman, D. (1956). *Constraint and variety in American education*. Lincoln, NB: University of Nebraska Press.
41. Rossi, R. (2009). Increased competition and diversity in higher education: an empirical analysis of the Italian university system. *Higher Education Policy*, 22(4), 1-25.

42. Rossi, R. (2010). Massification, competition and organizational diversity in higher education: evidence from Italy. *Studies in Higher Education*, 35(3), 277-300.
43. Ruch, R.S. (2001), *Higher Education, Inc.: The Rise of the For-Profit University*, Johns Hopkins University Press, Baltimore
44. Scott, P. (2007), Back to the future? The evolution of higher education systems. In B. Kehm (ed.) *Looking Back to Look Forward. Analyses of Higher Education after the Turn of the Millenium*. INCHER-Kassel 2007 (Werkstat-berichte Nr. 67)
45. Stadtman, V. A. (1980). *Academic adaptations*. San Francisco: Jossey-Bass.
46. Teichler, U. (1998). The changing roles of the university and the non-university sectors. *European Review*, 6(4), 475–487.
47. Teichler, U. (2007). *Higher Education Systems. Conceptual Frameworks, Comparative Perspectives, Empirical Findings*. Rotterdam: Sense Publishers
48. Teichler, U. (2008). Diversification? Trends and explanations of the shape and size of higher education. *Higher Education*, 56,349–379
49. Terrien, F. and Mills, D. (1955). The effects of changing size upon the internal structure of organizations. *American Sociological Review*, 20: 11-13.
50. Teixeira, P. & Amaral, A. (2001) Private Higher Education and Diversity: An Exploratory Survey. *Higher Education Quarterly*, 55 (4): 359–395
51. Teixeira, P. & Koryakina, T. (2011). Funding Reforms and Revenue Diversification – Patterns, Challenges and Rhetoric. *Studies in Higher Education*. 8: 1-18.
52. Teixeira, P., Rocha, V., Biscaia, R. & Cardoso, M.F. (2012) Competition and diversity in higher education: an empirical approach to specialization patterns of Portuguese institutions. *Higher Education*, 63: 337-352
53. Tolbert , PS. (1985). Institutional Environments and Resource Dependence: Sources of Administrative Structure in Institutions of Higher Education *Administrative Science Quarterly*, 30(1): 1-13
54. Tooley, J. (2001), *The Global Education Industry*, Institute of Economic Affairs, London.
55. Trow M. (1973). *Problems in the Transition from Elite to Mass Higher Education*. Carnegie Commission on Higher Education. Berkeley: Berkeley Press.
56. Turri, M. (2014) The difficult transition of the Italian university system: growth, underfunding and reforms. *Journal of Further and Higher Education*. In press
57. Van Vught, F. (2008). Mission diversity and reputation in higher education. *Higher Education Policy* 21(2), 151–174.