Accounting for Compositional Effects in Measuring Inter-Country Research Productivity Differences: The Case of Economics Departments in Four European Countries

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Introduction

Most of cross country studies on research productivity differences do not take into account compositional differences in academic staff force, such as sex, years of experience, origin of PhD studies, even though there are well documented evidence that (a) males tend to publish more than females (Gupta et al., 1999); (b) junior academic staff tend to publish more and in better outlets than senior stuff (Ben-David, 2010); and (c) academic staff with PhD studies in North America tend to be more productive (Katranidis et al., 2014). These aspects of observed faculty heterogeneity affect research productivity and are expected to have an impact on country average performance (Combes et al., 2003)[1].

Methodology and Data

In this paper we use the pure output or the single constant input DEA model, which is also known in the literature as the Benefit-of-the-doubt (BoD) model, to construct in the first stage a composite indicator of research productivity based on publication and citation counts at the faculty staff level. In particular, the BoD model in its multiplier form is given as (Cherchye et al., 2007):

$$\begin{aligned} I^k = \max_{s_i^k} & \sum_{i=1}^{N} s_i^k I_i^k \\ \text{st} & \sum_{i=1}^{N} s_i^k I_i^j \le 1^j \quad \forall\, j = 1, \dots, K \\ & s_i^k \ge 0 \qquad \forall\, i = 1, \dots, N \end{aligned} \tag{1}$$

where I_i^k is the i^{th} sub-indicator of the k^{th} unit, s_i^k are the weights to be estimated, j is used to index units and i to index sub-indicators which in our case correspond to different research outcomes (i.e., publication and citation counts). The BoD model is equivalent to the multiplier form of the input-oriented, constant returns to scale (CRS) DEA model when there is a single constant input that takes the value of one for all evaluated units. Based on this, the dual formulation of the BoD model is given as:

$$\begin{aligned} I^k = \min_{\lambda_j^k} & \sum_{j=1}^{K} \lambda_j^k 1^j \\ \text{st} & \sum_{j=1}^{K} \lambda_j^k I_i^j \ge I_i^k \quad \forall\, i = 1, \dots, N \\ & \lambda_j^k \ge 0 \qquad \forall\, j = 1, \dots, K \end{aligned} \tag{2}$$

where λ refers to intensity variables. Then the results at the country level are obtained by using the aggregation rule suggested by Karagiannis (2013), namely:

$$I = \frac{1}{K} \sum_{k=1}^{K} I^k \tag{3}$$

Thus, the aggregate composite performance indicator equals the simple (un-weighted) arithmetic average of the estimated individual composite indicators.

At the second stage we use Ray (1991) regression model to account for several contextual variables such as country dummies, a sex dummy, years of experience, and origin of PhD studies (i.e., overseas, Europe, home country and inbreeding), i.e.:

$$I^k = h\left(z_r^k\right) + e^k, \tag{4}$$

where r is used to index contextual variables and is $e^k < 0$ represents managerial inefficiency pure of (favorable and unfavorable) contextual variables. After taking into account the impact of contextual variables through (4) we re-calculate faculty level research performance scores and country averages. Our interest is to examine if and by how much these country averages differ from the unadjusted ones obtained via (1) or (2), and which countries are affected the most by the contextual variables.

We apply the above methodology to European faculty members in selected departments of Economics. In particular our sample consists of four countries, i.e., Belgium, Denmark, Greece and Portugal and a total of 383 faculty members and 15 departments. The analysis covers the period 1996-

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2012 and the publication and citation count data come from Scopus database.

Empirical Results

Our main empirical results are summarized in the following tables:

Table 1. Unadjusted Composite indicator vs. efficient and unproductive faculty members.

	Unadjusted Composite indicator	Number of efficient faculty members	Number of unproductive faculty members
Belgium	0.144	1	6
Denmark	0.105	0	10
Greece	0.084	0	9
Portugal	0.062	1	18

Table 2. Number of unproductive faculty members vs. Adjusted Composite Indicator.

	Number of unproductive faculty members	Max value	Standard deviation	Adjusted Composite Indicator
Belgium	6	1	0.18	0.120
Denmark	10	0.588	0.11	0.100
Greece	9	0.667	0.10	0.086
Portugal	18	1	0.13	0.062

According to the unadjusted composite indicator, Belgian faculty members are found to be the more efficient and Portuguese the less efficient. In addition, in these two countries we can find the two fully efficient faculty members we have identified. At the same time these two countries are the ones with the relatively higher heterogeneity in terms of research productivity as indicated by the standard deviation of the unadjusted composite indicator.

When the composite indicator scores are adjusted for the potential impact of the aforementioned contextual variables by means of (4), the resulting efficiency scores change but not as much. They tend to improve a little bit for Belgium, Denmark and Portugal because these countries have a relatively higher percentage of inbred faculty members who in turn perform better compared to other faculty members. On the other hand, Portugal performance is adversely affected by the relatively larger percentage of females (31%) who though publish less than males and this counteract with the positive effect of inbred faculty, resulting in an unchanged national average.

Concluding Remarks

The empirical results indicate that the overall effect of the contextual variables considered is positive for the two northern European countries, i.e. Belgium and Denmark, and negligible for the two southern European countries, i.e., Greece and Portugal. Nevertheless, the two northern European countries perform better than the two southern European countries, regardless of environmental differences.

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