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Conceptualizing and Measuring Performance Orientation of Research Funding Systems

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BACKGROUND AND AIM

The “new funding regime” toward competition (Geuna, 2001; Slaughter and Rhoades, 2004)

• Increasing the share of project funds assigned to research teams within universities and public research organizations (Lepori et al, 2007) — select the best research group;
• Performance-based research funding systems (PBRF) based on the assessment of the research performance at the organizational level (Hicks, 2012; Geuna and Piolatto, 2016) - supporting the best research organizations;
• Increasing costs of evaluation and gaming by researchers (Laudel, 2006).

Aim: to propose a replicable synthetic indicator for the performance orientation of public research funding, which would allow for quantitative comparisons across countries and over time, and to develop an operational methodology for its computation and validation

• Countries involved in the analysis: AT, CH, DE, DK, FR, FI, IT, NO, PL, PT, SE, UK.

• The paper is developed in the framework of a large-study funded by the European Commission on the characteristics of public R&D funding in European countries (PREF, EC- JRC contract PREF no. 154321).
DEALING WITH PERFORMANCE ORIENTATION

Competitive funding is a difficult concept
• Instruments where performers struggle for a limited amount of resources
• Allocation linked to the achievement of certain levels of performance. In this case, the deployment of available resources may exclude beneficiaries with a low performance, or equally allocate funding resources to the achievement of a certain level in performance values.

The consistency of the relationship between competitiveness of funding and performance is a problematic issue (Sandstrom et al., 2016)

Distortions may affect the allocation to performers (peer review functioning, traditions, market effects, Van den Besselaar et al, 2009; Aagaard et al., 2015; Reale and Zinilli, 2017)

Performance orientation
The extent to which performance is taken into account in the decision concerning the allocation of funding
• Attribute of policy design of the process and criteria for allocating
• Not the outcome of the funding distribution between performers
BASIC CONCEPTS (1/2)

Project funding vs Institutional Funding (Lepori et al, 2007)
- Basic division between type of public R&D funding

- Good for cross-country comparison
- Allowing a benchmark for controls of robustness
- Decomposition of GBARD by funding lines and funding instruments

Focus on instruments
- Distinct funding schemes and funding components with similar characteristics in terms of goals and criteria

Consider that a share of research funding is mixed with other tasks (e.g. education, Jonbloed and Vossensteyn, 2016)

Extension of the Hicks’ definition of PRFS
- Instruments can include a share of performance orientation
- Performance orientation can apply also in an indirect way (e.g. negotiation)
- Need to rely on experts’ judgement when formal criteria are not clear and to unpacking formula
**Ex-ante performance orientation** (Nieminan and Auranen, 2010)
- the allocation of funding is based on some expectations of future knowledge production or performance (competitive bid)

**Ex-post performance allocation**
- funding allocation is based on some measures of past performance of a research organization using ex-post evaluation of research outputs

**Allocation mode**
Process through which funding is allocated to beneficiaries
- *Competitive bid* (e.g. project funding, Lepori et al., 2017)
- *Historical* (dominant in HEIs and PROs, Jongbloed and Lepori, 2015)
- *Negotiated* (mixing historical and contracts, Boer et al., 2015)
- *Formula* (mathematical formula based on a set of indicators, Hicks, 2012)

**Allocation criteria**
Criteria used to allocate finding, which can reward
- the ‘merit’ of the proposal (Viner et al., 2006; Grimpe, 2012; van den Besselaar and Leydesdorff, 2009),
- the research performance of an organization using input and output measures (Jonkers and Zacharewicz, 2016)
Public research funding was decomposed into funding instruments associated with their amounts for each year of reference (2005-2014). Each instrument was characterized in terms of allocation mode and allocation criteria, so that scores were assigned based on these two classifications.

<table>
<thead>
<tr>
<th>Allocation mode</th>
<th>Score allocation mode (fixed)</th>
<th>Allocation criteria</th>
<th>Score allocation criteria (based on experts’ assessment)</th>
<th>Ex-ante performance orientation (fixed scores)</th>
<th>Ex-post performance orientation (score allocation mode* score allocation criteria)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Project funding</td>
<td>-</td>
<td>Indifferent</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Institutional funding: competitive bid</td>
<td>-</td>
<td>Indifferent</td>
<td>-</td>
<td>1</td>
<td>-</td>
</tr>
<tr>
<td>Institutional funding: historical allocation</td>
<td>0</td>
<td>Not applicable</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Institutional funding: negotiated allocation</td>
<td>0.5</td>
<td>Output or educational criteria</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Institutional funding: negotiated allocation</td>
<td>0.5</td>
<td>Research criteria</td>
<td>0 ≤ x &lt; 1</td>
<td>0</td>
<td>0 ≤ x &lt; 1 depending on the instrument’s characteristics</td>
</tr>
<tr>
<td>Institutional funding: funding formula</td>
<td>1</td>
<td>Input or educational criteria</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Institutional funding: funding formula</td>
<td>1</td>
<td>Research performance</td>
<td>0 &lt; x ≤ 1</td>
<td>0</td>
<td>0 &lt; x ≤ 1 depending on the instrument’s characteristics</td>
</tr>
</tbody>
</table>

In order to test the robustness of the indicator, we will apply lower and higher bounds on the scores selected by experts for negotiated and formula allocation, since are likely to be contestable measures, on which experts might disagree.
Synthetic indicators on ex-ante and ex-post performance orientation are computed as follows, for a specific year and national system of 12 countries (AT, CH, DE, DK, FR, IT, NL, NO, PL, PT, SE, UK):

**EX-ANTE PERFORMANCE ORIENTATION**

\[
\text{EX-ANTE PERFORMANCE ORIENTATION} = \frac{\sum (\text{funding}_i \times (\text{ex-ante})_i)}{\sum (\text{funding}_i)} = (\text{share project funds}) + \frac{\sum_{\text{institutional}} (\text{funding}_j \times (\text{ex-ante})_j)}{\sum_{\text{institutional}} (\text{funding}_j)}
\]

**EX-POST PERFORMANCE ORIENTATION**

\[
\text{EX-POST PERFORMANCE ORIENTATION} = \frac{\sum_{\text{institutional}} (\text{funding}_j \times (\text{ex-post})_j)}{\sum_{\text{institutional}} (\text{funding}_j)}
\]

Where the sum over \( j \) runs only on the institutional funding instruments since, by definition, ex-ante performance orientation is 1 and ex-post performance orientation is 0 for project funds.

Data have been collected in the framework of a large-study funded by the European Commission on the characteristics of research funding systems in European countries (PREF, contract PREF no. 154321). For this study data have been rechecked and sometimes limitedly modified.
METHODS AND SENSITIVITY ANALYSIS

1. Performing a cross-sectional comparison of the indicator
   → Overview on the national systems and consistency check with literature

2. Checking the coverage of instruments
   → Check of potential issues with the calculation of funding amounts
     (differences between PREF GBARD and ESTAT GBARD, missing data,
     distinction between institutional and project funding)

3. Finding and extracting the influential instruments
   → In order to discover which ones have stronger impact on the indicator

4. Performing a sensitivity analysis
   → Testing alternative scores and observing effects on the rankings of the
     countries for ex-post and total performance orientation
STEP 1: CROSS-SECTIONAL ANALYSIS OF PERFORMANCE ORIENTATION IN THE SELECTED COUNTRIES

- Wide variations among countries
- Limited role of ex-ante PO
- Change in PO due to emergence of ex-post
- Substantial share of non-competitive institutional funding
**STEP 2: CHECKING THE COVERAGE OF GBARD**

*To which extent data cover adequately public national funding?* Differences in the perimeter are likely also to affect the comparability of the performance-orientation indicator.

I. PREF total for total funding are identical to EUROSTAT GBARD data for seven countries, i.e. AT, CH, FI, IT, NO, SE and UK. The PREF total is 16% higher in DE, 12% in DK and 19% in FR. For two countries, PREF total is below the EUROSTAT figures: Poland (-34%) and Portugal (-16%).

II. The main issue concerns so-called exchange funds (i.e. contracts for services awarded by the state, usually by different ministries), which lowers the share of project funding.

III. The distinction between *institutional funds* and *project funds* was further checked in order to single out ambiguous cases.

PREF data provide, with few exceptions, a *reasonably good coverage* of the main funding instruments expected in public funding.

Diverging cases were taken into account in the sensitivity analysis (e.g. subtracting/adding a share of institutional/project funding to the total GBARD).
STEP 3: EXTRACTING INFLUENTIAL INSTRUMENTS
(which exceed 20% either of total funding, or ex-post PO or non-PO and whose scores have strong influence on the indicator)

<table>
<thead>
<tr>
<th>Country</th>
<th>Funding instrument name</th>
<th>Share total funding (&gt;20%)</th>
<th>Share performance ex-post (&gt;20%)</th>
<th>Share non performance (&gt;20%)</th>
<th>FI mode</th>
<th>FI criteria</th>
<th>Level of uncertainty</th>
<th>Score</th>
<th>Low</th>
<th>High</th>
</tr>
</thead>
<tbody>
<tr>
<td>AT</td>
<td>Funding for HE</td>
<td>0.50</td>
<td>0.20</td>
<td>0.10</td>
<td>High</td>
<td>0.10</td>
<td>0.00</td>
<td>0.30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CH</td>
<td>Transfer funds for Federal Institutes of Technology</td>
<td>0.50</td>
<td>0.50</td>
<td>0.25</td>
<td>High</td>
<td>0.10</td>
<td>0.05</td>
<td>0.45</td>
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<tr>
<td></td>
<td>Transfer funds for Cantonal Universities (regional)</td>
<td>0.50</td>
<td>0.20</td>
<td>0.10</td>
<td>High</td>
<td>0.00</td>
<td>0.30</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>DE</td>
<td>Funding for HE (regional)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>High</td>
<td>0.00</td>
<td>0.20</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Funding for HGF (national)</td>
<td>0.50</td>
<td>0.30</td>
<td>0.40</td>
<td>High</td>
<td>0.20</td>
<td>0.00</td>
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<tr>
<td></td>
<td>Funding for F Gh (national)</td>
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<td>0.60</td>
<td>0.60</td>
<td>High</td>
<td>0.40</td>
<td>0.00</td>
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<td></td>
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<tr>
<td>DK</td>
<td>Transfer funds to national universities and university colleges</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>Low</td>
<td>1.00</td>
<td>0.00</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td>Intra-mural R&amp;D expenditure of the government</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>Medium</td>
<td>0.00</td>
<td>0.00</td>
<td>0.10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>FI</td>
<td>Basic grants to universities and polytechnics</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>Low</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
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<tr>
<td></td>
<td>Basic grants to universities and polytechnics</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>Low</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td></td>
<td>Public funding to the PRO sector</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>High</td>
<td>0.00</td>
<td>0.00</td>
<td>0.20</td>
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<td>FR</td>
<td>Intra-mural R&amp;D expenditure of the government</td>
<td>0.50</td>
<td>0.50</td>
<td>0.25</td>
<td>Medium</td>
<td>0.25</td>
<td>0.05</td>
<td>0.25</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Basic state contribution to higher education institutions</td>
<td>1.00</td>
<td>0.15</td>
<td>0.15</td>
<td>Medium</td>
<td>0.15</td>
<td>0.05</td>
<td>0.25</td>
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<tr>
<td></td>
<td>State funding to Public Research Organizations</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>High</td>
<td>0.00</td>
<td>0.00</td>
<td>0.20</td>
<td></td>
<td></td>
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<tr>
<td>IT</td>
<td>State funding to CNRS</td>
<td>0.50</td>
<td>0.50</td>
<td>0.15</td>
<td>Medium</td>
<td>0.15</td>
<td>0.00</td>
<td>0.35</td>
<td></td>
<td></td>
</tr>
<tr>
<td>NO</td>
<td>General University Fund</td>
<td>1.00</td>
<td>0.50</td>
<td>0.50</td>
<td>Medium</td>
<td>0.50</td>
<td>0.40</td>
<td>0.60</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>General University Fund</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>Low</td>
<td>0.00</td>
<td>0.00</td>
<td>0.50</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PL</td>
<td>Funding for HEIs</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>Low</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PT</td>
<td>General University Funds for R&amp;D</td>
<td>1.00</td>
<td>0.70</td>
<td>0.70</td>
<td>Medium</td>
<td>0.70</td>
<td>0.60</td>
<td>0.80</td>
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<td>SE</td>
<td>Transfer funds to national universities and university colleges</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>Low</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Transfer funds to national universities and university colleges</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>Low</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td>UK</td>
<td>MRCF funding to research in HEIs</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td>Low</td>
<td>1.00</td>
<td>1.00</td>
<td>1.00</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Other funding streams</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td>Medium</td>
<td>0.00</td>
<td>0.00</td>
<td>0.10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

For each influential instrument we assigned a certain level of uncertainty on the experts’ assessments.

We focused particularly on instruments based on negotiated or formula allocation mode, whose scores are likely to be contestable examining the available information.

In order to test the robustness of the indicator, we set higher and lower bounds by increasing/decreasing the score by 0.1 for medium and 0.2 for high uncertainty.
Expectedly, countries that have introduced formula-based models by clearly distinguishing between an *historical* and a *performance-oriented component*, the measure is subject to limited uncertainty, while in countries where some performance elements have been introduced within *negotiated allocation* (AT and DE) and country where PROs are more important (FR) the indicator is much more uncertain.
Adding the low/high scores to the share of ex-ante performance orientation from the previous figure, we performed the sensitivity test on total performance orientation.

Since the uncertainty in the measure of project funding is smaller, the aggregated indicator proves to be more stable, particularly for what concerns the ranking of countries.
CONCLUSIONS

A synthetic indicator of performance orientation to figure out the policy designs of the decision makers, and how they balance allocations driven by *ex-ante* and *ex-post* assessment.

- Importance of setting reproducible and robust procedures to avoid misleading interpretations.

The robustness was controlled by:
- Checking the coverage of public national funding instruments;
- Testing the level of uncertainty of the funding criteria scores for the most influential instruments;
- Using sensitivity analysis.

- Next step will include the analysis of changes over time

Uncertainties exist, affecting countries where data are problematic, or suffering from missing values, or where the research system is really complex and the decomposition of performance orientation strongly relies on experts’ appreciation.

However high/low scores generated through the sensitivity analysis do not produce a different positioning between countries.

There is room for improving the strength on the experts’ appreciation (e.g. a small survey).