

The determinants of European universities patenting and co-patenting with companies

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RISIS Research Seminar 31
December 13, 2023

Motivation

- “third mission”, meaning “a contribution to society”
- generally difficult for universities and private enterprises to cooperate (Yamaguchi et al., 2019)
- there are some opportunities for exploiting potential transfers from academic research to industry
- most studies related to one country
- to examine in a systemic way the determinants of patenting and co-patenting with companies

Previous studies of the university patenting (1)

- **the links between publications and patenting** (Crespi et al. (2011), Grimm and Jaenicke (2015), Rizzo and Ramaciotti (2014), Wong et al. (2010))
- **funding and its structure:** public/private, internal/external (Coupe (2003), Azagra-Caro et al. (2006a) Lawson (2013), Azagra-Caro (2014));
- **institution support:** law and regulations (Link and Hasselt (2019), Grimm and Jaenicke (2012), Hvide and Jones, (2018));
- **university type**, e.g., private versus public, with and without medical schools (Duarte et al. (2020), Mathew et al. (2012))

Previous studies of the university patenting (2)

- **researcher situation and individual motivations:** age, seniority, position (Baldini et al. (2007), Neves and Brito (2020), Sellenthin (2009), Walter et al. (2018))
- **regional influence** (Acosta et al. (2012), Rizzo and Ramaciotti (2014))
- **multi factors** (Duarte et al. (2020), Neves and Brito (2020), Rizzo and Ramaciotti (2014), Yamaguchi et al. (2019)).

Data

- RISIS European Tertiary Education Register (RISIS-ETER): individual characteristics of universities
- OrgReg database: data on publication
- RISIS Patent: data on university patents and co-patents with companies
- cleaning procedure
- given the availability of the data: more than 400 universities from 17 countries, 2011-2018

Number of HEIs across different countries

	2011	2012	2013	2014	2015	2016	2017	2018	Total
AT	16	16	16	17	17	16	18	19	135
BE	5	5	5	5	5	5	5	5	40
CH	10	10	10	10	10	10	10	10	80
CZ	16	16	16	16	16	15	15	15	125
DE	77	78	77	79	79	79	79	79	627
ES	42	42	42	43	44	44	45	46	348
FI	10	10	9	9	9	9	9	9	74
FR	34	34	31	29	28	0	23	26	205
HU	15	16	15	16	16	17	17	16	128
IE	7	7	7	7	7	7	7	7	56
IT	36	36	36	36	36	37	37	37	291
LT	11	11	11	11	11	11	11	10	87
LV	6	6	6	6	6	6	6	6	48
NL	8	8	8	9	9	9	8	9	68
PL	49	50	50	50	50	50	50	50	399
PT	18	19	21	21	18	19	19	19	154
UK	82	81	79	78	77	76	76	76	625
Total	442	445	439	442	438	410	435	439	3490

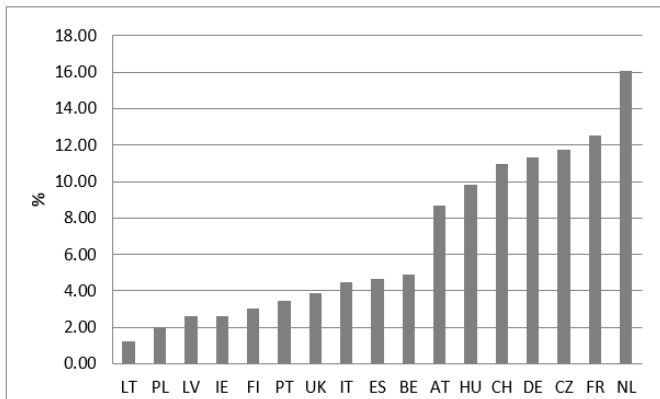
Key statistics on HEIs – mean values by country; time period 2011–2018

	Students	Students per academic staff	Non-academic staff to total staff	Publications per academic staff	Revenue per academic staff	Share of core budget	Share of third-party funding
AT	9404	13.70	0.43	0.77	199527	0.70	0.18
BE	9127	11.42	0.38	na.	113919	0.52	0.24
CH	9696	6.67	0.32	0.83	159350	0.70	0.23
CZ	11429	21.27	0.46	0.72	159452	0.90	na
DE	16148	13.16	0.47	0.70	151886	0.64	0.22
ES	18578	17.99	0.40	0.63	na.	na	na
FI	11129	9.48	0.41	0.75	123343	0.77	0.23
FR	13951	23.85	na.	0.42	176780	0.85	0.05
HU	10456	14.49	0.51	0.29	180289	0.41	0.11
IE	14642	14.07	0.46	1.05	191529	0.20	0.34
IT	20400	20.84	0.40	1.03	176054	0.66	0.12
LT	4609	15.78	0.53	0.21	101651	0.39	0.31
LV	7359	14.73	0.58	0.40	93361	0.64	0.11
NL	19992	10.52	0.41	2.04	240491	0.57	0.26
PL	15630	15.69	0.45	0.43	102571	0.71	0.08
PT	7771	13.47	0.18	0.60	111358	0.73	0.10
UK	15810	16.89	0.53	0.75	217559	0.27	0.16

Notes: na.: not available

Source: own elaboration based on ETER

The share of joint company-university patents in total university patents across countries; all years pooled together



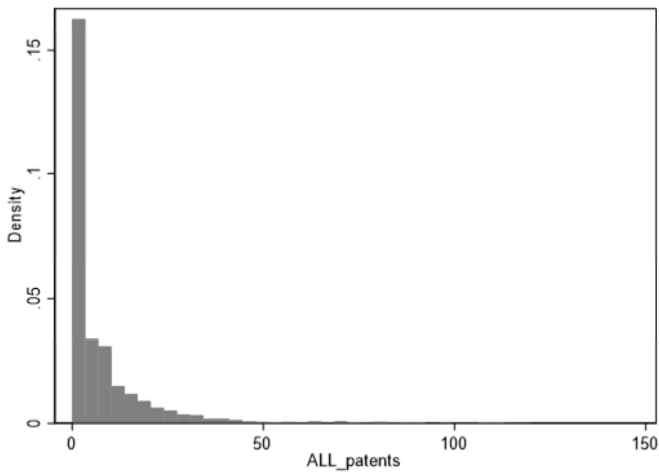
Source: Own elaboration based on RISIS Patent database

Model specification

$$\begin{aligned} \ln y_{it} = & \\ & \alpha + \beta_1 \ln Student_{it} + \beta_2 YearFound_i + \beta_3 Private_i + \beta_4 StudAcad_{it} + \\ & \beta_5 PublAcad_{it} + \beta_6 NonAcad_{it} + \beta_7 RevAcad_{it} + \beta_8 ThirdParty_{it} + \\ & + \beta_9 CoreBudget_{it} + D_t + D_c + \varepsilon_{ijct} \\ & (1) \end{aligned}$$

where: i: individual university, t: time, y - Patents/share of company patents

Distribution of all patents



Estimation results; dependent variable: number of university patents

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Count equation						
<i>lnStud_{it}</i>	0.511*** [0.041]	0.514*** [0.042]	0.614*** [0.039]	0.708*** [0.039]	0.713*** [0.049]	0.672*** [0.049]	0.673*** [0.048]
<i>YearFound_i</i>	0.001*** [0.000]	0.001*** [0.000]	0.000*** [0.000]	0.000 [0.000]	0.000* [0.000]	0.000 [0.000]	0.000* [0.000]
<i>Private_i</i>	-0.386 [0.452]	-0.58 [0.430]	-1.400*** [0.329]	-1.161*** [0.336]	-0.902** [0.420]	-0.576 [0.471]	-0.499 [0.572]
<i>Stu_acad_{it}</i>		-0.007 [0.006]	-0.052*** [0.005]	-0.099*** [0.007]	-0.118*** [0.008]	-0.087*** [0.009]	-0.086*** [0.009]
<i>Publ_acad_{it}</i>			0.697*** [0.062]	0.277*** [0.056]	0.163** [0.067]	-0.023 [0.080]	-0.026 [0.081]
<i>Non_acad_{it}</i>				0.646*** [0.249]	0.28 [0.302]	0.638** [0.297]	0.632** [0.295]
<i>Rev_acad_{it}</i>					0.000*** [0.000]	0.000** [0.000]	0.000** [0.000]
<i>Third party_{it}</i>						3.204*** [0.414]	3.252*** [0.450]
<i>Core budget_{it}</i>							0.097 [0.372]

Results (2)

	Probability of being zero						
<i>lnStud_{it}</i>	-1.119***	-1.643***	-1.479***	-1.421***	-1.368***	-1.336***	-1.326***
	[0.133]	[0.194]	[0.172]	[0.180]	[0.202]	[0.178]	[0.180]
<i>YearFound_{it}</i>	-0.004**	0.000	0.001	0.001	0.001	0.000	0.000
	[0.002]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
<i>Private_{it}</i>	3.884***	2.578***	2.306***	2.223***	0.951	1.339	1.635
	[0.381]	[0.484]	[0.501]	[0.486]	[1.099]	[0.973]	[1.260]
<i>Stu_acad_{it}</i>		0.252***	0.154***	0.114***	0.080***	0.081***	0.082***
		[0.047]	[0.021]	[0.025]	[0.028]	[0.030]	[0.030]
<i>Publ_acad_{it}</i>			-4.459***	-4.421***	-4.709***	-4.632***	-4.685***
			[0.494]	[0.499]	[0.536]	[0.560]	[0.579]
<i>Non_acad_{it}</i>				-2.343**	-2.322*	-2.468**	-2.527**
				[1.101]	[1.314]	[1.252]	[1.256]
<i>Rev_acad_{it}</i>					0.000	0.000	0.000
					[0.000]	[0.000]	[0.000]
<i>Third party_{it}</i>						-1.052	-0.759
						[1.089]	[1.324]
<i>Core budget_{it}</i>							0.386
							[0.912]
ll	-8520.52	-8286.72	-7974.45	-7175.15	-5822.91	-5229.43	-5229.31
N	3387	3370	3370	3118	2388	2203	2203
N_zero	1270	1254	1254	1173	821	776	776

Notes: country and time dummies included in all specifications. Robust standard errors in parenthesis, * p<0.10,

** p<0.05, *** p<0.01

Source: own elaboration based on data from RISIS Patents and ETER

Estimation results; dependent variable: the share of co-patents with companies in the total number of university patents

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Proportion equation						
<i>lnStud_{it}</i>	-0.206*** [0.046]	-0.212*** [0.047]	-0.255*** [0.048]	-0.307*** [0.048]	-0.308*** [0.053]	-0.289*** [0.056]	-0.295*** [0.057]
<i>YearFound_i</i>	-0.000** [0.000]	-0.000* [0.000]	0.000 [0.000]	0.000 [0.000]	0.000 [0.000]	0.000 [0.000]	0.000 [0.000]
<i>Private_i</i>	-0.721*** [0.181]	-0.718*** [0.181]	-0.579*** [0.178]	-0.636*** [0.182]	-0.661*** [0.224]	-0.814*** [0.229]	-1.398*** [0.400]
<i>Stu_acad_{it}</i>		0.003 [0.004]	0.017*** [0.004]	0.040*** [0.007]	0.039*** [0.007]	0.032*** [0.010]	0.031*** [0.009]
<i>Publ_acad_{it}</i>			-0.221*** [0.053]	-0.103* [0.061]	-0.128* [0.072]	-0.092 [0.076]	-0.089 [0.074]
<i>Non_acad_{it}</i>				-0.209 [0.307]	0.245 [0.331]	0.156 [0.358]	0.177 [0.352]
<i>Rev_acad_{it}</i>					0.000 [0.000]	0.000 [0.000]	0.000 [0.000]
<i>Third party_{it}</i>						-0.747* [0.425]	-1.197*** [0.428]
<i>Core budget_{it}</i>							-0.786* [0.421]

Results (3)

	Probability of being zero						
<i>lnStud_{it}</i>	-0.872*** [0.077]	-1.222*** [0.107]	-1.130*** [0.113]	-1.206*** [0.088]	-1.230*** [0.095]	-1.219*** [0.102]	-1.238*** [0.105]
<i>YearFound_{it}</i>	-0.002*** [0.000]	-0.001*** [0.000]	-0.001** [0.000]	-0.001* [0.000]	-0.001** [0.000]	-0.001** [0.000]	-0.001** [0.000]
<i>Private_{it}</i>	3.691*** [1.009]	2.708*** [1.019]	3.499** [1.675]	3.089** [1.250]	2.587* [1.400]	2.697* [1.613]	1.951 [1.825]
<i>Stu_acad_{it}</i>		0.149*** [0.024]	0.131*** [0.029]	0.162*** [0.013]	0.179*** [0.015]	0.162*** [0.019]	0.157*** [0.019]
<i>Publ_acad_{it}</i>			-0.991*** [0.231]	-0.861*** [0.113]	-0.705*** [0.149]	-0.520*** [0.171]	-0.477*** [0.179]
<i>Non_acad_{it}</i>				-0.133 [0.635]	0.865 [0.665]	0.472 [0.704]	0.468 [0.707]
<i>Rev_acad_{it}</i>					-0.000*** [0.000]	-0.000* [0.000]	-0.000* [0.000]
<i>Third party_{it}</i>						-3.153*** [0.635]	-4.498*** [0.869]
<i>Core budget_{it}</i>							-2.161** [0.842]
ll	-1063.59	-943.87	-896.56	-769.66	-652.73	-565.38	-560.53
N	3387	3370	3370	3118	2388	2203	2203

Extensions

- regression with all the time-varying variables lagged. It can solve the problem of potential endogeneity of the variables
- estimation for the panel dataset (each university is reported in all years) with the lagged number of patents as an additional independent variable. Universities which patented in the past are more likely to patent in the future.

Conclusions (1)

- bigger, older, public and richer institutions patent more;
- teaching load (students per academic staff) impacts negatively on patenting;
- research orientation: publications per academic staff, positively affects patenting activities
- third-party funding is positively correlated with patenting
- the higher the stock of patents of a university is, the higher its propensity to apply for patents will be;
- proportion of joint patents:differences for the two-part model: a different impact of the determinants of patenting or no patenting with companies and the proportion of joint patents

Conclusions (2)

- the bigger, older, more research-orientated, with a higher proportion of core and third-party budget are more likely to co-patent with companies;
- Conversely, the higher the number of students per academic staff, the higher the probability of no patenting, but for those universities that already patent with a company, the proportion is higher. Private institutions patent less with a company than public ones.
- limitation: limited sample of universities, no information on the characteristics of patents (IPC) and the quality of patents (forward citation).

Thank you for your attention.

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