NEMO
NETWORK MODELS, GOVERNANCE AND R&D COLLABORATION NETWORKS

AIT AUSTRIAN INSTITUTE OF TECHNOLOGY

UNIVERSITY OF SURREY

Top-ranked Universities in the European Framework Programmes

Does status matter for performance?

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"Evaluating R&D Collaboration networks in Europe:
Lessons from a comprehensive interdisciplinary approach"

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Structure of the presentation

- Background and aim of the study
- Problem statement and research questions
- Perspectives and hypotheses
- Methodology and data
- Results and discussion
- Conclusions

Background and aim of the study

- Universities face increasing competition for students, staff, funding and prestige on national as well as international level
- Ranking lists:
  - a popular approach to measuring the market value of universities
  - however, they build on sometimes idiosyncratic sets of indicators
  - acknowledged and conceded a significant impact on the universities
- EU Framework Programmes:
  - fund basic and applied research with industrial and societal relevance
  - increasingly important market for universities

- Aim of the paper:
  - to explore whether established university rankings are appropriate for predicting the performance of universities in the EU FPs

Research questions

- How important is the ranking position of a university for a high involvement in the EU FP?
  - Relation between ranking and number of participations and number of coordinated projects

- Which rankings are good predictors for success in the EU FP market, and can these be associated with the specific focus of these rankings?
  - *Shanghai Jiao Tong University's Academic Ranking of World Universities (ARWU)*
  - *Times Higher Education World University Ranking (THE)*

- Which other factors can we find that also determine a university's involvement in the EU FP?
  - Influence of human resources, funding opportunities, FP experience, and relational capital

Composition of the Academic Ranking of World Universities (*ARWU*)

Criteria	Indicator	Weight
Quality of Education	Alumni of an institution winning Nobel Prizes and Fields Medals	10%
Quality of Faculty	Staff of an institution winning Nobel Prizes and Fields Medals	20%
	Highly cited researchers in 21 broad subject categories	20%
Research Output	Articles published in Nature and Science	20%
	Articles indexed in Science Citation Index-expanded, and Social Science Citation Index	20%
Per Capita Performance	Per capita academic performance of an institution	10%
Total		**100%**

Source: Liu & Cheng 2005 and *www.arwu.org*

Composition of the Times Higher Education World University Ranking (*THE*)

Criteria	Indicator	Weight
Reputation	Survey of academic peers in five subject areas	40%
	Survey of global employers	10%
Teaching quality	Student-staff ratio	20%
Research quality	Citations per staff	20%
Internationalisation	Proportion of international students	5%
	Proportion of international staff	5%
Total		**100%**

Source: Marginson & van de Wende 2007 and *www.topuniversities.com*

Hypothesis H1

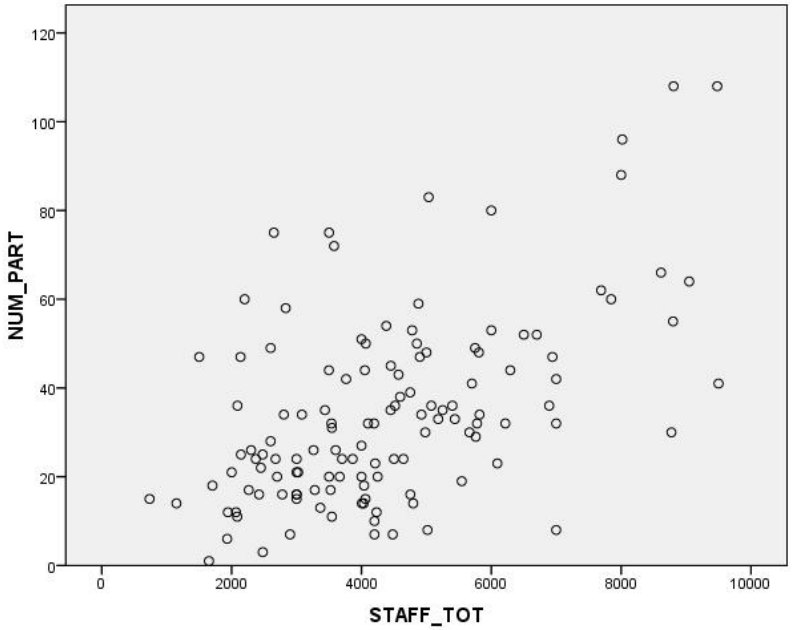
Size matters – a resource-based perspective

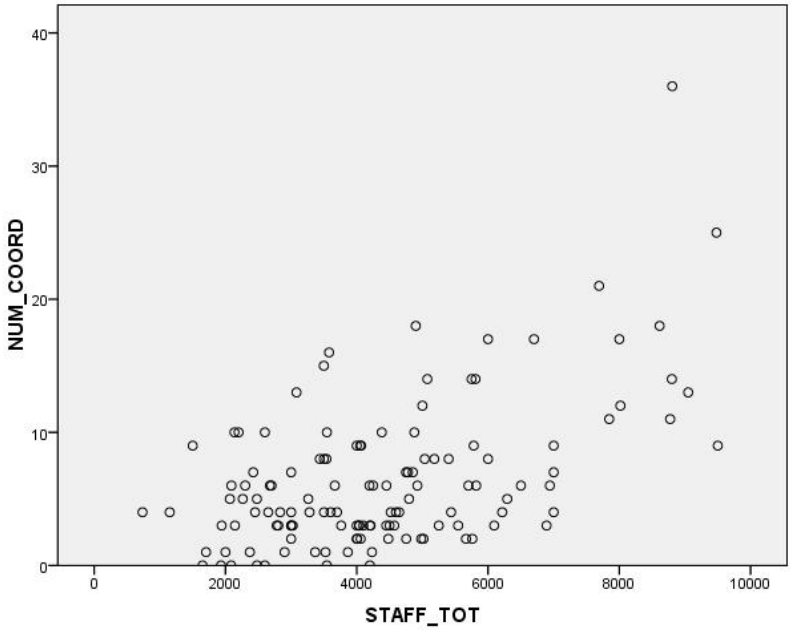
- Universities with a high number of total staff, are equipped with abundant resources (scientific expertise, technical and administrative infrastructure) for a successful engagement in the Framework Programmes.

- Frequent critiques towards ranking lists are related with the influence of university size: Large universities tend to be ranked higher than small ones (Marginson & van der Wende 2007).

➢ Thus, we hypothesise that larger (higher ranked) universities are involved more often in EU FP projects.

Exploratory analysis (H1)
FP6 participations and coordinations by university size





NUM_PART: number of project participations in FP6 (project start after 31.12.2004).
NUM_COORD: number of coordinated projects in FP6 (project start after 31.12.2004).
STAFF_TOT: headcount of total staff.
Source: AIT sysres EUPRO Database; staff data from university websites.

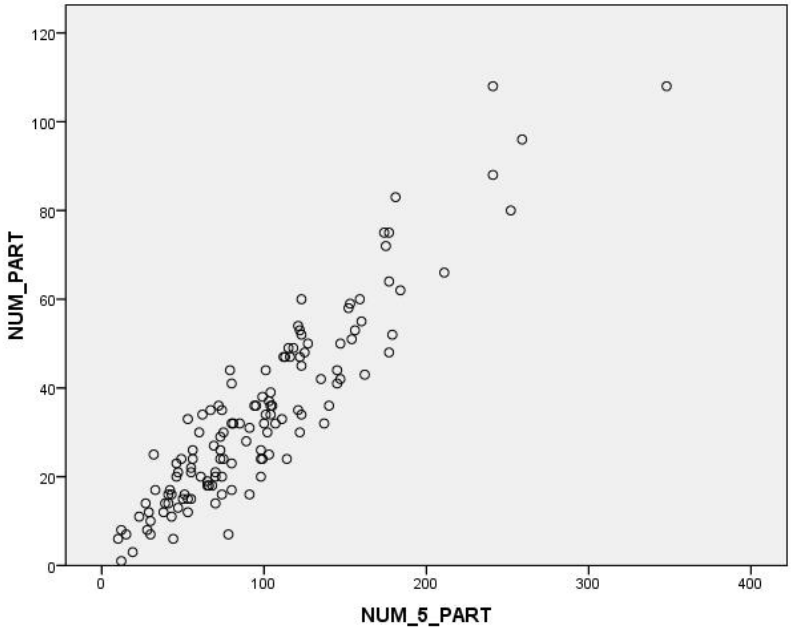
Hypothesis H2

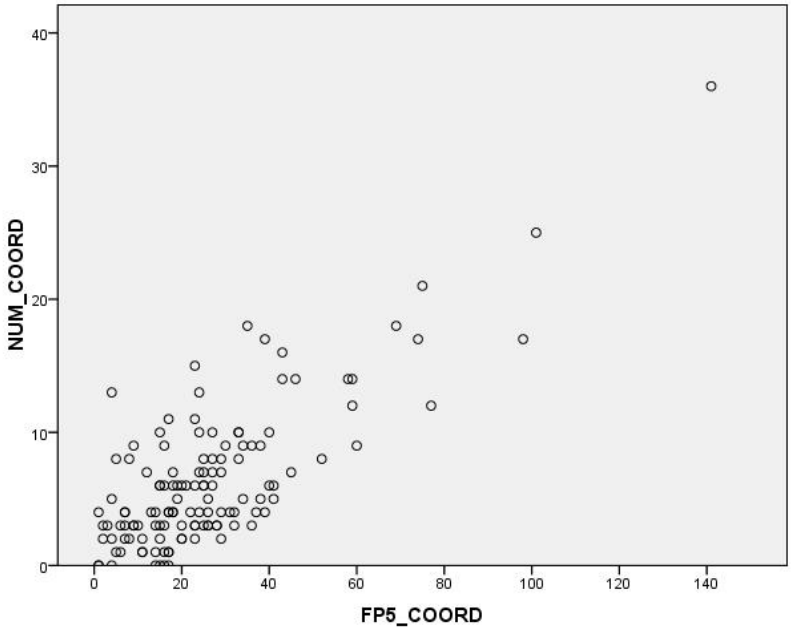
Experience matters – a trajectory-based perspective

- Universities which participated and coordinated intensively in earlier FPs are experienced actors in ERA. They are familiar with formal requirements, initiation and coordination of collaborative arrangements.
- Prior acquaintance is by far the most important determinant for partner choice in EU FP projects (Nokkala et al. 2008, Paier & Scherngell 2008).
- On the other hand, public rankings have been conceded relevance in new partner search (Hazelkorn 2007, 2008).

- ➢ We expect a stronger influence of experience on participation (consortium building) than of ranking positions
- ➢ However, there might be a positive influence of ranking positions on coordination (reputation of the coordinator affects the standing of the project)

Exploratory analysis (H2)
University participations and coordinations: FP5 versus FP6





NUM_PART: number of project participations in FP6 (project start after 31.12.2004).
NUM_5_PART: number of project participations in FP5.
NUM_COORD: number of coordinated projects in FP6 (project start after 31.12.2004).
FP5_COORD: number of coordinated projects in FP5.
Source: AIT sysres EUPRO Database.

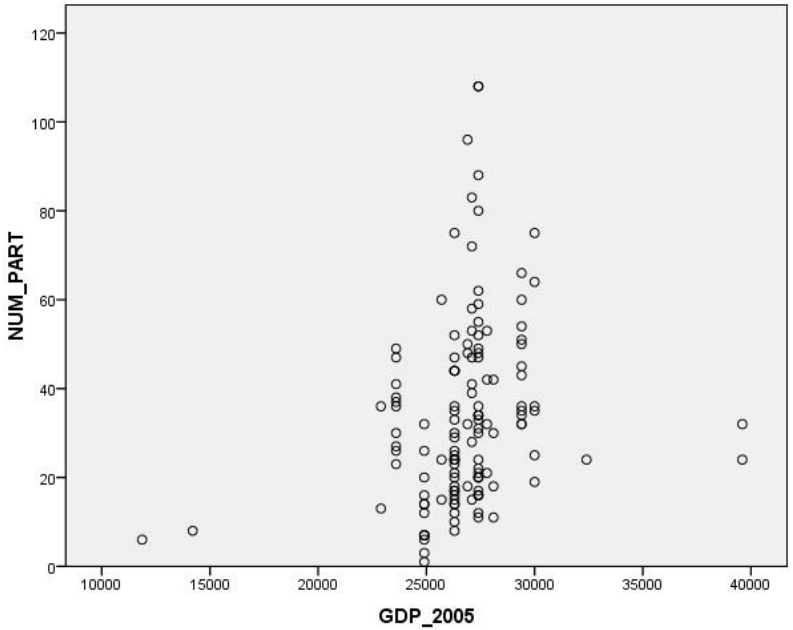
Hypothesis H3

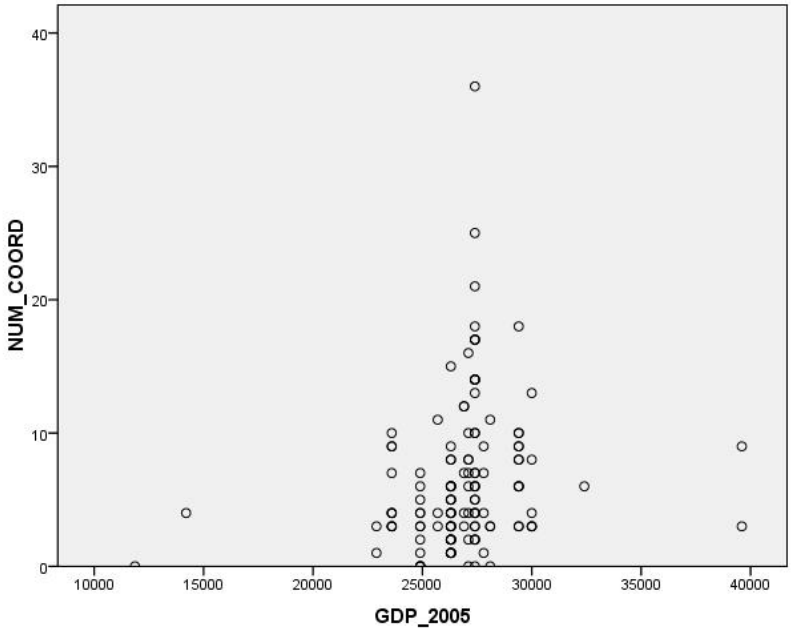
Funding opportunities matter – a networked economy perspective

- A country is richer if its industry is more competitive and its products are better, i.e. more knowledge-intensive (OECD 1996). Thus, universities in high-GDP-countries are more used to the specific rationality of industrial research and acquisition of third-party funding.
- University rankings – focusing on scientific performance or reputation – on the other hand are intended to reflect scientific excellence more than industrial relevance.

- ➢ Thus, we expect only a weak influence of ranking lists on the participation and coordination numbers of a university.
- ➢ However, we assume that universities from high-GDP-countries are more successful players in the EU FP.

Exploratory analysis (H3)
FP6 university participations and coordinations versus GDP





NUM_PART: number of project participations in FP6 (project start after 31.12.2004).
NUM_COORD: number of coordinated projects in FP6 (project start after 31.12.2004).
GDP_2005: per capita GDP 2005 (PPP) of the university´s home country.
Source: AIT sysres EUPRO Database; OECD-Eurostat

Methodology

- Econometric approach
  - to determine the influence of reputation on university performance in FP6
  - with Poisson loglinear models (estimated by maximum likelihood)
- Unit of analysis is the university
- Dependent variables
  - Number of FP6 participations (per capita total staff)
  - Number of FP6 coordinations (per capita total staff)
- Independent variables
  - Reputation: ranking position in *ARWU* and *THE*
  - Human resources: headcount of total staff of universities
  - National funding resources: GDP per capita 2005
  - EU experience: number of participations and coordinations in FP5
  - Relational capital: degree centrality in FP5
  - Institutional factors: EU membership and Language (English)

Data

- 124 European universities in the estimation
  - 133 universities in 2004 rankings
  - THE (85 in Top 200)
  - ARWU (125 in Top 500)

- FP6 participations and coordinations
  - Data from sysres EUPRO database (CORDIS)
  - Projects starting after 31.12.2004
    - 3404 projects
    - 4482 participations
    - 830 coordinations

- Total staff numbers (head count) from university websites

- National per capita GDP 2005
  - in PPP (OECD)

Descriptive statistics

Criteria	Variable name	Min	Max	Mean	Std.Dev.
Dependent variables					
FP6 participations	NUM_PART_N10000	6	313	84.35	53.388
FP6 coordinations	NUM_COORD_N10000	0	60	15.27	12.031
Independent variables					
Excellence	ARWU	1	123	57.62	33.151
	THE	1	86	59.64	27.849
Human resources	STAFF_TOT	736	9500	4385.55	1895.045
National funding opportunities	GDP	22,900	39,600	27,064.52	2,307.224
EU FP experience	5_PART_N10000	33	753	245.46	140.129
	5_COORD_N10000	2	209	63.54	41.414
Relational capital	5_DEGREE	0.00368	0.05941	0. 02641	0.01304
Institutional factors	MEM_AGE	0	52	39.60	15.848

Estimation results for project participations

Covariates	Coefficients (ML estimates)								
	Networked economy model			Resource-based model			Trajectory-based model		
	Magnitude	Std. Error	Marginal effect	Magnitude	Std. Error	Marginal effect	Magnitude	Std. Error	Marginal effect
Excellence									
ARWU rank	-	-	-	-0.112**	(0.037)	0.894	-	-	-
Human resources									
Number of total staff	-	-	-	0.196***	(0.051)	1.217	-	-	-
National funding opportunities									
GDP per capita	0.440***	(0.066)	1.553	-	-	-	-	-	-
EU FP experience									
FP5 participations	-	-	-	-	-	-	0.898***	(0.023)	2.456
FP5 coordinations	0.379***	(0.092)	1.461	0.590***	(0.089)	1.805	-	-	-
Relational capital									
Degree centrality in FP5	0.430***	(0.101)	1.537	-	-	-	0.137***	(0.035)	1.147
Log-likelihood	-1.270.939			-1.632.714			-723.435		
Likelihood ratio chi-square test	73.873.904***			73.150.354***			74.968.912***		

Number of cases: n=124; GL regression model: Poisson loglinear
Dependent Variable: Number of FP6 participations per 10,000 total staff (NUM_PART_N10000).
Independent Variables: ARWU rank (LOG_ARWU_INV). Number of total staff (LOG_STAFF_TOT). GDP per capita (LOG_GDP). FP5 participations (LOG_5_PART_N10000). FP5 coordinations (LOG_5_COORD_N10000). Degree centrality in FP5 (LOG_5_DEGREE).
Significance levels: *) significant at the 0.05 level. **) significant at the 0.01 level. ***) significant at the 0.001 level.

Estimation results for project coordinations

Covariates	Coefficients (ML estimates)								
	Networked economy model			Resource-based model			Trajectory-based model		
	Magnitude	Std. Error	Marginal effect	Magnitude	Std. Error	Marginal effect	Magnitude	Std. Error	Marginal effect
Excellence									
ARWU rank	-	-	-	0.163***	(0.038)	1.177	-	-	-
THE rank	-	-	-	-	-	-	0.153***	(0.034)	1.165
Human resources									
Number of total staff	-	-	-	-0.123**	(0.045)	0.884	-	-	-
National funding opportunities									
GDP per capita	0.432***	(0.047)	1.540	-	-	-	-	-	-
EU FP experience									
FP5 participations	-	-	-	0.654***	(0.123)	1.923	0.420***	(0.069)	1.522
FP5 coordinations	-	-	-	0.187*	(0.083)	1.206	0.252***	(0.075)	1.287
Relational capital									
Degree centrality in FP5	0.453***	(0.134)	1.573	-	-	-	-	-	-
Log-likelihood	-752.306			-545.335			-566.695		
Likelihood ratio chi-square test	6.904.161***			7.318.103***			7.275.383***		

Number of cases: n=124; GL regression model: Poisson loglinear
Dependent Variable: Number of coordinated projects in FP6 per 10,000 total staff (NUM_COORD_N10000).
Independent Variables: ARWU rank (LOG_ARWU_INV). THE rank (LOG_TIMES_INV). Number of total staff (LOG_STAFF_TOT). GDP per capita (LOG_GDP). FP5 participations (LOG_5_PART_N10000). FP5 coordinations (LOG_5_COORD_N10000). Degree centrality in FP5 (LOG_5_DEGREE).
Significance levels: *) significant at the 0.05 level. **) significant at the 0.01 level. ***) significant at the 0.001 level.

Estimation results (1)

Size matters – results of the resource-based model

- Our results confirm the correlation between university size and ranking position, moreover we find that *ARWU* correlates considerably stronger with university size than the *THE* ranking.
- Smaller universities with higher scientific excellence (*ARWU*) are more likely to become project coordinators, while the opposite seems to be true for mere project participation.
- Moreover, experience based on former participation and project coordination in FP5 matters significantly in the resource-based model.

➢ Hypothesis H1 - larger universities are involved more often in EU projects - has to be rejected for coordination and is confirmed for participation.

Estimation results for project participations

Covariates	Coefficients (ML estimates)								
	Networked economy model			Resource-based model			Trajectory-based model		
	Magnitude	Std. Error	Marginal effect	Magnitude	Std. Error	Marginal effect	Magnitude	Std. Error	Marginal effect
Excellence									
ARWU rank	-	-	-	-0.112**	(0.037)	0.894	-	-	-
Human resources									
Number of total staff	-	-	-	0.196***	(0.051)	1.217	-	-	-
National funding opportunities									
GDP per capita	0.440***	(0.066)	1.553	-	-	-	-	-	-
EU FP experience									
FP5 participations	-	-	-	-	-	-	0.898***	(0.023)	2.456
FP5 coordinations	0.379***	(0.092)	1.461	0.590***	(0.089)	1.805	-	-	-
Relational capital									
Degree centrality in FP5	0.430***	(0.101)	1.537	-	-	-	0.137***	(0.035)	1.147
Log-likelihood	-1.270.939			-1.632.714			-723.435		
Likelihood ratio chi-square test	73.873.904***			73.150.354***			74.968.912***		

Number of cases: n=124; GL regression model: Poisson loglinear
Dependent Variable: Number of FP6 participations per 10,000 total staff (NUM_PART_N10000).
Independent Variables: ARWU rank (LOG_ARWU_INV). Number of total staff (LOG_STAFF_TOT). GDP per capita (LOG_GDP). FP5 participations (LOG_5_PART_N10000). FP5 coordinations (LOG_5_COORD_N10000). Degree centrality in FP5 (LOG_5_DEGREE).
Significance levels: *) significant at the 0.05 level. **) significant at the 0.01 level. ***) significant at the 0.001 level.

Estimation results for project coordinations

Covariates	Coefficients (ML estimates)								
	Networked economy model			Resource-based model			Trajectory-based model		
	Magnitude	Std. Error	Marginal effect	Magnitude	Std. Error	Marginal effect	Magnitude	Std. Error	Marginal effect
Excellence									
ARWU rank	-	-	-	0.163***	(0.038)	1.177	-	-	-
THE rank	-	-	-	-	-	-	0.153***	(0.034)	1.165
Human resources									
Number of total staff	-	-	-	-0.123**	(0.045)	0.884	-	-	-
National funding opportunities									
GDP per capita	0.432***	(0.047)	1.540	-	-	-	-	-	-
EU FP experience									
FP5 participations	-	-	-	0.654***	(0.123)	1.923	0.420***	(0.069)	1.522
FP5 coordinations	-	-	-	0.187*	(0.083)	1.206	0.252***	(0.075)	1.287
Relational capital									
Degree centrality in FP5	0.453***	(0.134)	1.573	-	-	-	-	-	-
Log-likelihood	-752.306			-545.335			-566.695		
Likelihood ratio chi-square test	6.904.161***			7.318.103***			7.275.383***		

Number of cases: n=124; GL regression model: Poisson loglinear
Dependent Variable: Number of coordinated projects in FP6 per 10,000 total staff (NUM_COORD_N10000).
Independent Variables: ARWU rank (LOG_ARWU_INV). THE rank (LOG_TIMES_INV). Number of total staff (LOG_STAFF_TOT). GDP per capita (LOG_GDP). FP5 participations (LOG_5_PART_N10000). FP5 coordinations (LOG_5_COORD_N10000). Degree centrality in FP5 (LOG_5_DEGREE).
Significance levels: *) significant at the 0.05 level. **) significant at the 0.01 level. ***) significant at the 0.001 level.

Estimation results (2)

Experience matters – results of the trajectory-based model

- Scientific excellence is beneficial for a high number of project coordinations and more important for project coordination than for mere participation.
- Difference between rankings: While *THE* shows no significant influence in the resource-based model, in the trajectory-based model it is a better predictor of project coordination than *ARWU.* In contrast to *ARWU*, *THE* is size-independent, and correlates stronger with EU FP experience
- Strong indication for a high influence of experience (participation, relational capital) in project participation as well as project coordination in the EU FP; less influence can be attributed to university size in this model

➢ Hypothesis H2 – minor influence of rankings on project participation, greater influence on project coordination - can be strongly confirmed.

Estimation results for project participations

Covariates	Coefficients (ML estimates)								
	Networked economy model			**Resource-based model**			**Trajectory-based model**		
	Magnitude	Std. Error	Marginal effect	Magnitude	Std. Error	Marginal effect	Magnitude	Std. Error	Marginal effect
Excellence									
ARWU rank	-	-	-	-0.112**	(0.037)	0.894	-	-	-
Human resources									
Number of total staff	-	-	-	0.196***	(0.051)	1.217	-	-	-
National funding opportunities									
GDP per capita	0.440***	(0.066)	1.553	-	-	-	-	-	-
EU FP experience									
FP5 participations	-	-	-	-	-	-	0.898***	(0.023)	2.456
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Relational capital									
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Log-likelihood	-1.270.939			-1.632.714			-723.435		
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Number of cases: n=124; GL regression model: Poisson loglinear
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Independent Variables: ARWU rank (LOG_ARWU_INV). Number of total staff (LOG_STAFF_TOT). GDP per capita (LOG_GDP). FP5 participations (LOG_5_PART_N10000). FP5 coordinations (LOG_5_COORD_N10000). Degree centrality in FP5 (LOG_5_DEGREE).
Significance levels: *) significant at the 0.05 level. **) significant at the 0.01 level. ***) significant at the 0.001 level.

Estimation results for project coordinations

Covariates	Coefficients (ML estimates)								
	Networked economy model			Resource-based model			Trajectory-based model		
	Magnitude	Std. Error	Marginal effect	Magnitude	Std. Error	Marginal effect	Magnitude	Std. Error	Marginal effect
Excellence									
ARWU rank	-	-	-	0.163***	(0.038)	1.177	-	-	-
THE rank	-	-	-	-	-	-	0.153***	(0.034)	1.165
Human resources									
Number of total staff	-	-	-	-0.123**	(0.045)	0.884	-	-	-
National funding opportunities									
GDP per capita	0.432***	(0.047)	1.540	-	-	-	-	-	-
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Relational capital									
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Log-likelihood	-752.306			-545.335			-566.695		
Likelihood ratio chi-square test	6.904.161***			7.318.103***			7.275.383***		

Number of cases: n=124; GL regression model: Poisson log-linear

Dependent Variable: Number of coordinated projects in FP6 per 10,000 total staff (NUM_COORD_N10000).

Independent Variables: ARWU rank (LOG_ARWU_INV). THE rank (LOG_TIMES_INV). Number of total staff (LOG_STAFF_TOT). GDP per capita (LOG_GDP). FP5 participations (LOG_5_PART_N10000). FP5 coordinations (LOG_5_COORD_N10000). Degree centrality in FP5 (LOG_5_DEGREE).

Significance levels: *) significant at the 0.05 level. **) significant at the 0.01 level. ***) significant at the 0.001 level.

Estimation results (3)

Funding opportunity matters – results of the networked economy model

- Scientific excellence does not show an influence on participation and project coordination in FP6 within this model.
- In contrast, collaboration experience (project coordinations, relational capital) of the university and the GDP of the country determine the involvement in the EU FP; less influence of university size in this model
- Since university rankings aim to value the scientific excellence of universities based on research output and scientific reputation, this result supports our hypothesis that universities from countries with high GDP show a stronger orientation for applied industrial research than for fundamental research.

➢ Hypothesis H3 – minor influence of ranking positions on participation and coordination numbers of a university – can be confirmed.

Conclusions

- Overall, we find only a weak influence of university rankings on the involvement of universities in the EU FP.
- But: there is a difference between project coordination and mere project participation.
  - This might indicate a high degree of industry orientation of the FP, while pure scientific excellence (measured by rankings) plays a minor role for participations. However, a strong scientific lead based on high reputation seems to be relevant.
- More critical success factors for FP involvement of universities are: FP experience, relational capital and national funding opportunities
- Moreover, we find a surprisingly low correlation between *THE* and *ARWU*
  - *ARWU* only significant if we take the size of the university into account
  - *THE* ranking is significant only in the trajectory-based approach
  - It is worthwhile to further size-independent measures of scientific excellence

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Thank you for your attention!

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