

The Heterogeneity of Non-academic Staff and its Relationships with the Performance of European and US Universities

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Abstract

The new public management paradigm, the raise of the number of students and a stronger international competition in attracting external funds for large research projects have lead universities to increase the number and role of non-academics. Non-academic staff may be beneficial to university performance if it supports the main activities carried out by the academic staff. On the other hand, it may be detrimental for university performance if it translates in an increase of administrative burden. We shed new lights analyzing European and US universities. We consider the heterogeneity of non-academic staff as an “unobserved” factor and estimate it non-parametrically. We find indeed some differences of unobserved heterogeneity between Europe and the US. In the case of US universities, the latent variable is positively correlated with publication activity and core funding, while, for Europe, the relationships are inverse.

1. Introduction

In the last two decades, the new public management paradigm, the raise of the number of students and a stronger international competition in attracting external funds for large research projects have lead European universities to a corporatization process, namely, changing their organization and governance with the aim of operating more like private organizations and thus enhancing their productivity and efficiency (Szekeres 2006, De Boer et al. 2007; Deem et al. 2007, Bleike et al. 2011). To deal with this organizational evolution and to support the efforts of the academic staff to effectively face these new and complex challenges, the number of non-academic (both administrative and technical) personnel have raised as well as their roles have become more crucial, even in the strategic planning process (Mcinnis 1998, Gornitza and Larsen 2004, Graham 2013, Veles and Carter 2016, Baltaru 2019). Therefore, non-academic staff often results to be a big part of the total staff of the university (in many cases, even larger than the academic staff) and it is located in every organizational structure of the organization (e.g. departments, faculties, central offices).

Non-academic staff is usually characterized by a multitude of very different professional roles. For instance, general staff may include technical personnel, maintenance staff, office workers and high professional administrative personnel. However, while the role of academic staff for university performance is clear (professors teach, do research and possibly other knowledge transfer activities), the contribution of non-academic staff is more vague. Non-academic staff may be beneficial to university performance if it supports the main activities carried out by the academic staff. On the other hand, it may be detrimental for university performance if it translates in an increase of administrative burden to academics that subtracts time to teaching and research. Avenali et al. (2022) in a recent study on the determinants of the non-academic staff incidence in higher education institutions analyse how the proportion of non-academic staff is related to key features such as size, prestige, year of foundation, and financial structure of universities. They find that both in Europe and in the US, public and larger (if sufficiently large) as well as more research-oriented HEIs are characterized by a higher proportion of non-academic staff. In Europe, they observe an inverted U-shaped effect of the share of non-personnel expenditure and the foundation year on the proportion of non-academic staff, while the proportion of non-academic staff decreases with the share of core and third-party funding. For the US, they obtain similar findings except that the share of core funding and third-party funding is characterized by a U-shaped effect, and the impact of the share of non-personnel expenditure has no empirical effect on the proportion of non-academic staff. Additionally, they conclude that some factors that contribute to the proportion of non-academic staff may constitute indicators of performance, suggesting the need for further research.

We shed new lights on this relevant topic analysing the impact of the heterogeneity of non-academic staff on the performance of universities. We estimate the unobserved heterogeneity of the non-academic staff in European and US universities, and compare their performance in an indirect comparative way.

The contribution of our analysis is manifold. First, we assess the effect of the incidence of non-academic staff on university's performance. Generally, universities produce teaching, research and the so-called "third mission" outputs by using their resources, including capital investment and infrastructures, academic staff and non-academic staff, being localized in a city/region/country with a specific level of economic and cultural development. However, in the complex production process of contemporary universities, it is difficult to disentangle the contribution of each input of production on the outputs produced. To carry out the analysis we apply a one stage non-parametric regression-type procedure which allows us to make inference on the impact of the non-academic staff on the conditional efficiency scores (Badin et al. 2012). By means of a nonparametric efficiency analysis (assessing the

performance considering the inputs used to produce the maximum feasible outputs, given the external factor), we find a U-shaped impact of the percentage of non-academic staff on the best practices. Then, we consider the heterogeneity of non-academic staff as an “unobserved” factor and we estimate it non-parametrically. Indeed, moving from standard production activities towards complex production processes induced a significant raise of the importance of the role of human capital. On the other hand, however, it gets more ambiguous to define what the effectiveness of non-academic staff inside these complex university processes is and how it can be quantitatively assessed. When people are involved, it is more difficult to collect all the information related for instance to their efforts, motivation, skills and ability. Human capital and managerial tasks coordination and activities related to people in general are very difficult to measure quantitatively. To estimate the (unobserved) heterogeneity of non-academic staff then, we follow the approach proposed by Simar et al. (2016), which allows us to identify a latent factor linked to some input, as extended to the estimation in efficiency analysis in Daraio et al. (2021).

2. Data

The main source of the data for Europe is the European Tertiary Education Register (ETER, www.eter-project.com) which gives an open access to a cross-country database at the level of individual HEIs containing information of their characteristics, such as financial resources, staff, students’ enrolment, graduates etc. Our analysis is restricted to the sample of universities defined as academic institutions with the right to award doctoral degree (as opposed to university of applied sciences, college, vocational schools). Additionally we exclude also distance education universities where off campus teaching (e.g. through online courses) constitutes a substantial component of the educational offer which affects the staff structure and students to staff ratios. Further, we limit the sample to the balanced panel of those HEIs reported for the subsequent six years from 2011 to 2016. As a result, we possess information on 508 HEIs from 17 countries.

In Table 1 we present the key descriptive statistics on the institutions in our sample and on Figure 1 the cross-country comparison of non-academic staff to total staff ratio.

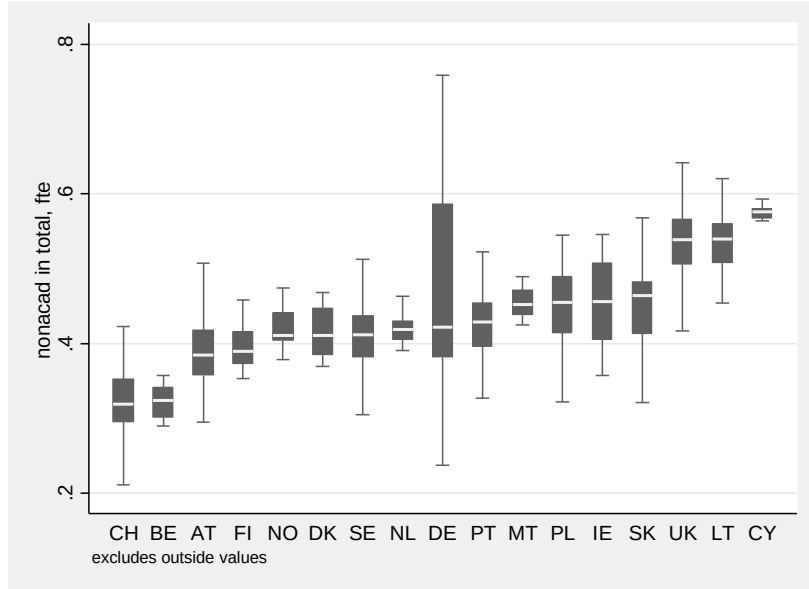
Table 1. Key statistics on HEIs – mean values by country, time period 2011-2016.

	Number of students per academic staff	Revenue per Academic staff per year in ppp	Core budget to total budget	Third party budget to total budget	Publications per academic staff member	Participation in EU projects
AT	11.2	165266.7	0.76	0.16	0.56	44.7
BE	6.2	112439.7	0.49	0.23	0.91	141.1
CH	5.5	157441.7	0.70	0.23	0.79	112.0
CY	16.8	270473.2	0.60	0.17	1.30	66.8
DE	10.9	127182.8	0.70	0.25	0.58	43.9
DK	10.2	137772.5	0.68	0.28	0.61	122.8
FI	9.2	125610.0	0.78	0.22	0.75	45.8
IE	14.0	184565.2	0.21	0.32	0.88	86.6
LT	14.4	91584.5	0.41	0.36	0.25	7.9
MT	11.5	101481.2	0.79	0.07	0.19	31.5
NL	10.4	233090.9	0.56	0.27	1.68	154.4
NO	11.0	154543.2	0.78	0.18	0.73	43.3
PL	16.4	102954.9	0.70	0.09	0.27	6.8

PT	12.0	112519.9	0.71	0.12	0.87	27.2
SE	20.1	178256.3	0.72	0.26	0.75	61.0
SK	12.6	100806.7	0.91	0.03	0.19	5.5
UK	17.2	214707.9	0.29	0.16	0.62	59.4

Source: own elaboration based on data from ETER, CWTS and EUPRO

Figure 1: Non-academic staff to total staff, FTE – across countries, all years.



The main source of data for the US higher education institutions is the Integrated Postsecondary Education Data System (IPEDS). The final sample includes the institutions classified as public or private not-for-profit 4-year or longer, including institutions conducting research, excluding specialist (one-field) institutions such as: theological seminaries or medical schools (according to Carnegie classification): for which CWTS provides data on publication records and which are recorded in all analysed years (balanced panel). The final sample includes 341 HEIs.

3. Methodology

We assume that heterogeneity of nonacademic staff may be an unobserved (latent) factor of production and may affect the performance of universities. We propose to use the approach suggested by Simar et al. (2016), which allows identification of a latent factor linked to some input as extended to the estimation of efficiency analysis in Daraio et al. (2021).

Let us assume, without loss of generality, that the latent heterogeneity factor, LQ is linked to the input X and that we can write the link through the following nonparametric model

$$X = \gamma(W, LQ) \quad (1)$$

Where W is an auxiliary variable, correlated to X but independent of LQ . This model is nonseparable in LQ (see Matzkin, 2003). The classical assumptions of the model are:

- monotonicity (increasing) of γ with respect to LQ, and
- LQ is uniformly distributed on [0; 1]; this is just a rescaling of LQ such that it can be interpreted as a quantile.

It is known that under these assumptions LQ is identified by the conditional distribution of X given W

$$LQ = F_{X|W} \quad (2)$$

Hence, we can see the latent heterogeneity variable LQ as the part of X which is independent of W.

The choice of the input X and of the auxiliary variable W are crucial to identify the latent heterogeneity variable we are interested in. We may identify latent quality factors using a different auxiliary variable for each input (Simar et al. 2016) or we could even use the same auxiliary variable for identifying latent heterogeneity factors linked to different inputs. As pointed in Simar et al. (2016), it has to be noticed that the function γ is unknown and in nonseparable models like (1) LQ plays the role of residual. Under the monotonicity assumption, LQ is identified by (2) and since LQ is uniform on $[0; 1]$, γ can be interpreted as a quantile function. This is a nice duality property of these nonseparable models. The choice of the uniform distribution for LQ is not a limitation since it is just a matter of rescaling LQ, but if we rescale it in another way, then we lose the natural interpretation in terms of quantile function and cdf (cumulative distribution function). Since γ and then $FX|W$ are unknown, we will estimate them, nonparametrically, by means of kernel methods. For each observation i (university in our case), the latent heterogeneity factor LQ_i will be estimated by a natural estimator given by

$$\widehat{LQ}_i = \widehat{F}_{X \vee W}(X_i | W_i) = \frac{\sum_{k=1}^n I(X_k \leq X_i) K_{h_w}(W_i - W_k)}{\sum_{k=1}^n K_{h_w}(W_i - W_k)} \quad (3)$$

Where K is a kernel function and h_w is a bandwidth parameter that can be estimated on the sample. Once the estimation is carried out, we have to check the independence of $\widehat{LQ}_i$, the estimated LQ factor, from W and the correlation of the partial observed indicators of quality with the estimated latent heterogeneity factor $\widehat{LQ}_i$. The latent heterogeneity factor $\widehat{LQ}_i$ can be viewed as the part of X that is independent of W . In our case, X is the contribution of the Non-Academic staff to the output of university, W is the size of the Non-Academic Staff and the estimated latent heterogeneity measured as a kind of residual, provides us what remains from the contribution of the Non-Academic staff that is independent from the size of the Non-Academic staff (number of people).

4. Results (preliminary)

We estimated the latent heterogeneity variable $\widehat{LQ}_i$ for Europe and the US separately. In Table 2 we show the correlation between this latent variable and main characteristic of European HEIs and in Table 3 the analogous for the US sample.

Table 2. Correlations of selected variables with $\widehat{LQ}_i$ – Europe

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\widehat{LQ}_i$.	1.000							
NonAC_TOT	0.918*	1.000						
Publication_AC	-0.148*	-0.038	1.000					
GRAD_AC	0.370*	0.297*	-0.215*	1.000				
STUD_AC	0.109*	0.023	-0.123*	0.623*	1.000			
CORE_TOT	-0.270*	-0.251*	0.006	-0.106*	-0.004	1.000		
THIRdPARTY_TOT	-0.146*	-0.042	0.321*	-0.519*	-0.440*	-0.254*	1.000	
foundation year	0.119*	-0.023	-0.238*	0.217*	0.119*	-0.019	-0.146*	1.000

Table 3. Correlations of selected variables with $\widehat{LQ}_i$ – USA

Variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(13)
$\widehat{LQ}_i$.	1.000							

NonAC_TOT	0.860*	1.000						
Publication_AC	0.245*	0.484*	1.000					
GRAD_AC	-0.058	-0.207*	-0.450*	1.000				
STUD_AC	-0.050	-0.229*	-0.489*	0.883*	1.000			
CORE_TOT	0.168*	0.269*	0.300*	-0.150*	-0.071	1.000		
THIRdPARTY_TOT	0.072	0.272*	0.594*	-0.501*	-0.431*	0.166*	1.000	
foundation year	-0.075	-0.217*	-0.365*	0.415*	0.492*	-0.039	-0.184*	1.000

We find some interesting results, and some differences between Europe and the US. The main difference is related to the correlation between latent variable and the measure of scientific performance (publication per academic staff). In case of Europe there is negative correlation between latent variable and publication record, while for the US the latent variable is positively correlated with publication per academic staff. Additionally, the latent variable is negatively correlated with the ratio *core funding to total budget* in case of European universities and positively for the US sample.

5. Conclusion

Preliminary results show that the latent heterogeneity is correlated positively with scientific performance indicators in case of the US sample and negatively for the European one. Additionally, there is also an inverse correlation for core budget, namely, the latent variable is correlated positively in case of the US sample and negatively for Europe. We can conclude that this unobserved heterogeneity (proxy of the effectiveness of non-academic staff) acts differently in European and US universities. If this findings will be confirmed by further analyses, they will be very important as far as policy implications are concerned. For European universities we find that the effectiveness of non-academic staff does not provide any clear contribution in terms of enhancing the research activity (proxied by the publication records). It should give concern for the university managers.

Open science practices

In case of the European universities the main source of the data is European Tertiary Education Register (ETER, www.eter-project.com) which gives an open access to a cross-country database at the level of individual HEIs. For the US we use the data coming from the Integrated Postsecondary Education Data System (IPEDS), which is open source.

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Author contributions

Alessandro Avenali: conceptualization and methodology. Cinzia Daraio: conceptualization, methodology and formal analysis. Joanna Wolszczak-Derlacz: conceptualization, data curation, investigation, visualisation. All authors: writing original draft.

Competing interests

Authors have no competing interests.

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