UNIVERSITIES AND PUBLIC RESEARCH ORGANISATIONS AS DRIVERS OF ECONOMIC DEVELOPMENT

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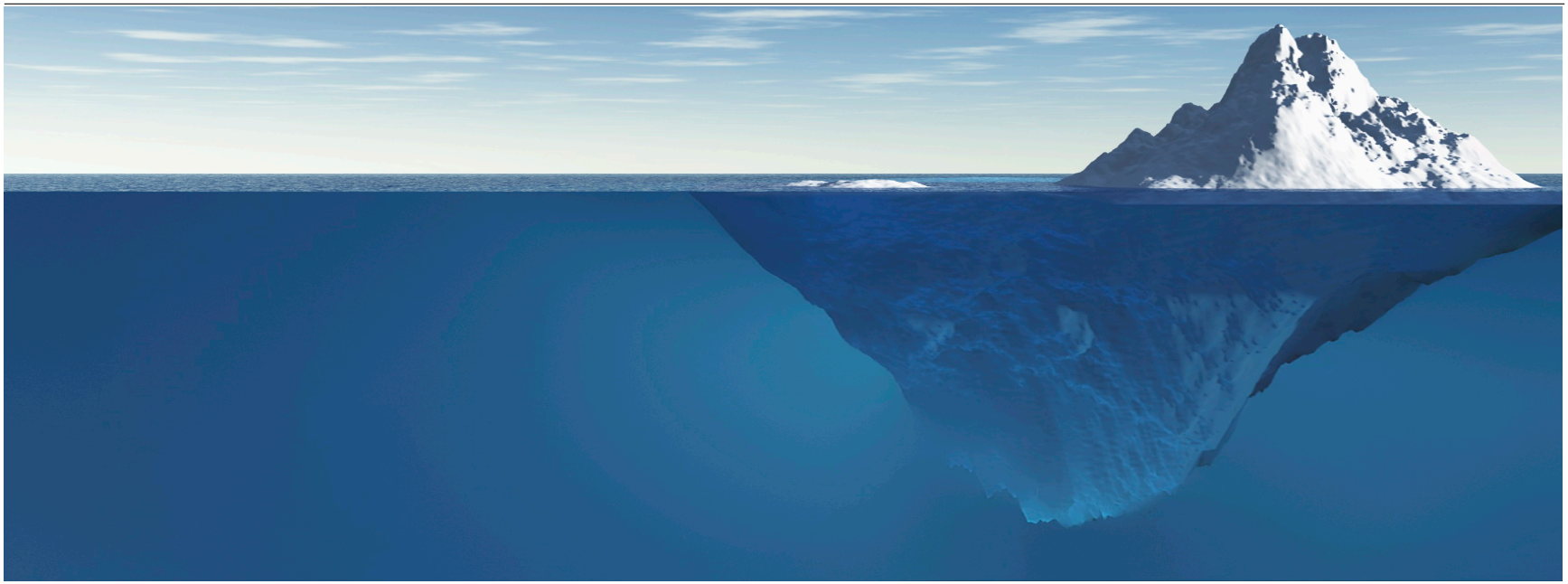

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Outline and project context

- Ongoing and past research at the Fraunhofer ISI on the role of public research organizations and universities for economic development
- Various projects
  - Wirtschaftsfaktor Hochschule (2012-2013): The Stifterverband https://www.stifterverband.org/wirtschaftsfaktor-hochschule
  - Fraunhofer Impact (2016-2017): Fraunhofer Headquarter https://www.fraunhofer.de/de/forschung/leistungsangebot/wirkung-von-fraunhofer-forschung.html
  - Wirtschaftsfaktor Hochschule Baden-Württemberg: Ministry of Research and Culture Baden-Württemberg
  - Several self-administered research projects
- Topic 1: The economic effects of universities
- Topic 2: The economic effects of PROs, in particular the Fraunhofer Society

Do universities and PROs differ?

- **Universities:** create knowledge
  - which generates spillovers to broader economy (e.g. collaboration)
  - Well-studied positive effects on firms (Belderbos, 2004; Monjon and Waelbroeck, 2003; Lööf and Broström, 2008)

- **Applied Public Research Organizations (A)PRO**
  - Often focus on applied research & technological co-development
  - Closer to market, easier to appropriate (Toole et al, 2014)

- **Potentially different policy rationale:**
  - U: overcome public good market failure of (basic) R&D
  - (A)PRO: overcome knowledge exploitation bottlenecks, especially those with typically lower absorptice capacity

English core references

- Comin, D., Licht, G., Pellens, M., & Schubert, T. (2019). Do companies benefit from public research organizations? The impact of the Fraunhofer Society in Germany. *The Impact of the Fraunhofer Society in Germany*, 19-006.
- Robin, S., & Schubert, T. (2013). Cooperation with public research institutions and success in innovation: Evidence from France and Germany. *Research Policy*, *42*(1), 149-166.
- Schubert, T., & Kroll, H. (2016). Universities' effects on regional GDP and unemployment: The case of Germany. *Papers in Regional Science*, *95*(3), 467-489.

Topic 1: The economic effects of universities

Background

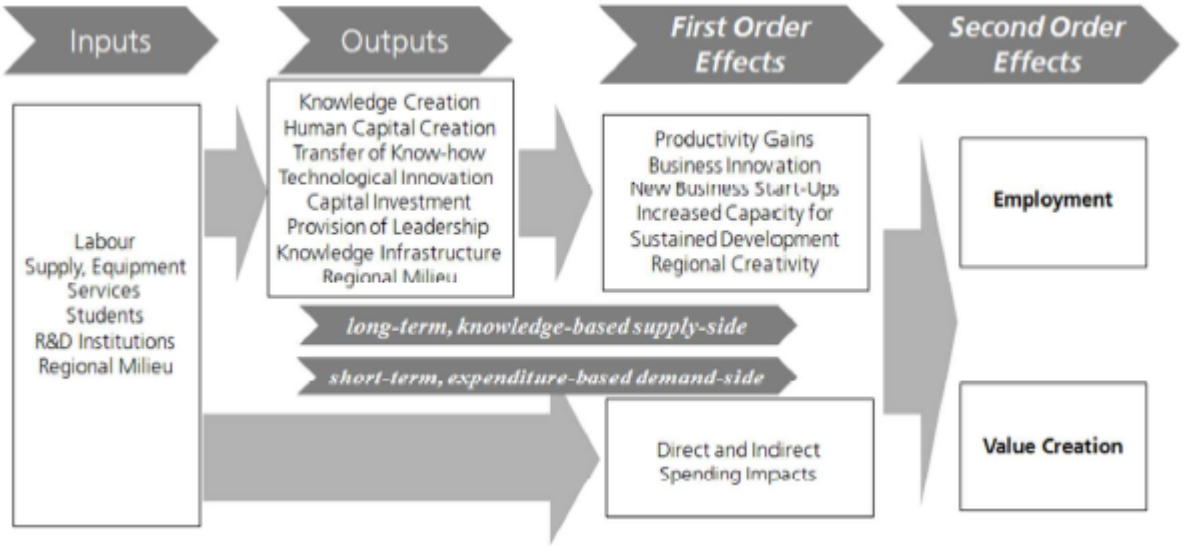
- Discussion on the regional impact of Higher Education Institutions (HEI) has a long tradition dating back to the 1970s
- Since the late 1980s, an increasing political interest in universities' economic contribution to their environment has added further momentum to the debate

But:

- most studies have focused on the directly observable demand side effects of HEI (e.g. demand by students, employees, or HEI investments), underestimating real effects
- knowledge and human capital creation are the key tasks of HEIs
  ➔ indirect, knowledge-mediated impacts are extremely important (Florax 1992)
- few contributions have sought to take the methodological ambition of estimating impacts on a nationwide level
- the modelling framework of existing studies (Goldstein and Drucker, 2006; Goldstein and Renault, 2004)
  - leaves room for methodological improvement
  - focused on the US case

Conceptual Framework
Which impacts?

- **variety of different outputs**, from tangible (publications, patents) to less tangible ones (regional leadership, influence on regional milieu) (Florax 1992; Goldstein et al. 1995)
- a **broad range of transfer and interaction channels** related to various types of outputs (Abreu et al. 2009; Benneworth et al. 2009; Koschatzky et al. 2011)
- first order effects vs. **second order macroeconomic impacts** (Florax 1992; Garrido-Yserte, Gallo-Rivera 2010)



Source: own figure, based on: Goldstein et al. (1995); Stokes and Coornes (1998); Segarra i Blasco (2003)

Contribution to the literature
➔ in several ways

Reflect the multidimensionality of HEI outputs and (to the extent possible)

- empirically identify the marginal effects of investment, employment, education, and knowledge output on regional income and unemployment taking into account a broader part of HEIs' multiple functions discussed in the literature (e.g. Florax 1992, Goldstein et al. 1995, Goldstein, Drucker 2006; Uyarra 2008)

Look at the role of regional spillovers

- not only capture the impact of academic activities within a certain region's boundaries but also that of those in its adjoining vicinity

Take into account the importance of the socio-economic environment

- control for observable regional characteristics and for unobserved regional heterogeneity

➔ **Then use these results to gauge the average impact of higher education institutions' activities on German regions**

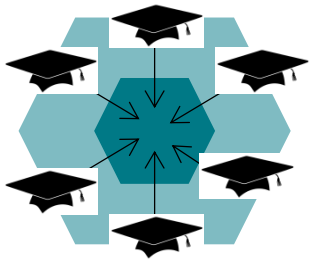
Methodology

- **Panel data set for Germany in the period between 2001 and 2011 (NUTS3 level)**

1. **use regression to estimate average marginal impacts (coefficients)**
2. **multiply (significant) coefficient by regional average of the corresponding variable** to assess effect at the regional or, by aggregation, the national level.

   example: $DE_{stud} = \beta_{stud}\,\overline{stud}$

- Use **fixed effects model** to cancel out unobserved heterogeneity – impact of stable means
  - unobserved heterogeneity is substantial in a dataset composed of regions
  - but: hardly orthogonal to the IV – so random effects is not an option
- Use **spatial econometric regression** models to account for spillovers:
  - Regional spillovers by inclusion of **lagged independent variables**
  - Regional lags in stochastic shocks



Hypotheses

- *Hypothesis 1:*
  Key HEI outputs will display a positive effect on regional value creation (as measured by GDP per capita)
- *Hypothesis 2:*
  Key HEI outputs, in particular the education of graduates, will display a significantly positive effect on employment in the long-run, but none or a negative one in the short-run (as measured by unemployment rates)
- *Hypothesis 3:*
  A large part of HEIs' positive effects on value creation and employment spill over to neighbouring regions
- *Hypothesis 4:*
  The socio-economic environment matters
  - *In regions with a high technology-orientation of the local industry the HEIs positive effects on value creation and employment are stronger.*
  - *In regions where local HEIs generate higher shares of their income from private firms the positive effects on value creation and employment are stronger.*

Variables

- **Dependent variables**
  - GDP per capita (pure economic perspective)
  - Unemployment rate (stronger social component)
- **Key independent variables**
  - triggering demand side effects:
    - number of students, HEI investment, number of staff.
  - triggering supply side effects:
    - number of publications, number of graduates, third party funds.

  ➔ all variables as per capita values
- **Control variables**
  - *How relevant? – Economic size (*Total employment*)*
  - *How fertile? – Technology orientation (*High-tech employment*)*
  - *Relative importance of HEI? – Peripherality of the region (*Agricultural employment*)*
  - *How likely to bind outputs? – Brain drain (Net migration)*

Step 1: Regression Results

Dependent Variable	GDP p.c.		Unemployment rate		Unemployment rate	
	Estimate	t-value	Estimate	t-value	Estimate	t-value
University characteristics						
Graduates p.c. (l1)	119.4200 ***	6.7686	-14.4370	-0.9204	-45.3030 **	-2.2039
Investment p.c. (l1)	-0.5537	-0.7196	-3.5839 ***	-5.2570	-2.6718 ***	-3.6976
TPF p.c. (l1)	-2.4442	-1.0891	-0.8339	-0.4167	0.4755	0.2301
Students p.c. (l1)	10.7280 **	2.4000	32.8770 ***	8.3040	27.3150 ***	5.5521
Staff p.c. (l1)	10.1560	0.7129	38.9420 ***	3.0639	15.8650	0.8891
Publications p.c. (l1)	142.5900 ***	2.5974	-17.5320	-0.3622	2.6140	0.0528
Graduates p.c. (l3)					10.4530	0.4146
Investment p.c. (l3)					-2.2567 ***	-2.9082
TPF p.c. (l3)					-12.0950	-1.4687
Students p.c. (l3)					8.2911	1.5192
Staff p.c. (l3)					36.7490 *	1.8977
Publications p.c. (l3)					-58.7410 ***	-5.7048
Regional controls						
Net migration	66.8720 **	2.3383	-63.9090 **	-2.5119	-74.4960 ***	-2.8938
Regional employment	0.0325 ***	7.0723	-0.0139 ***	-3.3114	-0.0148 ***	-3.5121
Share hightech employment	0.0290	0.9012	-0.0799 ***	-2.7988	-0.0641 **	-2.2469
Share agricultural employment	-14.6450 *	-1.8528	20.2630 ***	2.9042	22.5740 ***	3.2368

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Step 1: Regression Results (continued)

Spatial lags						
Graduates p.c. (l1)	258.1800	1.0910	-967.8700***	-3.0790	-546.6500	-1.5739
Investment p.c. (l1)	-17.8550**	-2.0950	-10.7490	-1.0275	-14.6840	-1.4463
TPF p.c. (l1)	79.9150**	2.3686	-81.2870**	-1.9800	-81.1750*	-1.9533
Students p.c. (l1)	-60.4240	-1.4066	-90.6600	-1.5896	-94.9640	-1.4076
Staff p.c. (l1)	453.6800***	5.5146	569.4900***	5.0596	182.6000	1.3772
Publications p.c. (l1)	-59.6250	-0.1507	3844.6000***	6.3524	2459.5000***	4.0963
Graduates p.c. (l3)					-1114.5000***	-2.6378
Investment p.c. (l3)					26.6890**	2.4441
TPF p.c. (l3)					-365.2200**	-2.2346
Students p.c. (l3)					-49.1490	-0.8344
Staff p.c. (l3)					916.5900***	6.2695
Publications p.c. (l3)					-143.4700	-1.0097
Net migration	74.4790	0.3636	-590.0300**	-2.1658	-806.4000***	-3.1054
Regional employment	0.2679***	5.3175	-0.1116*	-1.7156	-0.0999	-1.0962
Share hightech employment	-0.0822	-0.6120	-0.0572	-0.2974	-0.0541	-0.2973
Share agricultural employment	-255.4500***	-4.1107	57.2660	0.5615	63.6250	0.6780
Year dummies	YES		YES		YES	
N	429		429		429	
T	19		19		19	
R2	0.9864		0.9560		0.9564	
rho	0.2900		0.9600		0.8600	

Results –
GDP effects on average regions

$$DE_{stud} = \beta_{stud}\,\overline{stud} \qquad IE_{stud} = \beta_{spatstud}\,\overline{spatstud} \qquad TE_{stud} = DE_{stud} + IE_{stud}\,.$$

	DE	IE	TE
Graduates p.c. (l1)	302.12		302.12
Investment p.c. (l1)		-406.64	-406.64
Third Party Funding p.c. (l1)		4729.92	4729.92
Students p.c. (l1)	202.65		202.65
Staff p.c. (l1)		2729.62	2729.62
Publications p.c. (l1)	297.43		297.43
Total	**802.20**	**7052.90**	**7855.09**

Results –
Unemployment effects on average regions

$$DE_{stud} = \left(\beta_{stud,-1} + \beta_{stud,-3}\right)\overline{stud} \qquad IE_{stud} = \left(\beta_{spatstud,-1} + \beta_{spatstud,-3}\right)\overline{spatstud}$$

	Lag 1			Lag 1+Lag 3		
	DE	**IE**	**TE**	**DE**	**IE**	**TE**
Graduates p.c. (l1)/(l1/l3)		-0.04	-0.04	-0.11	-3.75	-3.86
Investment p.c. (l1)/(l1/l3)	-0.07		-0.07	-0.10	0.61	0.51
Third party funding p.c. (l1)/(l1/l3)		-4.81	-4.81		-4.71	-4.71
Students p.c. (l1)/(l1/l3)	0.62		0.62	0.52		0.52
Staff p.c. (l1)/(l1/l3)	-0.08	3.43	3.35	0.16	-0.30	-0.14
Publications p.c. (l1)/(l1/l3)		6.80	6.80	-0.12	4.35	4.23
Total	**0.47**	**5.38**	**5.85**	**0.35**	**-3.80**	**-3.45**

Moderating effects of regional environment

Interaction effects: Patent Intensity

Dependent Variable	GDP p.c.			Unemployment rate		
	Estimate		t-value	Estimate		t-value
University characteristics						
Graduates p.c. (l1)	202.1000	***	9.6563	-10.8500		-0.5815
Investment p.c. (l1)	0.7169		0.7204	-6.1065	***	-6.9439
Tfp p.c. (l1)	2.8063		1.1660	-3.1986		-1.4805
Students p.c. (l1)	-1.2254		-0.2475	33.0940	***	7.5309
Staff p.c. (l1)	3.5790		0.2198	49.9910	***	3.4326
Publications p.c. (l1)	139.6200	*	2.5568	-23.3930		-0.4822
Patents p.c. (l1)	21.2490		0.5697	-18.9580		-0.5681
Graduates p.c. (l1)#Patents p.c. (l1)	-31234.0000	***	-7.3528	-4889.8000		-1.2931
Investment p.c. (l1)#Patents p.c. (l1)	-90.8340		-0.3945	1003.1000	***	4.9367
Tfp p.c. (l1)#Patents p.c. (l1)	-299.6500		-1.3565	194.8400		0.9975
Students p.c. (l1)#Patents p.c. (l1)	4672.2000	***	5.7988	-758.5200		-1.0637
Staff p.c. (l1)#Patents p.c. (l1)	9424.4000	***	4.1223	-3349.0000	.	-1.6588
Publications p.c. (l1)#Patents p.c. (l1)	13845.0000	.	1.9088	8801.0000		1.3721
Regional controls						
Net migration	57.7750	*	2.0387	-63.5050	*	-2.5021
Regional employment	0.0410	***	8.8120	-0.0174	***	-4.0854
Share hightech employment	0.0167		0.5217	-0.0787	**	-2.7546
Share agricultural employment	-13.5380	.	-1.7223	21.9420	**	3.1394
Spatial lags						
Graduates p.c. (l1)	190.3100		0.7766	-1156.6000	***	-3.4320
Investment p.c. (l1)	-13.5170		-0.9292	-14.3580		-0.9102
Tfp p.c. (l1)	35.6790		0.8864	-192.4700	***	-4.1498
Students p.c. (l1)	-14.0550		-0.2853	0.9178		0.0145
Staff p.c. (l1)	568.5000	***	4.0247	1167.6000	***	7.3911
Publications p.c. (l1)	-87.4800		-0.1975	3927.9000	***	6.4156
Net migration	118.3900		0.5895	-761.6500	**	-2.8325
Graduates p.c. (l1)#Patents p.c. (l1)	-37032.0000		-0.9443	74801.0000	.	1.6657
Investment p.c. (l1)#Patents p.c. (l1)	465.4500		0.1556	947.1200		0.3004
Tfp p.c. (l1)#Patents p.c. (l1)	3637.0000		1.0767	8930.3000	*	2.4178
Students p.c. (l1)#Patents p.c. (l1)	-7891.3000		-0.7717	-24402.0000	*	-2.1563
Staff p.c. (l1)#Patents p.c. (l1)	-22284.0000		-1.1016	-90548.0000	***	-4.1916
Publications p.c. (l1)#Patents p.c. (l1)	34919.0000		1.4817	101410.0000	**	2.7390
Regional employment	0.2676	***	5.0653	-0.2294	**	-3.1990
Share hightech employment	-0.1484		-1.1345	-0.2846		-1.5230
Share agricultural employment	-274.0300	***	-4.4100	171.3700	.	1.7248
Year dummies	YES			YES		
N	429			429		
T	19			19		
R2	0.9868			0.9564		
rho	0.2300			0.9200		

Interaction effects: Third Party Funding from Industry

Dependent Variable	GDP p.c.			Unemployment rate		
	Estimate		t-value	Estimate		t-value
University characteristics						
Graduates p.c. (l1)	115.8000	***	5.2192	-9.8559		-0.5004
Investment p.c. (l1)	0.4322		0.3810	-5.6498	***	-5.6559
TPF p.c. (l1)	0.3271		0.1081	-3.9698		-1.4772
Students p.c. (l1)	6.8491		1.2288	26.4000	***	5.3593
Staff p.c. (l1)	37.7010	.	1.7956	66.7900	***	3.5996
Publications p.c. (l1)	150.7200	***	2.6841	-2.7211		-0.0548
TPF industry p.c. (l1)	0.3154	***	3.2886	0.0266		0.3145
Graduates p.c. (l1)#TPF industry p.c. (l1)	-0.3883		-0.1127	0.3878		0.1280
Investment p.c. (l1)#TPF industry p.c. (l1)	-0.1150		-0.7036	0.2708	*	1.8885
TPF p.c. (l1)#TPF industry p.c. (l1)	-0.3510		-1.2570	0.1875		0.7642
Students p.c. (l1)#TPF industry p.c. (l1)	0.8944		1.1993	0.8317		1.2719
Staff p.c. (l1)#TPF industry p.c. (l1)	-3.0189		-1.1075	-4.9440	**	-2.0700
Publications p.c. (l1)#TPF industry p.c. (l1)	6.6088		0.5640	-5.1762		-0.5040
Regional controls						
Net migration	64.2520	**	2.2419	-63.7040	**	-2.4939
Regional employment	0.0368	***	7.8209	-0.0121	***	-2.8472
Share hightech employment	0.0210		0.6470	-0.0870	***	-3.0324
Share agricultural employment	-12.6160		-1.5952	18.4120	***	2.6352
Spatial lags						
Graduates p.c. (l1)	-1.1142		-0.0029	-1138.5000	**	-2.3939
Investment p.c. (l1)	-22.6960		-0.8786	41.8780		1.5522
Tfp p.c. (l1)	191.9100	***	4.3170	-201.0500	***	-3.8181
Students p.c. (l1)	-66.0660		-0.7350	-68.4240		-0.6776
Staff p.c. (l1)	222.8800		0.8708	1977.2000	***	7.4218
Publications p.c. (l1)	-785.0300		-1.4647	3131.5000	***	4.3526
TPF industry p.c. (l1)	2.4437		1.5021	0.0663		0.0421
Net migration	-196.2300		-0.8644	-1112.6000	***	-3.8899
Regional employment	0.2004	***	3.6488	-0.2350	***	-3.1685
Share hightech employment	-0.0684		-0.5220	-0.1400		-0.7564
Share agricultural employment	-197.3200	***	-3.0294	9.6621		0.0979
Graduates p.c. (l1)#TPF industry p.c. (l1)	-0.5610		-0.0025	486.0800	**	2.1093
Investment p.c. (l1)#TPF industry p.c. (l1)	0.5981		0.0338	-36.8430	**	-2.0344
Tfp p.c. (l1)#TPF industry p.c. (l1)	-87.3610	***	-3.7247	73.9510	***	3.2603
Students p.c. (l1)#TPF industry p.c. (l1)	9.4454		0.1447	-86.9160		-1.3015
Staff p.c. (l1)#TPF industry p.c. (l1)	132.7900		0.5916	-1155.3000	***	-5.2707
Publications p.c. (l1)#TPF industry p.c. (l1)	1092.8000	***	3.5683	950.1600	**	2.7163
Year dummies	YES			YES		
N	429			429		
T	19			19		
R2	0.9867			0.9563		
rho	0.21			0.9076		

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Results –
DE differentiated by technology intensity (max/min)

$$DE_{stud} = \left(\beta_{stud} + \beta_{patstud}\,\overline{pat}\right)\overline{stud} \qquad DE_{stud} = \left(\beta_{stud} + \beta_{patstud}\,\min(\text{pat})\right)\overline{stud} \qquad DE_{stud} = \left(\beta_{stud} + \beta_{patstud}\,\max(pat)\right)\overline{stud}$$

	GDP p.c.			Unemployment rate		
	DE (mean)	DE (min)	DE (max)	DE (mean)	DE (min)	DE (max)
Graduates p.c. (l1)	395.70	510.61	-3470.60			
Investment p.c. (l1)				-0.09	-0.12	0.89
TPF p.c. (l1)						
Students p.c. (l1)	128.99	0.62	4448.25	0.63	0.63	0.63
Staff p.c. (l1)	59.45	0.29	2050.00	0.20	0.22	-0.52
Publications p.c. (l1)	333.83	291.97	1742.21			
Total	**917.97**	**803.49**	**4769.86**	**0.73**	**0.72**	**1.00**

➔ no similar effect for third party funds from industry

Hypotheses

- *Hypothesis 1:* ✓
  Key HEI outputs will display a positive effect on regional value creation
- *Hypothesis 2:* ✓
  Key HEI outputs will display a positive effect on employment in the long-run, but none or a negative one in the short-run
- *Hypothesis 3:* ✓
  A large part of HEIs' positive effects on value creation and employment spill over
- *Hypothesis 4: (* ✓ *)*
  The socio-economic environment matters
  - *high technology-orientation of the local industry* ✓
  - *where local HEIs generate higher shares of their income from private firms* ✗

The role of the subjects taught…

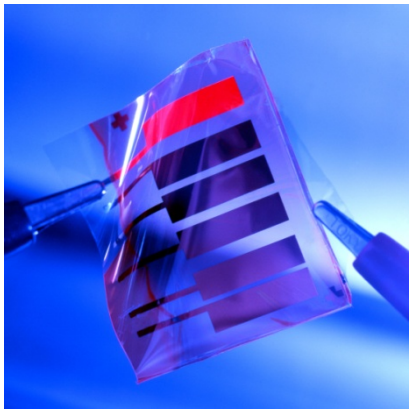
Mathematics/Sciences				Engineering				Law/Economics/Social Sciences			
	DE (mean)	DE (min)	DE (max)		DE (mean)	DE (min)	DE (max)		DE (mean)	DE (min)	DE (max)
Graduates p.c. (l1)	406.06	406.06	406.06	Graduates p.c. (l1)	355.27	436.99	-847.79	Graduates p.c. (l1)	127.30	0.00	918.15
Investment p.c. (l1)				Investment p.c. (l1)				Investment p.c. (l1)			
TPF p.c. (l1)	-290.63	-347.43	568.73	TPF p.c. (l1)				TPF p.c. (l1)			
Students p.c. (l1)	333.03	333.03	333.03	Students p.c. (l1)	133.97	0.00	2106.30	Students p.c. (l1)	400.82	612.08	-911.63
Staff p.c. (l1)				Staff p.c. (l1)	-55.01	0.00	-864.81	Staff p.c. (l1)			
Publications p.c. (l1)	345.81	312.37	851.73	Publications p.c. (l1)	326.34	326.34	326.34	Publications p.c. (l1)	304.72	335.54	113.25
Total	**794.27**	**704.03**	**2159.56**	**Total**	**760.57**	**763.32**	**720.03**	**Total**	**832.84**	**947.62**	**119.77**

Languange/Culture				Medicine				Art			
	DE (mean)	DE (min)	DE (max)		DE (mean)	DE (min)	DE (max)		DE (mean)	DE (min)	DE (max)
Graduates p.c. (l1)	88.62	0.00	4559.16	Graduates p.c. (l1)	290.73	290.73	290.73	Graduates p.c. (l1)	315.08	315.08	315.08
Investment p.c. (l1)				Investment p.c. (l1)				Investment p.c. (l1)			
TPF p.c. (l1)				TPF p.c. (l1)				TPF p.c. (l1)			
Students p.c. (l1)	538.58	601.23	-2622.00	Students p.c. (l1)	182.88	182.88	182.88	Students p.c. (l1)	204.49	277.01	-3716.20
Staff p.c. (l1)	252.01	313.37	-2843.71	Staff p.c. (l1)				Staff p.c. (l1)			
Publications p.c. (l1)	389.37	389.37	389.37	Publications p.c. (l1)	361.05	361.05	361.05	Publications p.c. (l1)	366.53	293.77	4300.56
Total	**1268.57**	**1303.97**	**-517.18**	**Total**	**834.66**	**834.66**	**834.66**	**Total**	**886.10**	**885.86**	**899.44**

Topic 2: The economic effects of PROs, in particular the Fraunhofer Society

Objective

- Calculating the macroeconomic effect of public science on the economy
- In particular with respect to
  - GDP
  - tax revenue
- Calculating fiscal multipliers
- Analyzing contingency effects (e.g. proximity to business, etc...)
- Method: panel regression-based approaches based on the systematic matching regional data on public science (NUTS3) with regional economic statistics



Some core results for Fraunhofer

	FE	FE	FE
	GDP per capita	GDP per capita	GDP per capita
Net migration	165841.5538***	153657.6729***	91927.5500*
	(3.64)	(3.36)	(1.69)
Labor force	42.4203***	41.9945***	68.5971***
	(6.37)	(6.31)	(3.94)
Share HT employment	8.9139	16.4537	35.8295
	(0.20)	(0.36)	(0.93)
Share agricultural employment	122.3714	113.3253	-282.0650
	(1.35)	(1.25)	(-0.99)
FhG third party funds (p.c.)	18.3193*		
	(1.73)		
FhG investments (p.c.)		14.6410***	
		(2.82)	
FhG researchers (p.c.)			1972732.8155***
			(3.02)
Constant	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes
Observations	4027	4030	1216

Macroeconomic effects

	Third party funds	Scientists
Regression multiplier	18.30	1,972,732.00
Indicator value Germany (million €)	1,100.00	9,125.00
GDP effect (million €)	20,130.00	18,001.18
Total tax revenue (billion €)	588,50	588,50
GDP (billion €)	2,915.00	2,915.00
Taxes as share of GDP (%)	20.19	20.19
Expected tax effect (million €)	4,063.98	3,634.20
Fraunhofer budget (million €)	2,060.00	2,060.00
Fraunhofer#s public funds without revenue from other countries	1,100.00	1,100.00
Tax multiplier (total budget)	1.97	1.76
Tax multiplier (public revenue)	3.69	3.30

Sources: Destatis, Kassenmäßige Steuereinnahmen der Gebietskörperschaften 2014; Bundesfinanzministerium, Geschäftsbericht der Fraunhofer Gesellschaft 2014, internal databases, own calculations

Excursus: Some firm-level analyses

- Robin and Schubert (2013, Research Policy):
  - Science-business linkages increase innovativity and productivity on the firm-level
    - Increase of share with new products by 5-6.5 p.p. Roughly a sixth compared to the mean.
    - On the macroeconomic level stopping cooperation would reduce overall labor productivity by 13-16%
- Comin, Licht, Pellens, and Schubert (2019, CIRCLE working paper # 2019-6):
  - Substantial effects of Fraunhofer interactions on the firm level in particular on growth and labor productivity
  - On the macroeconomic level a doubling of Fraunhofer funds from industry (+ € 660 million) would increase overall labor productivity by 0.55%

Summary 1

- Overall substantial economic effects of universities (about 8,000 € in GDP per capita and a long run decline of unemployment by 3.5 percentage points)
- The majority of these effects spills over between regions
- Distribution of significant coefficients is broadly in line with what the existing literature says about types and relevance of effects and channels
- Subject coverage plays a role but is less important than one might be lead to think
- Similar results hold for Fraunhofer as a PRO
- Overall increase in GDP of € 20 billion annually
- Tax-multipliers ranging between 1.7 and 3.7

Summary 2

- Implication:
  - Strong argument for (sustained) government support for higher education
  - But: effects do not necessarily occur in the region where investment takes place
    Surrounding regions may benefit strongly.
  - But: effects are likely to take longer periods to manifest
    No or little basis for assumptions about very short term benefits.
  - And: Intentionally, this is a general and generalising model
    as we've shown: effects may deviate notably depending on the context

Thank you!

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