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Institutional embeddedness and resource competition in higher education funding. A comparative analysis on European countries

Barbara Antonioli Mantegazzini* and Benedetto Lepori**

[*barbara.antonioli@usi.ch](mailto:barbara.antonioli@usi.ch)

Università della Svizzera italiana, via Buffi 13, 6904 Lugano, Switzerland.

[**benedetto.lepori@usi.ch](mailto:benedetto.lepori@usi.ch)

Faculty of Communication Sciences, Università della Svizzera italiana, 6904 Lugano, Switzerland and Laboratoire Interdisciplinaire Sciences, Innovations et Sociétés (LISIS), University of Paris Est, 77454 Marne-la-Vallée Cedex 02, France

Background



Funding in higher education is a crucial issue

- Since the '80, research policies and higher education studies have devoted a lot of attention to changes in the model of allocation of financial resources to Higher Education Institutions (HEIs) in European countries.
- While much effort was devoted to characterize funding allocation systems by country, there is lack of empirical evidence on how characteristics of funding allocation systems affect the distribution of funds between different HEIs.

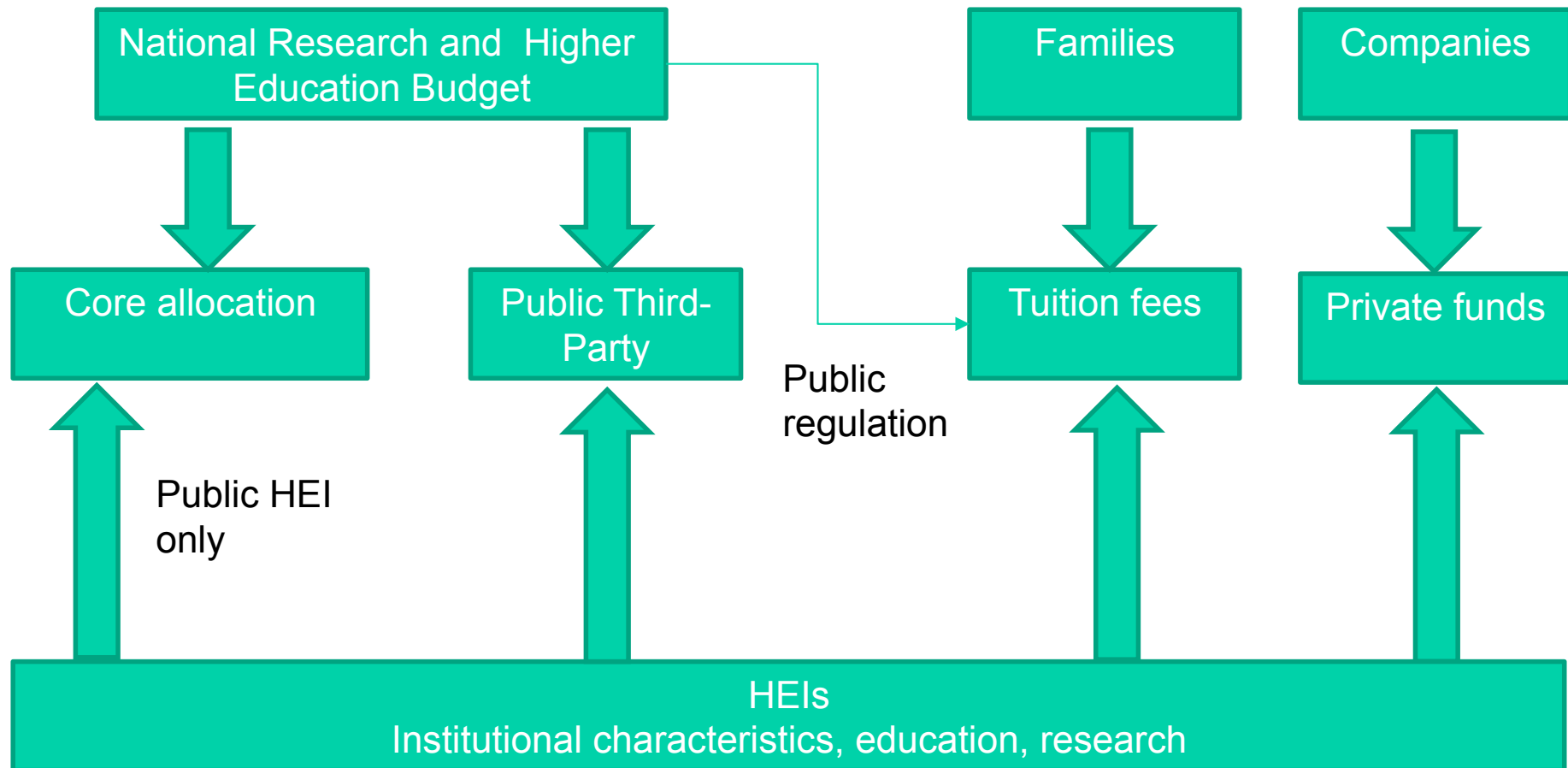
Why investigate this issue?



- **Goal** of the paper: fill the gap, by providing a quantitative analysis of the association between the level of resources of European HEIs and three dimensions:
 - Funding environment at Country level
 - Legal status / Institutional category
 - HEIs characteristics: volume of education and the level of international research reputation

- By using ETER data we analyse separately the impact of these factors on different resource streams for HEIs.

RESOURCE SPACES IN HIGHER EDUCATION



Determinants of resourcing



Characteristics of national systems

- Different level of resourcing from the state to HEIs and their repartition between core funding and third-party funds
- Rules for the allocation of core funds
- Regulations concerning tuition fees
- The readiness of companies to invest in HEIs
- The national wealth, approximated by the GDP per capita

HEI regulatory characteristics

- The public vs. private nature of HEIs
- The distinction between HEI types (mainly Universities vs. other HEIs)

HEI activities

- Volumes of their main activities
 - Education (nr of undergraduate students)
 - Research (nr of publications operationalized through bibliometric impact indicators)
 - Subject composition

Our hypothesis



We have expectations on the importance of each factor for different streams, as well as of the importance of country specificities.

Table 1. Importance of factors in levels of resourcing by stream

Factor	Core funding	Public third-party	Tuition fees	Private funds
<i>Country characteristics</i>				
National wealth	Y	Y	Y	Y
Public investment in tertiary education	Y	Y	N	N
Share of project funding	Y	Y	N	N
BERD	N	N	N	Y
<i>HEI regulatory status</i>				
Legal status	Y	N	Y	Y
Type	Y	N	N	N
<i>HEI characteristics</i>				
Volume of education	Y	Y	Y	Y
Research reputation	Y	Y	N	Y
Subject composition	Y	Y	Y	Y

Empirical approach adopted



Cross-section data (ETER-RISIS register, 2014 data, 19 countries)

■ Three step analysis:

- **Descriptive statistics** to investigate:
 - Funding allocation levels
 - Funding allocation mix
 - Funding allocation differences due to HEIs type and legal status
- **ANOVA** three factors test to investigate relative importance of each dimension (country, legal status and type of HEI) on funding mix allocation.
- **Multivariate regression**, to disentangle the association of the various factors to the observed level of revenues.

Our multi-level model



$$\ln(\text{stream})_{ij} = \alpha + \beta_j (\text{country})_j * \gamma_j \overline{\text{legal}}_j + \delta_j (\text{HEI})_{ij} + u_j + \varepsilon_{ij}$$

Is a Multi-level random intercept model where:

- $\ln(\text{stream})_{ij}$ is the log-transformed amount of resources acquired by HEI i within country j
 - Stream: alternatively Lncorefunding , Lnthirdpublic , Lnthirdprivate , Lnstudentfees
- $(\text{country})_j$ is a vector of country characteristics. Due to collinearity between the original variables (tertiary expenditure in higher education, GDP per inhabitant, share of project in public research funding and business R&D expenditure as share of GDP) we run a PCA obtaining two new variables “investment” and “PPRF” that represent the orthogonal combination of the previous ones;
- $(\text{legal})_{ij}$ is a vector of legal (regulatory) characteristics of the HEI:
 - Dummy legal status: 1 if private, 0 if public or private government dependent
 - Dummy institutional category: 1 if university, 0 otherwise
- $(\text{HEI})_{ij}$ is a vector of HEI characteristics:
 - Total students: $\ln$ of total students enrolled ISCED 5-7
 - Reputation: nr of publications over total students as above
 - HSSQ : share of students in humanities and social sciences
- u_j is country-level intercept, which takes into account that observations within a country are not independent
- ε_{ij} is a HEI-level error term

We also specified the model as a fixed-effects models including country dummies.

Results (1): descriptive statistics



- Revenues are extremely different (minimum of about 290k, maximum of 1.740.000k);
- the distribution is very skewed (few HEIs with a very large budget, large number of medium-size and small HEIs);
- The distribution of revenues is nearly lognormal as current in most distributions of organizational size;

Top-25 HEIs by budget: several important patterns

- concentrated in a few countries, 9 are in the UK, 8 in Germany, 3 in Italy, 2 in Switzerland, 1 each in Sweden, Belgium and in Netherlands
- Many of them are among the top-ranked European universities in the Shanghai-ARWU ranking -> research orientation is strongly associated with top-budgets.
- The distribution of revenues per students is very skewed as well and includes a few extreme cases of outliers
- Two groups of HEIs with high revenues per students:
 - Large top-ranked international universities (Cambridge, Oxford, ETH Zurich)
 - Smaller specialized universities in technical sciences (ENS Paris, EPFL Lausanne)

Results (2) ANOVA three factors



Table 4. Three way ANOVA for the composition of revenues

Source	Ln revenues per student			Share of core budget			Share of third-party			Share of tuition fees		
	SS	%	Sig.	SS	%	Sig.	SS	%	Sig.	SS	%	Sig.
Model	302.091	44%	0.000	70.31	77%	0.000	6.209	37%	0.000	51.801	75%	0.000
DummyLegSt	18.329	3%	0.000	36.945	40%	0.000	0.102	1%	0.000	29.920	43%	0.000
CountryCode	163.216	24%	0.635	44.322	48%	0.000	1.940	12%	0.867	35.895	52%	0.000
InstitutionCategorystandardized	91.507	13%	0.000	0.658	1%	0.000	1.600	10%	0.000	1.211	2%	0.154
DummyLegSt * CountryCode	4.991	1%	0.000	8.536	9%	0.000	0.431	3%	0.000	1.917	3%	0.000
DummyLegSt * InstitutionCategorystandardized	10.374	2%	0.000	3.659	4%	0.000	0.051	0%	0.000	3.813	5%	0.091
CountryCode * InstitutionCategorystandardized	47.998	7%	0.000	3.848	4%	0.027	1.560	9%	0.027	0.678	1%	0.007
DummyLegSt * CountryCode * InstitutionCategorystandardized	7.105	1%	0.000	0.725	1%	0.000	0.549	3%	0.000	0.214	0%	0.561
Error	378.309	56%		21.408	23%		10.478	63%		17.631	25%	
Corrected Total	680.399			91.718			16.687			69.432		

The terms display the share of variance in the HEI's revenues per student and in the composition of revenues associated with a specific factor, after taking into account all previous factors.

- About half of the variance in revenues per student is due to institutional factors
- $\frac{3}{4}$ of the variance in the shares of core funding and fees due to institutional factors
- HEI-level differences more important for third-party funds

Results (3) Multi-level regression

Core budget

		S.E.	Sig.
Cons	***9.7279	0.2524	0.000
Investment	***0.1424	0.0505	0.005
PPRF	*-0.1514	8.3E-02	0.068
Dummy Legal status	***-1.5035	0.0846	0.000
Dummy Inst. category	***1.2208	0.3373	0.000
Total students	***0.8352	0.0295	0.000
Reputation	***2.4141	0.5496	0.000
HSSQ	***0.7783	0.1003	0.000
Dummy Inst. Category*Total students	-0.0671	0.0386	0.082
Dummy Inst. Category*Reputation	-0.5255	0.5811	0.366
Dummy Inst. Category*HSSQ	***-0.9117	0.1735	0.000
R-sq within		0.7943	
R-sq between		0.7219	
R-sq overall		0.7797	
Observation		1153	
Groups		16	
***Significant p < 0.01			
**Significant p < 0.05			
*Significant p < 0.1			

Core budget allocation between HEIs is largely explained (see R squared values) by our model. Results confirm our hypothesis about the relevance of the different determinants of resources. R-sq within (differences between countries) > R-sq between (differences between HEIs).

Results (3) Multi-level regression

Third public party

		S.E.	Sig.
Cons	***6.1027	0.7490	0.003
Investment	***0.8542	0.2549	0.001
PPRF	-0.3117	0.5077	0.539
Dummy Legal status	***-0.7098	0.2336	0.002
Dummy Inst. category	-0.7067	0.8515	0.407
Total students	***0.7889	0.0733	0.000
Reputation	***7.1980	1.2534	0.000
HHSQ	***-0.7671	0.2331	0.001
Dummy Inst. Category*Total students	*0.1665	0.0969	0.086
Dummy Inst. Category*Reputation	*-2.4409	1.3323	0.067
Dummy Inst. Category*HSSQ	-0.2407	0.4138	0.561
R-sq within		0.6319	
R-sq between		0.7941	
R-sq overall		0.6102	
Observation		744	
Groups		12	

***Significant $p < 0.01$

**Significant $p < 0.05$

*Significant $p < 0.1$

For Third public funds we can observe that the PPRF and the nature of university or not of HEIs are not relevant while the legal status is (contrarily to our hypothesis).

HEIs activities largely influence the funds allocation. The model better explain variations between HEIs.

Results (3) Multi-level regression

Third private party

		S.E.	Sig.
Cons	***6.4025	0.6504	0.000
Investment	***0.5518	0.0472	0.000
PPRF	***-0.3691	0.0665	0.000
Dummy Legal status	-0.2158	0.2571	0.401
Dummy Inst. category	1.0751	0.9114	0.238
Total students	***0.6994	0.0772	0.000
Reputation	***2.7114	1.0360	0.009
HSSQ	***-0.4852	0.1990	0.015
Dummy Inst. Category*Total students	0.0175	0.1020	0.863
Dummy Inst. Category*Reputation	**2.5006	1.1269	0.026
Dummy Inst. Category*HSSQ	-0.3927	0.4558	0.389
R-sq within		0.5810	
R-sq between		0.7222	
R-sq overall		0.6030	
Observation		728	
Groups		12	

***Significant $p < 0.01$

**Significant $p < 0.05$

*Significant $p < 0.1$

For Third private funds the characteristics of national systems seems to influence the allocation; this is probably mainly due to the weight of national wellness and to Business R&D expenditure. HEIs regulatory variables are not relevant while HEIs activities are (see in particular the interaction between the category and reputation). R-sq between points out their importance.

Results (3) Multi-level regression

Student fees

		S.E.	Sig.
Cons	***7.3948	0.5004	0.000
Investment	** -0.5125	0.1724	0.003
PPRF	*0.5281	2.8E-01	0.059
Dummy Legal Status	***1.9411	0.1434	0.000
Dummy Inst. category	**1.1653	0.5731	0.042
Total students	***0.9061	0.0509	0.000
Reputation	*1.9918	1.0809	0.065
HHSQ	**0.3303	0.1688	0.050
Dummy Inst. Category*Total students	-0.0722	0.0657	0.271
Dummy Inst. Category*Reputation	-1.3178	1.1232	0.241
Dummy Inst. Category*HHSQ	***-1.1760	0.3002	0.000
R-sq within	0.5319		
R-sq between	0.3806		
R-sq overall	0.5691		
Observation	916		
Groups	13		
***Significant p < 0.01			
**Significant p < 0.05			
*Significant p < 0.1			

For Student fees all our variables seems to be relevant (with some contradiction with our hypothesis). The model explains only a limited part of differences between HEIs. So, we decided to run a OLS FE with Dummy countries.

Results (3 bis) OLS FE regression



Student fees

		S.E.	Sig.
Cons	***7.2366	0.3854	0.000
Dummy Legal status	***1.9298	0.1353	0.000
Dummy Inst. category	***0.2339	0.1047	0.026
Total students	***0.8633	0.0347	0.000
Reputation	***0.8690	0.2649	0.001
HHSQ	-0.0175	0.1321	0.895
DummyCH	***0.8245	0.3111	0.008
DummyCY	**1.4667	0.6908	0.034
DummyDE	***-1.6813	0.2483	0.000
DummyFR	***-0.7911	0.2658	0.003
DummyHR	0.1538	0.3188	0.630
DummyIE	***2.1368	0.3322	0.000
DummyIT	**0.6610	0.2755	0.017
DummyLT	***1.3767	0.3080	0.000
DummyLV	-0.4109	0.3267	0.209
DummyNL	***1.1540	0.2831	0.000
DummyNO	**0.6513	0.3273	0.047
DummyPT	***0.9948	0.3056	0.001
DummySE	***-2.5114	0.3137	0.000
DummySK	-0.3211	0.3524	0.363
DummyUK	***2.6684	0.2595	0.000
R-sq	0.8019		
Adj R-sq	0.7978		
F	193.35		
Prob > F	0.0000		
SS Model	4790.78		
SS Residual	1183.14		
Observation	976		

***Significant p < 0.01

**Significant p < 0.05

*Significant p < 0.1

Dummies for AT, BE, BG, CZ, DK, EE, ES, FI, GR, HU, IS, ME, MK, PL, RO, RS, SI, TR omitted due to lack of data

The model is more robust and the R-sq and Adj R-sq considerably higher than the Multi-level RE model.

In nearly all cases Dummies for countries are significant and match expectations (for example high values for IE and UK).

To sum up: what have we learned?



- Our goal was to investigate on how characteristics of funding allocation systems and HEI characteristics are associated with the volume and composition of HEI revenues
- The models explain a large share of differences between HEIs in resources and provide the expected results
- Regulatory and country-specific factors are still highly relevant in resourcing
- We cannot always interpret the results in causal terms because of endogeneity (particularly for reputation)
- But empirical regularities are relevant as they apply across a very heterogeneous set of systems and HEIs and the extent of variance predicted is very high

Futures improvement



- ☐ Extended database (2008-2014, for several countries the analysis could be extended up to last 20 years)
- ☐ Panel data regression
- ☐ Country effects analysis

Thank you for your kind attention