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RESEARCH INFRASTRUCTURE FOR SCIENCE
AND INNOVATION POLICY STUDIES

How universities react to funding policies: The effects at performance level

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Outline

- Background
- Aim of the paper
- Conceptual framework
- Methodology and data
- Results
- Conclusions

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Background



- HE policies design different types of incentives for stimulating the reaction of the Universities toward the achievement of pre-determined results
- The organization response of the Universities to policies is very heterogeneous, because of
 - their special nature as organization (Musselin, 2006; Bleiklie et al., 2015),
 - the content of the policies (Jongbloed, 2004), cultural and local conditions
 - the paradigmatic or incremental change they suggest (Paradeise et al, 2009; Paradeise, 2013),
 - the different stimuli that generate reactions across the disciplinary fields (Reale and Seeber, 2011)
 - the different attitude of fields to be steered through policies (Whitley, 1984; Bonaccorsi, 2010, Seeber, 2014).
- Funding policies are a prominent policy mean for steering HEIs

Aim of the paper

- Main research question:
 - How far the inputs used in the policy action are likely to pursue a chosen target, considering the capability of the HEIs to react to the inputs themselves producing the expected outputs?
- Testing the responsiveness of each University toward funding inputs policy makers can activate in order to pursue the specific policy objective related to the research performance
- Examples of funding policies' inputs can be:

	Direct	Indirect
Positive	Increasing core funding	Setting project funding instruments
Negative	Cutting down core funding	Threshold on student fees

Conceptual framework

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- Funding considered is:
 - Core funding provided by the government
 - Student fees applied by the HEIs
 - Third-party funding the HEIs are able to attract
- Research responses (outputs) considered are:
 - Number of graduates ISCED 8 (PhDs)
 - Capability to participate in EUFPs
 - Number of Publications in WoS
 - Mean normalized citation score
 - Share top 10% cited



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17, Number 2, pp. 422–441

Estimating responsiveness scores using `rscore`

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Abstract. `rscore` computes unit-specific responsiveness scores using an iterated random-coefficient regression approach. The model fit by `rscore` considers a regression of a response variable y , that is, *outcome*, on a series of factors (or regressors) x , that is, *varlist*, by assuming a different reaction (or “responsiveness”) of each unit to each factor contained in x . `rscore` allows for i) ranking units according to the obtained level of the responsiveness score; ii) detecting more influential factors in driving unit performance; and iii) studying the distribution (heterogeneity) of factors’ responsiveness scores across units. Also, `rscore` offers useful graphical representation of results. We provide two illustrative applications of the model: the first is on a cross-section, and the second is on a longitudinal dataset.



Why Responsiveness Scores (RS)?

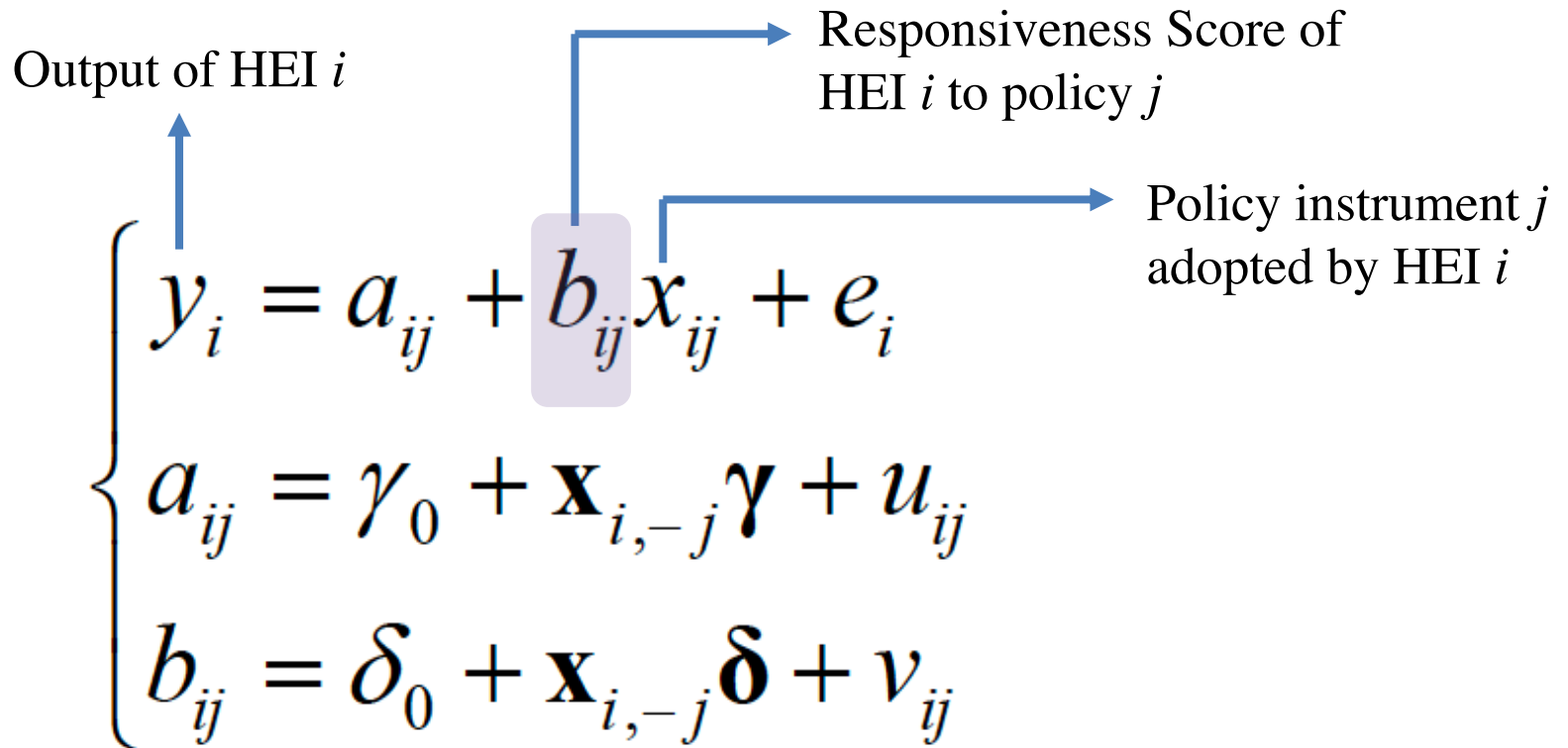
- Going beyond the “magic number” for policy impact evaluation
- Stressing units’ response heterogeneity by response distribution analysis
- Detecting factor importance for impact assessment
- Allowing for studying returns to factor accumulation (“Matthew effect of accumulated advantage”)
- Allowing for ranking units according to their RS
- Allowing for clear results’ graphical inspection

Methodology 3

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Random-coefficient regression



Methodology 4

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Matrix of the **Responsiveness Scores**

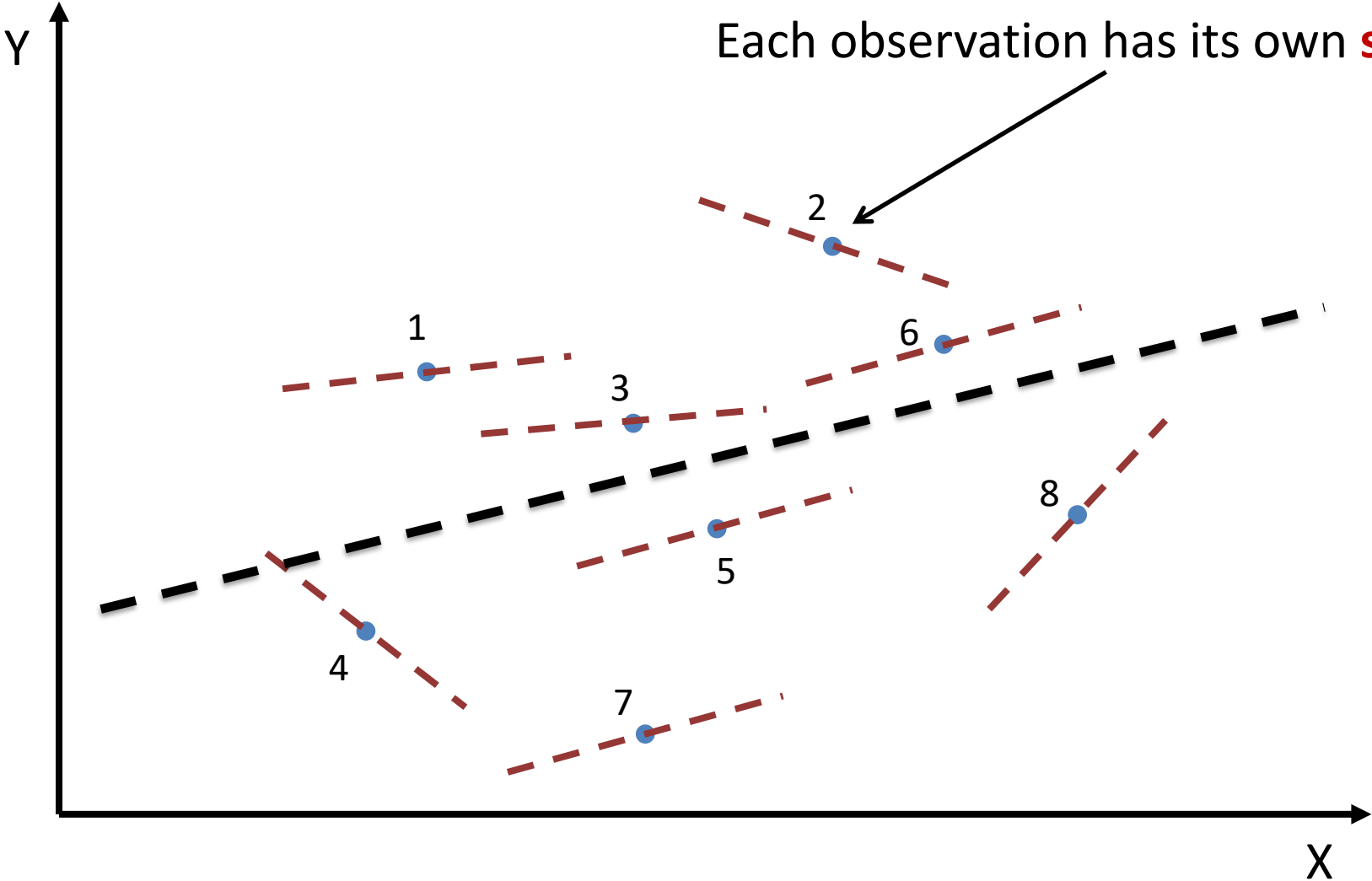
$$\mathbf{B} = \begin{pmatrix} E(b_{11}|\mathbf{x}_{i,-j}) & \dots & E(b_{1Q}|\mathbf{x}_{i,-j}) \\ \vdots & E(b_{ij}|\mathbf{x}_{i,-j}) & \vdots \\ E(b_{N1}|\mathbf{x}_{i,-j}) & \dots & E(b_{NQ}|\mathbf{x}_{i,-j}) \end{pmatrix}$$

When a longitudinal dataset is available, the estimation of \mathbf{B} can be obtained by using either random-effects or fixed-effects estimation of the following panel-data regression,

$$y_{it} = \gamma_0 + \mathbf{x}_{i,-j,t}\gamma + (\delta_0 + \bar{\mathbf{x}}_{-j,t}\delta)x_{ijt} + x_{ijt}(\mathbf{x}_{i,-j,t} - \bar{\mathbf{x}}_{-j,t})\delta + \alpha_i + \eta_{it}$$

Methodology 5

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Methodology 6

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The `rscore` command

Syntax

As seen above, `rscore` computes unit-specific RSs using an iterated RCR model. The model fit by `rscore` considers a regression of a response variable y , that is, *outcome*, on a series of factors \mathbf{x} , that is, *varlist*, by assuming a different reaction (or “responsiveness”) of each unit to each factor contained in \mathbf{x} . The basic syntax of `rscore` is

```
rscore outcome [varlist] [if] [in] [weight], model(modeltype) rs_name(stub)
  [factors(varlist_f) xlist(varlist_c) graph(#) radar(numlist)
  id_string(varname) vce(vcetype) save_graph1(filename)
  save_graph2(filename) ]
```

```
. ssc install rscore
```

RISIS-ETER database:

- A register of European Higher Education Institutions
- Collecting information on around 9,000 HEIs (where the 80 % are Universities), in the time span 2011-2016
- Basic statistical information on HEIs, including descriptors, geographical information, students and graduates, personnel, finances, and research activities
- Sample used: Research-active organizations in EU27+UK
 - Ref: ETER Handbook 205.6.1

Model specification

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RESEARCH OUTPUTS

Total graduates at ISCED 8; Publications; Participation to European projects; Mean Normalized Citation Score; Share Top 10% cited

TREATMENTS

Core funding; Third-party funding; Student fees

CONTROLS

Total students enrolled ISCED 5-7(size); Geographical location (NUTS 2); Presence of multi-site campuses; STEM orientation (towards science-based sectors); STEM orientation (students); Age; Foundation year

Variables are standardized by HEIs' size



- Policy-inputs are not assumed to affect the output at the same time. The “time-lag dilemma” is attenuated by introducing a lag between inputs and outputs in our model
- Some important countries do not enter in the model because we do not have enough observations (e.g. France)
- HEIs performance is affected not only by the observable input-policies, but by many unobservables, such as the specific ability of its researchers, organizational features, social and contextual elements not directly correlated with what is effectively grasped by the variables considered in the paper.
 - However RS estimation is made using a fixed-effect regression so that some time-invariant unobservable can be caught

Descriptives 1

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Institution Category	Freq.	Percent	Cum.
Other	1,642	18.06	18.06
University	5,222	57.45	75.51
University of applied sciences	2,226	24.49	100.00
Total	9,090	100.00	

Note: only research active HEIs are considered (according to the ETER definition)

Descriptives 2

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Country Code	Freq.	Percent	Cum.
AT	46	4.51	4.51
BE	13	1.27	5.78
CY	6	0.59	6.37
DE	250	24.51	30.88
HU	2	0.20	31.08
IE	48	4.71	35.78
IT	187	18.33	54.12
LT	10	0.98	55.10
MT	2	0.20	55.29
NL	13	1.27	56.57
PT	37	3.63	60.20
SE	82	8.04	68.24
SK	12	1.18	69.41
UK	312	30.59	100.00

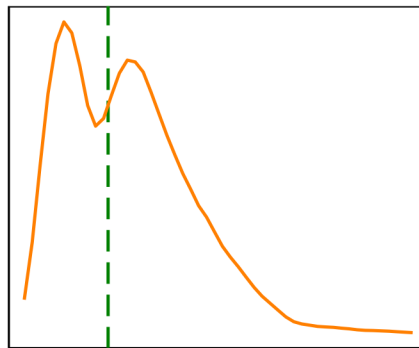
NOTE: N= **1,020 HEIs** - We consider only the HEIs used in the RS estimates

Descriptives 3

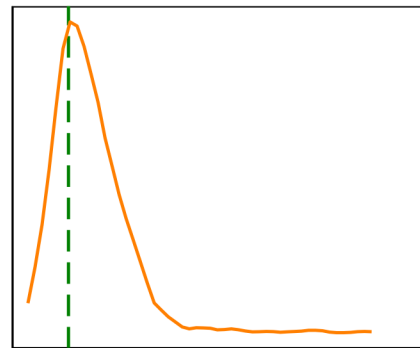
RISIS



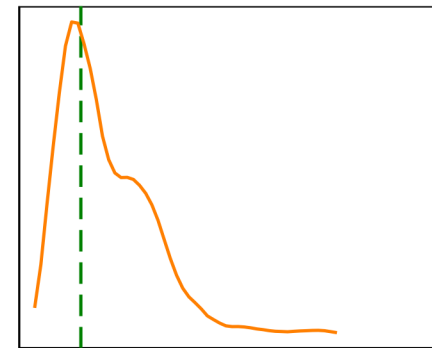
Distribution of the **Research Outputs**



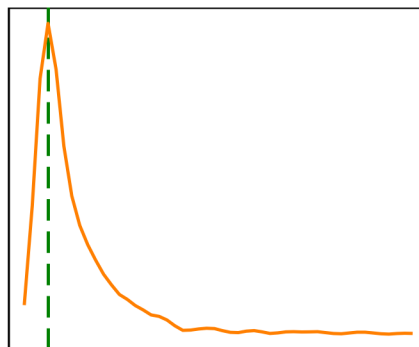
Total graduates at ISCED 6 and 7
N = 893; Mean = 2.7456; Median = 2.0481



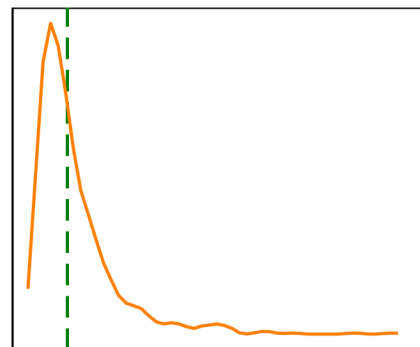
Total graduates at ISCED 8
N = 893; Mean = .0897; Median = .07



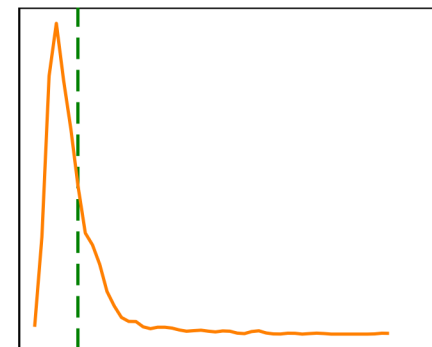
Publications
N = 893; Mean = .1832; Median = .1439



Number of EU-FP participations
N = 893; Mean = .019; Median = .01



Mean Normalized Citation Score
N = 893; Mean = .0016; Median = .0008



Share Top10% cited
N = 893; Mean = .0002; Median = .0001

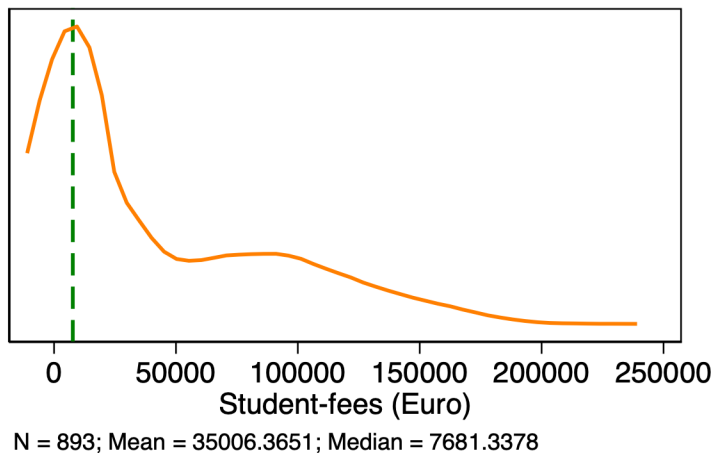
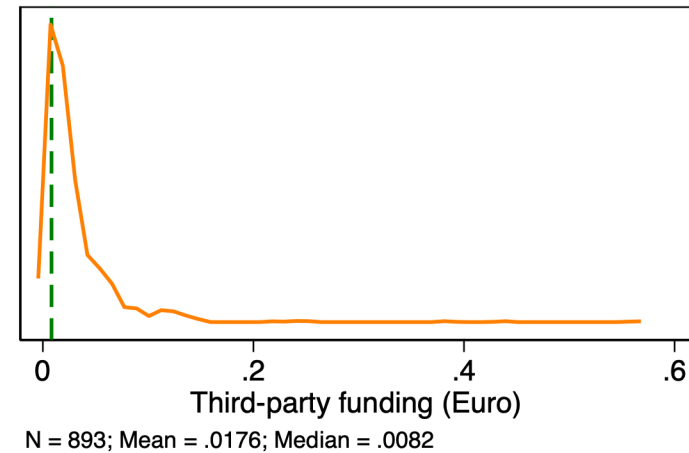
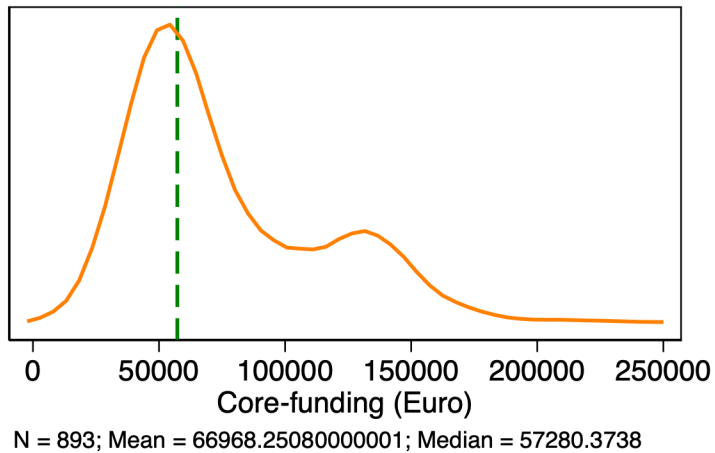
NOTE: Variables divided by 'Total academic staff'; Vertical line = Median

Descriptives 3

RISIS



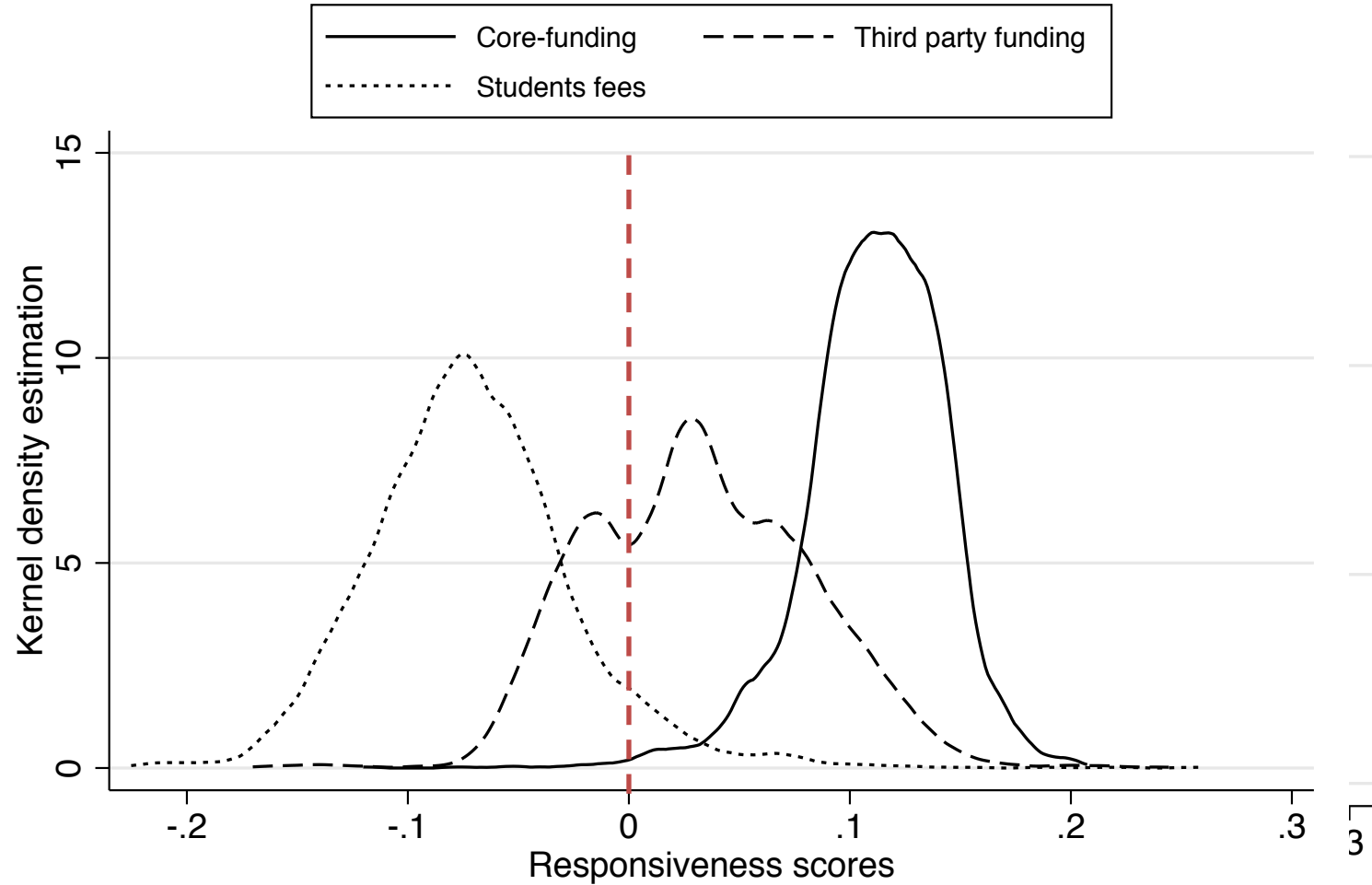
Distribution of the Funding Instruments



NOTE: Variables divided by 'Total academic staff'; Vertical line = Median

Results

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Outcome: Total graduates at ISCED 6 and 7



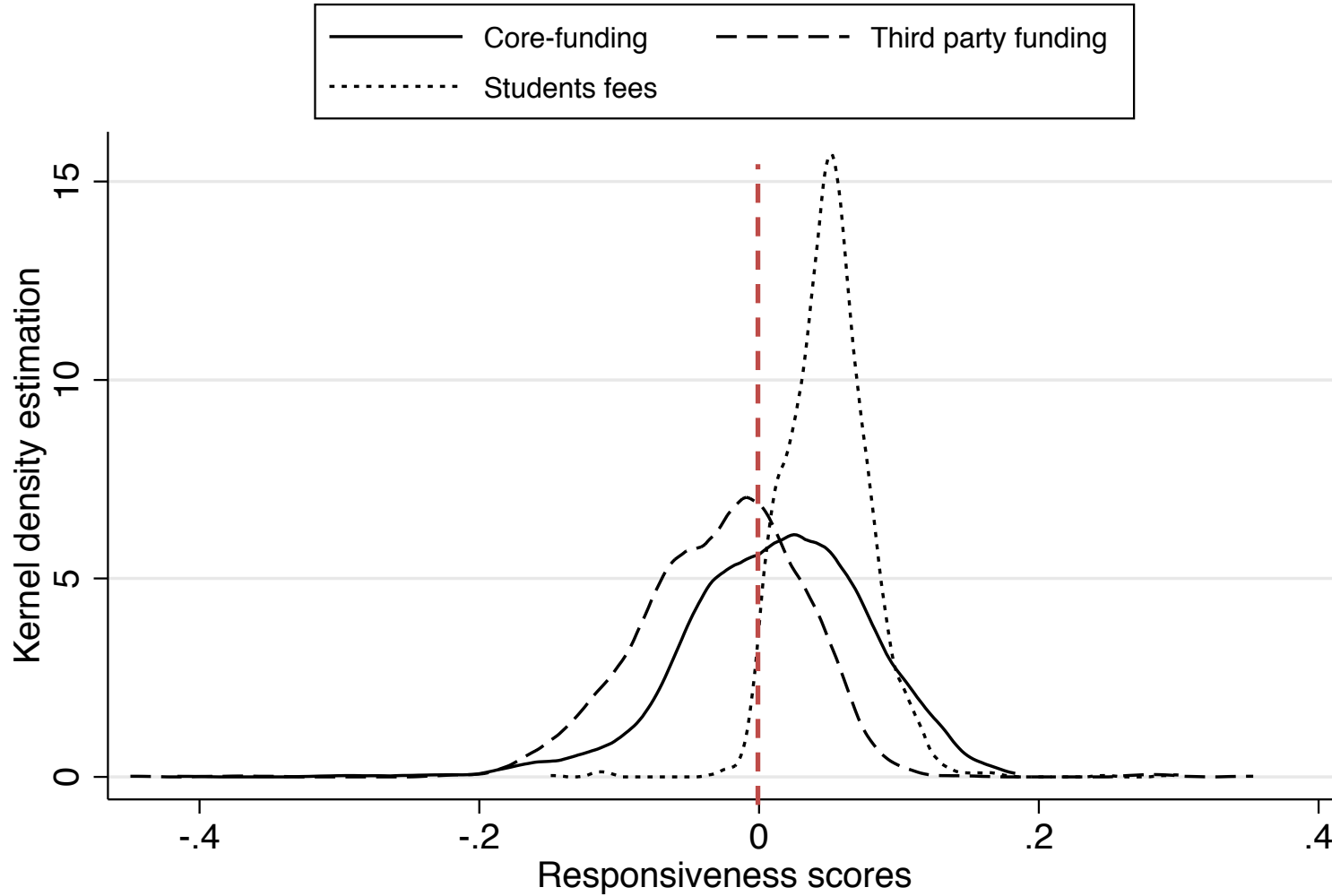
Descriptive statistics for Responsiveness Scores

	Mean	Std. Dev.	T-test	Median	25th Percentile	75th Percentile
Core-funding	0.111***	0.032	3.469	0.113	0.094	0.133
Third party funding	0.032	0.050	0.640	0.030	-0.007	0.068
Students fees	-0.071	0.046	-1.543	-0.074	-0.101	-0.046
<i>N</i>	2528					

Output = Total graduates at ISCED 6 and 7

Results

RISIS



Outcome: Total graduates at ISCED 8

Results

RISIS



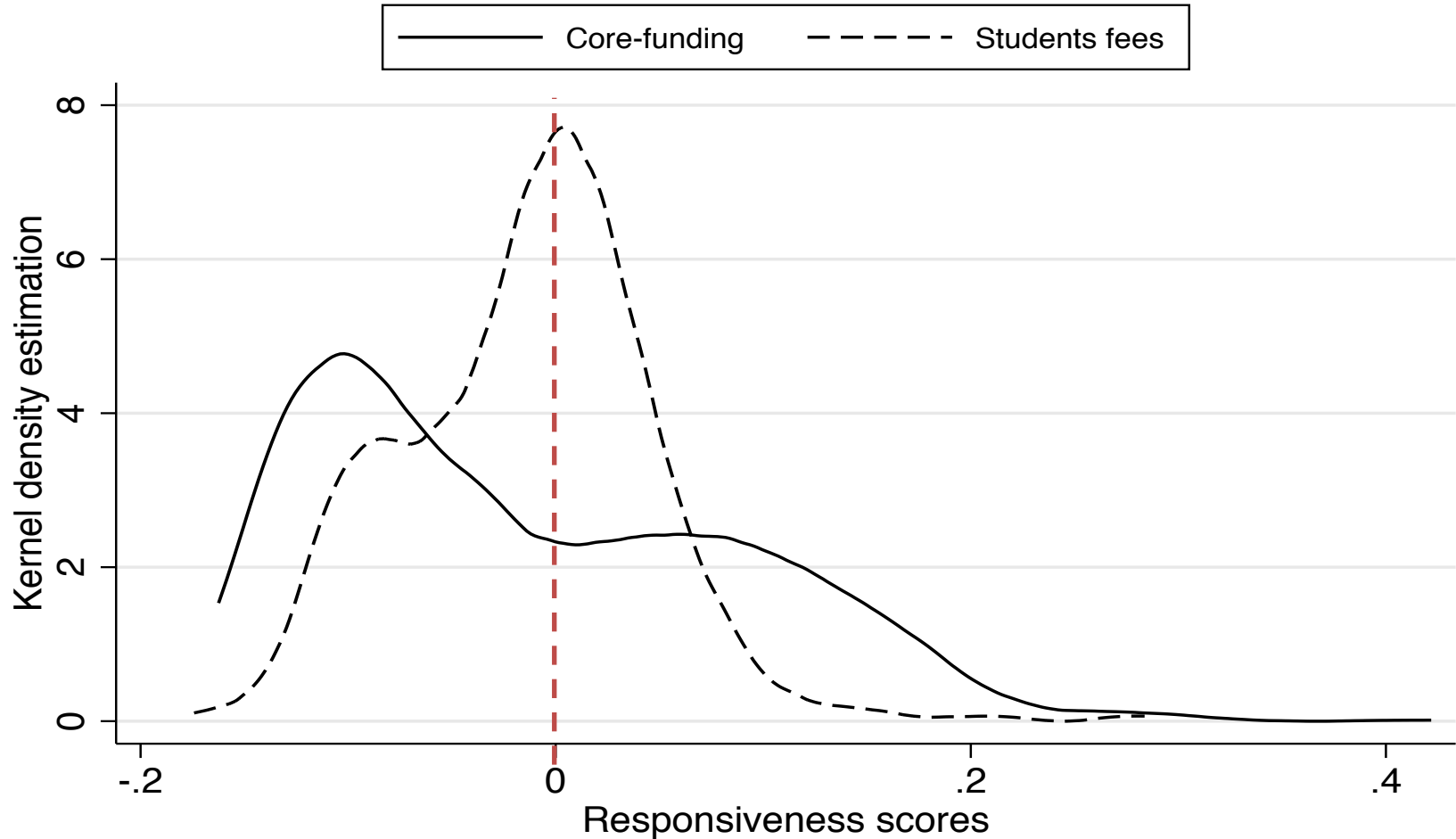
Descriptive statistics for Responsiveness Scores

	Mean	Std. Dev.	T-test	Median	25th Percentile	75th Percentile
Core-funding	0.012	0.066	0.182	0.016	-0.029	0.058
Third party funding	-0.027	0.060	-0.450	-0.022	-0.065	0.013
Students fees	0.050	0.031	1.613	0.050	0.030	0.067
<i>N</i>	1807					

Output = Total graduates at ISCED 8

Results

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Outcome: Number of EU-FP participations

Note: Third-party funding eliminated as treatment but inserted as control



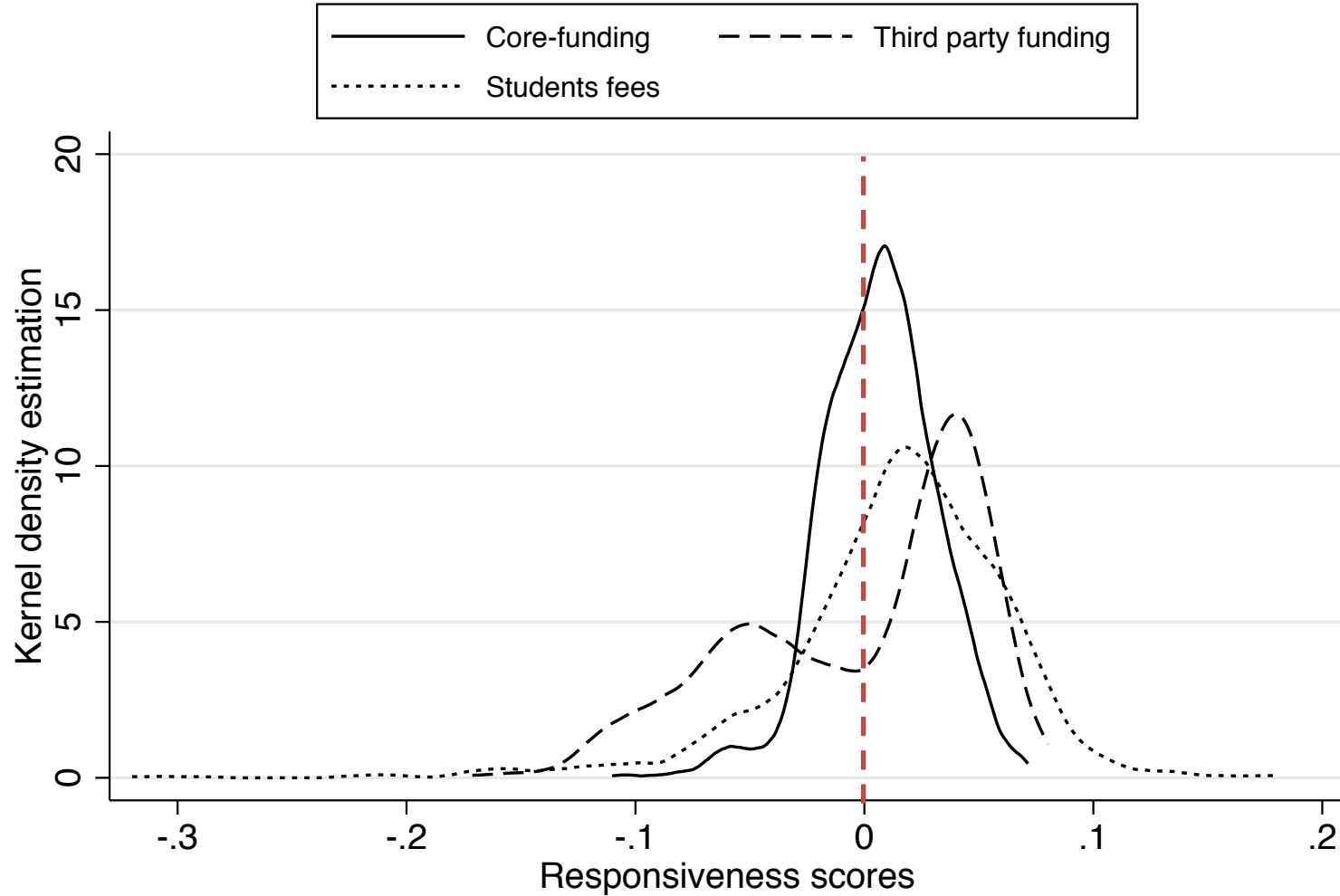
Descriptive statistics for Responsiveness Scores

	Mean	Std. Dev.	T-test	Median	25th Percentile	75th Percentile
Core-funding	-0.014	0.101	-0.138	-0.041	-0.104	0.066
Students fees	-0.014	0.060	-0.233	-0.009	-0.057	0.024
N	1171					

Output = Number of EU-FP participations

Results

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Outcome: Publications

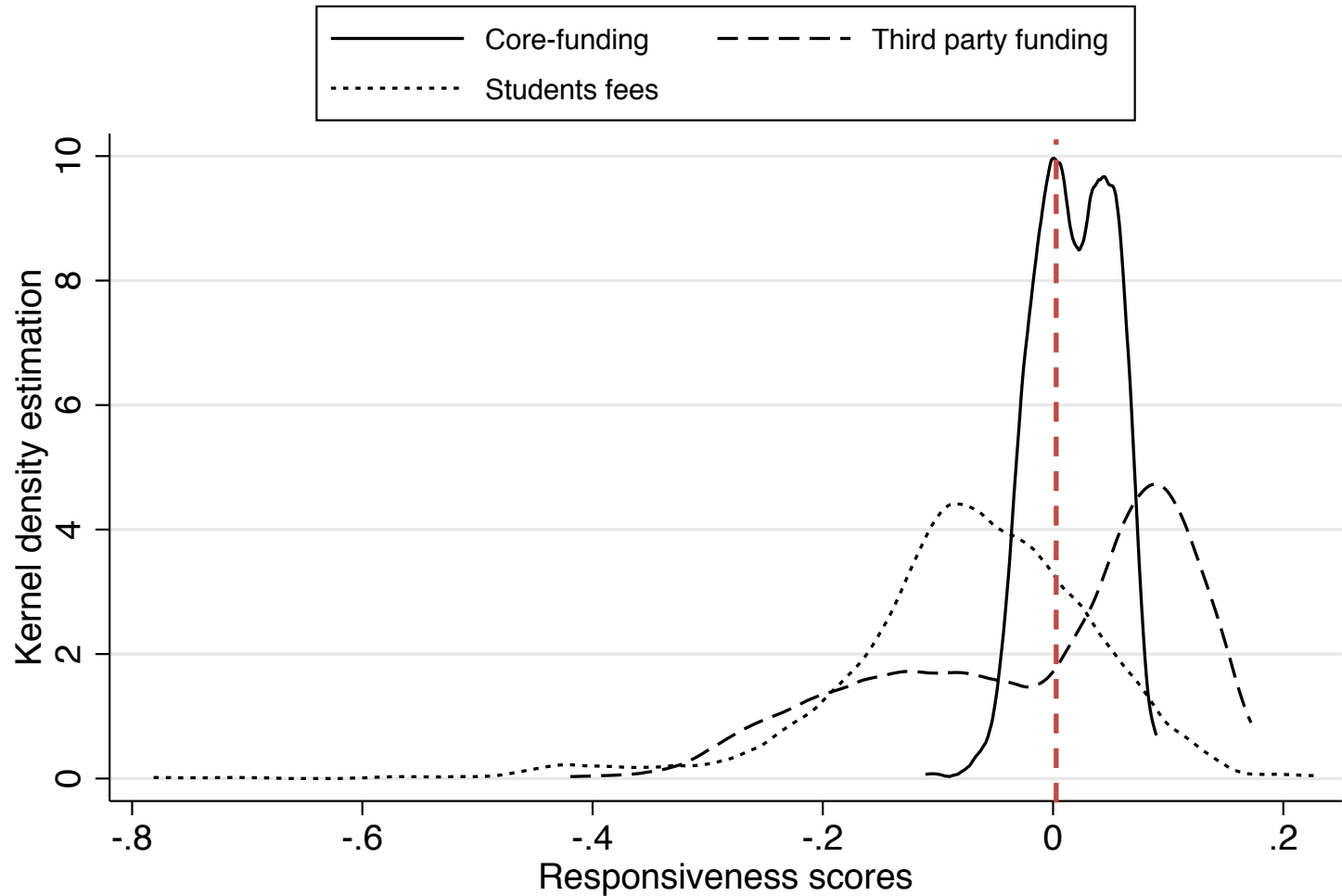
Descriptive statistics for Responsiveness Scores

	Mean	Std. Dev.	T-test	Median	25th Percentile	75th Percentile
Core-funding	0.006	0.025	0.240	0.007	-0.010	0.023
Third party funding	-0.002	0.053	-0.038	0.022	-0.046	0.041
Students fees	0.014	0.050	0.280	0.019	-0.008	0.045
<i>N</i>	1024					

Outcome = Publications

Results

RISIS



Outcome: Mean Normalized Citation Score

Results

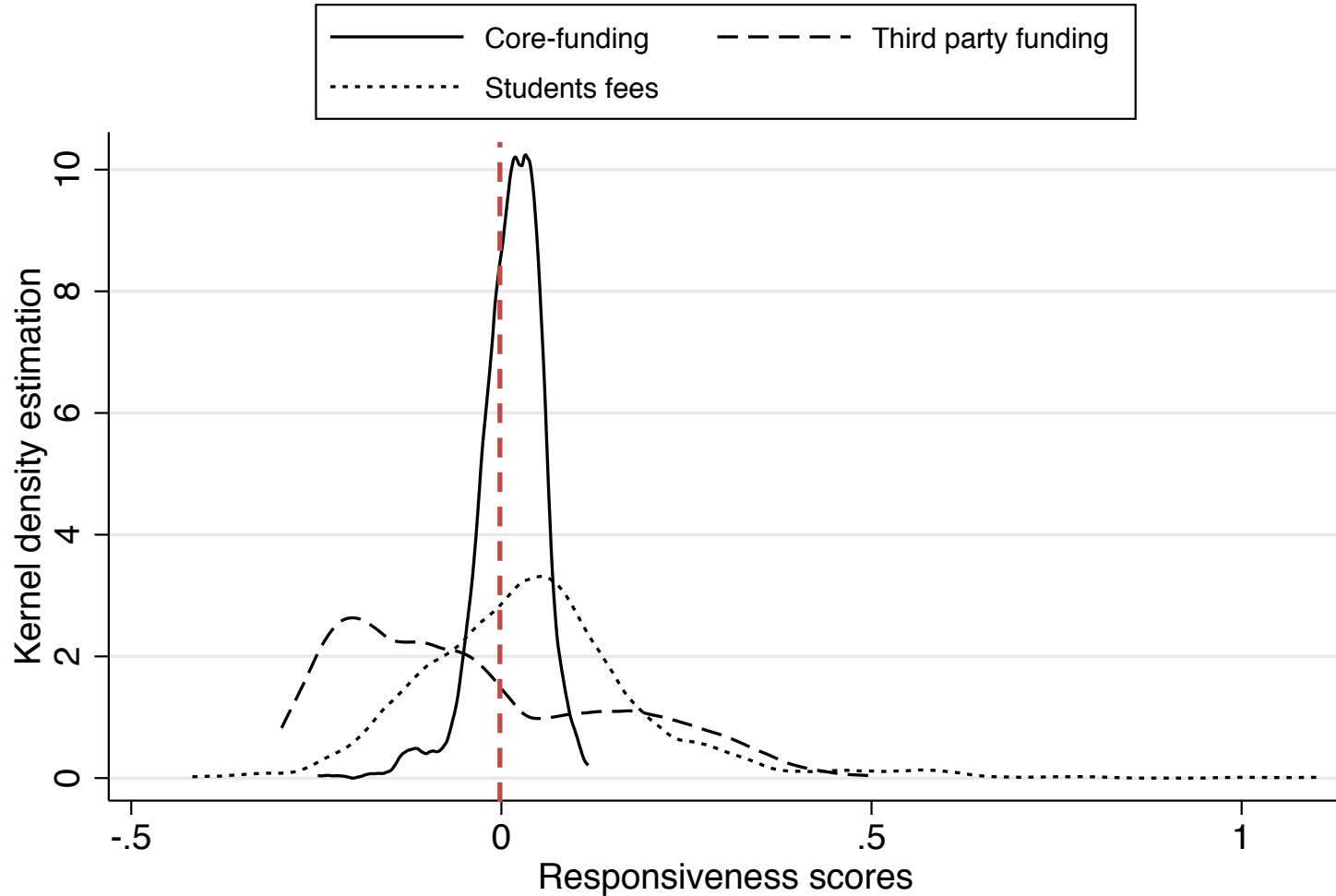
Descriptive statistics for Responsiveness Scores

	Mean	Std. Dev.	T-test	Median	25th Percentile	75th Percentile
Core-funding	0.018	0.033	0.545	0.018	-0.006	0.045
Third party funding	-0.011	0.127	-0.087	0.042	-0.112	0.097
Students fees	-0.074	0.111	-0.667	-0.067	-0.125	-0.003
<i>N</i>	1020					

Output = Mean Normalized Citation Score

Results

RISIS



Outcome: Share Top10% cited

Results

Descriptive statistics for Responsiveness Scores

	Mean	Std. Dev.	T-test	Median	25th Percentile	75th Percentile
Core-funding	0.013	0.043	0.302	0.017	-0.010	0.042
Third party funding	-0.034	0.179	- 0.190	-0.067	-0.186	0.106
Students fees	0.047	0.160	0.294	0.039	-0.052	0.114
<i>N</i>	977					

Output = Share Top10% cited

Share of positive RS by treatment and output

	Total graduates at ISCED 6 and 7	Total graduates at ISCED 8	Publications	Number of EU-FP participations	Mean Normalized Citation Score	Share Top10% cited
Core-funding	99.53	59.82	61.62	40.96	67.84	67.25
Third party funding	70.53	33.7	56.93	N.A.	57.55	35.41
Students fees	6.17	97.62	69.04	43.88	23.43	62.03

Note: number of observations is around 1,000 HEIs



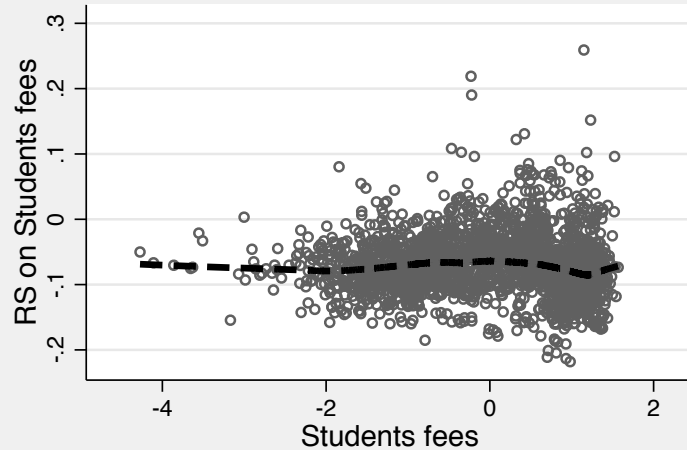
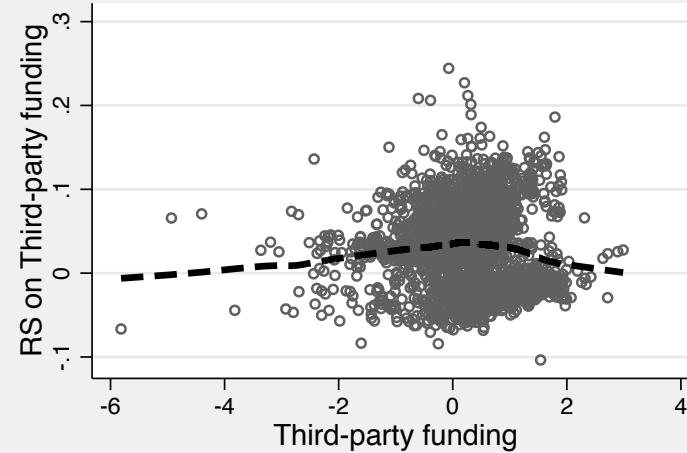
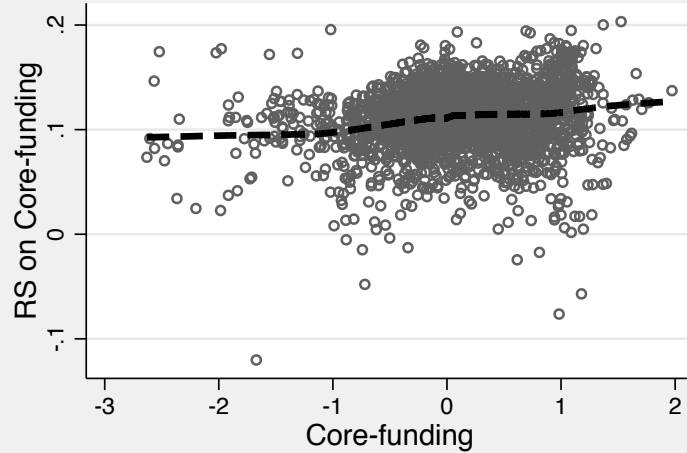
Median Responsiveness Scores

	Total graduates at ISCED 6 and 7	Total graduates at ISCED 8	Publications	Number of EU-FP participations	Mean Normalized Citation Score	Share Top10% cited
Core-funding	0.113	0.016	0.007	-0.014	0.018	0.017
Third party funding	0.030	-0.022	0.022	0.110	0.042	-0.067
Students fees	-0.074	0.050	0.019	-0.012	-0.067	0.039

Note: number of observations is around 1,000 HEIs

Returns to factor accumulation

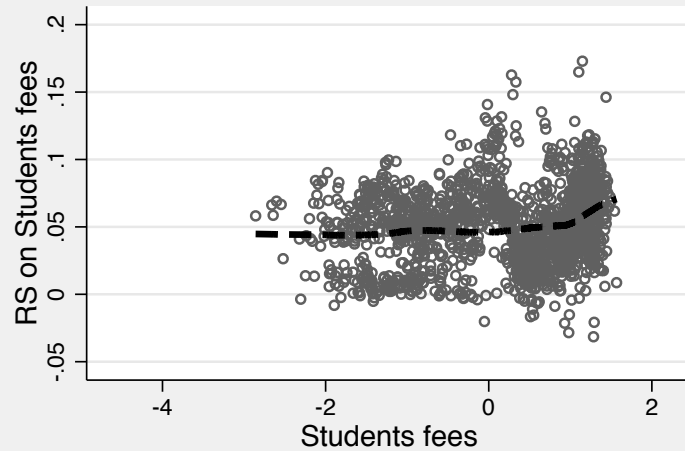
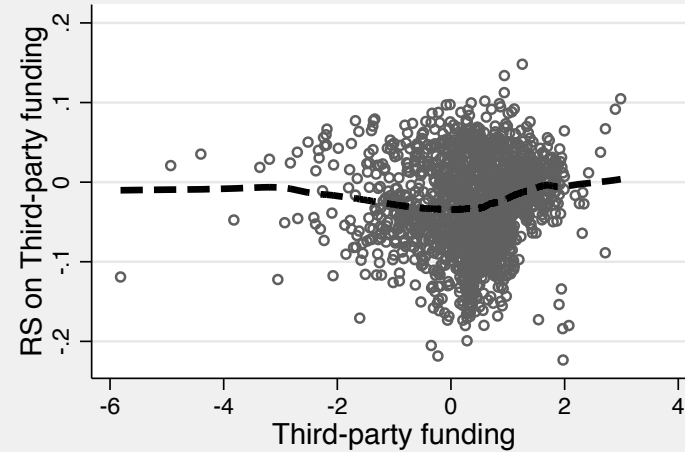
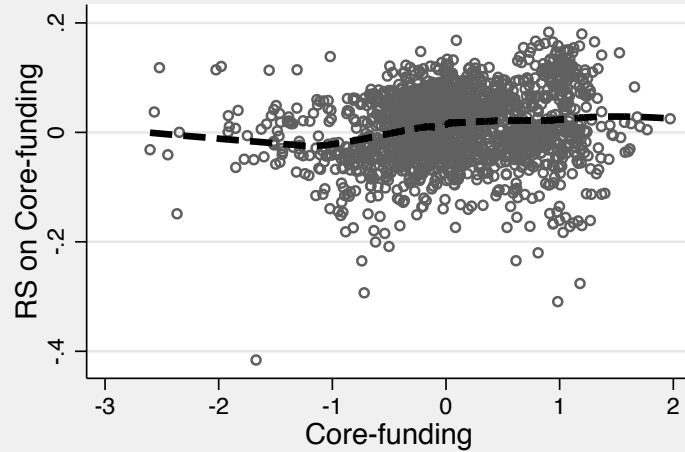
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Outcome = Total graduates at ISCED 6 and 7

Returns to factor accumulation

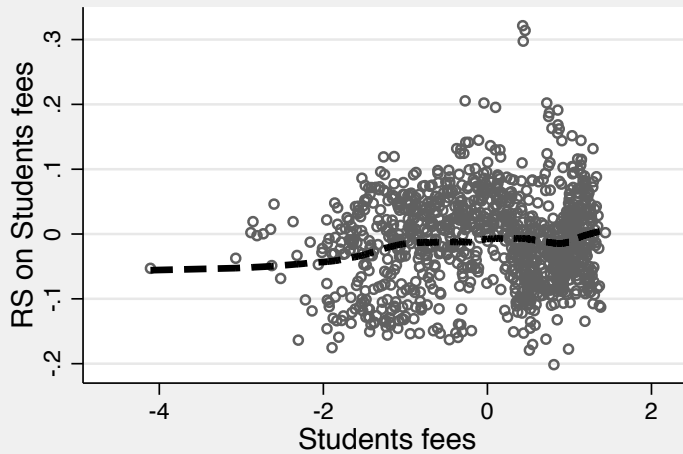
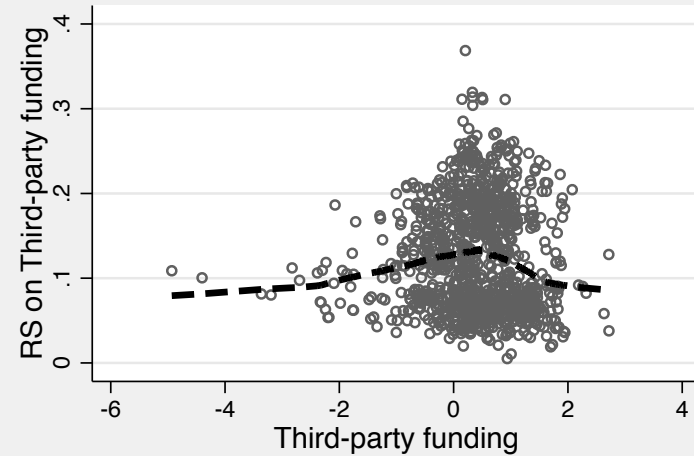
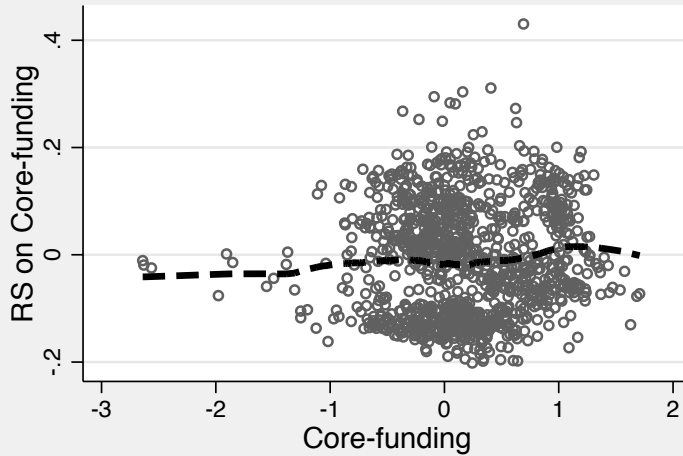
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Outcome = Total graduates at ISCED 8

Returns to factor accumulation

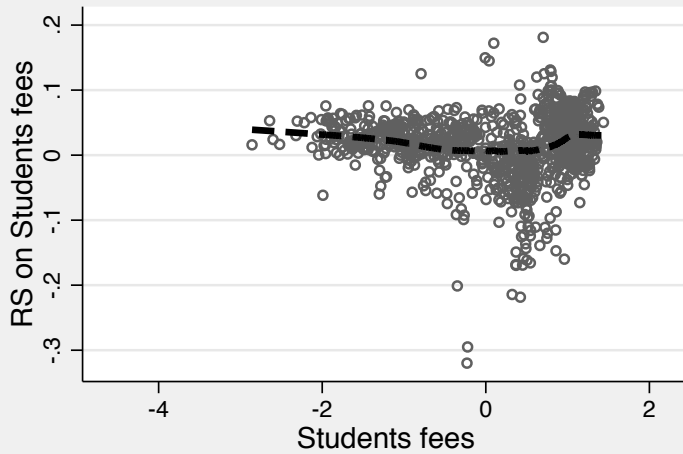
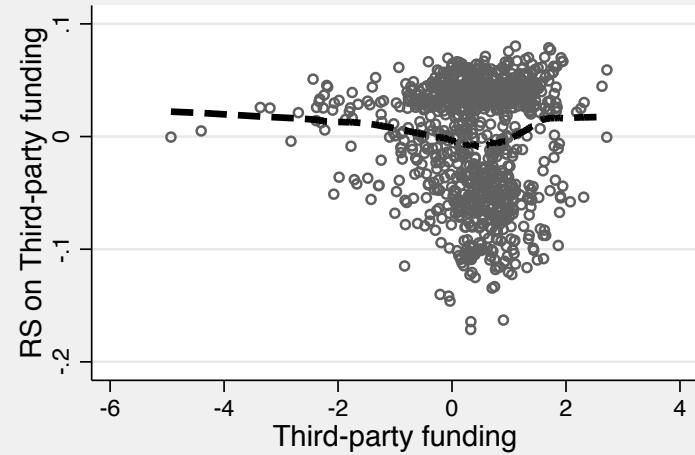
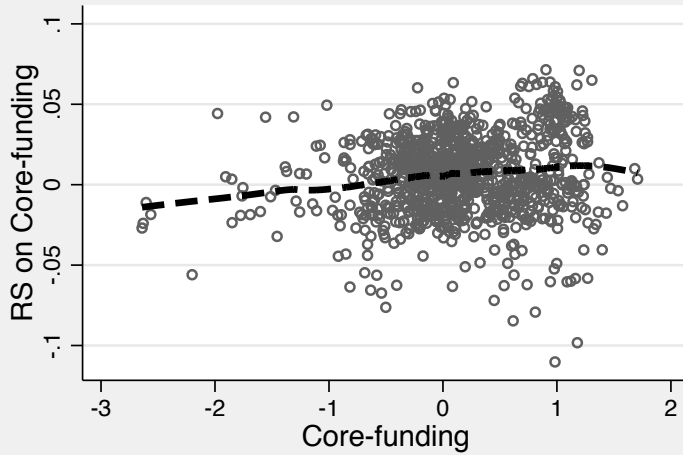
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Outcome = Number of EU-FP participations

Returns to factor accumulation

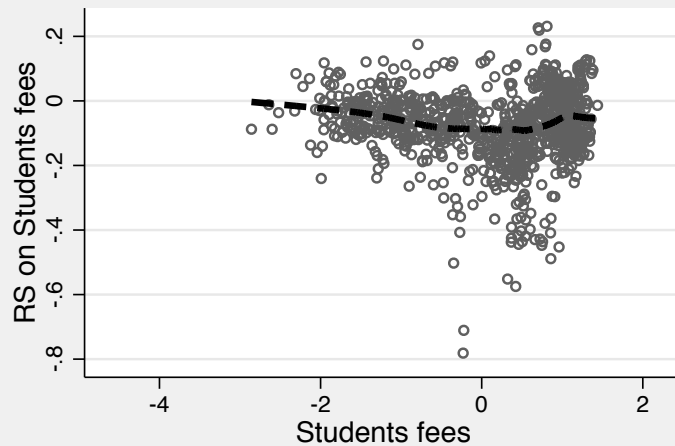
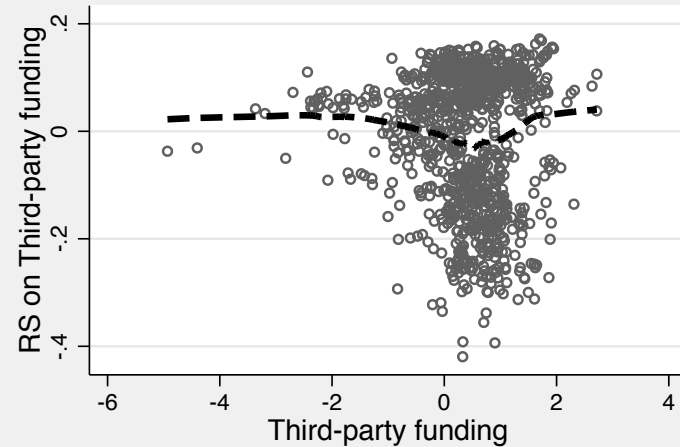
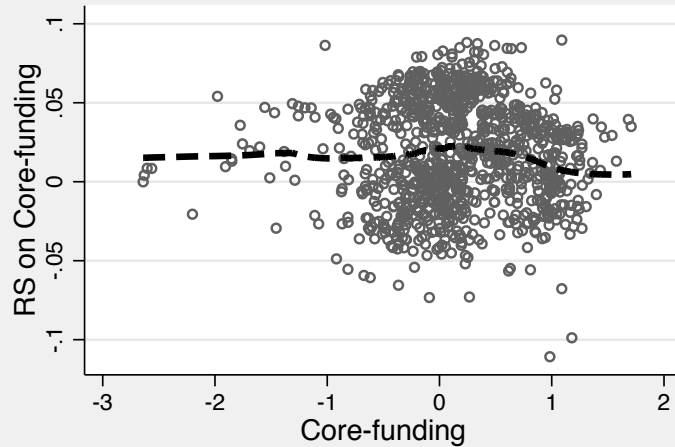
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Outcome = Publications

Returns to factor accumulation

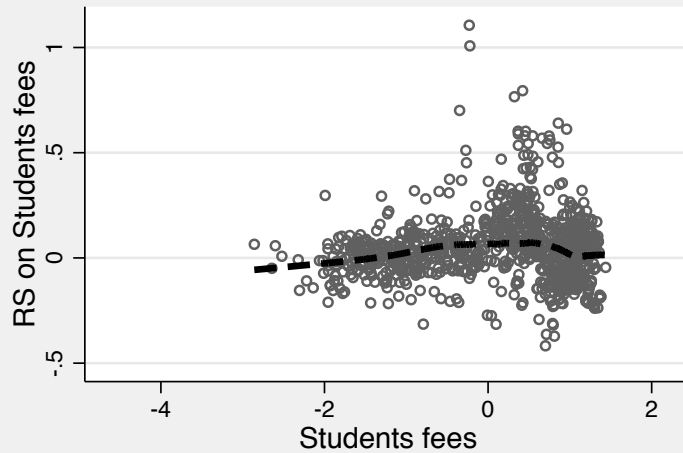
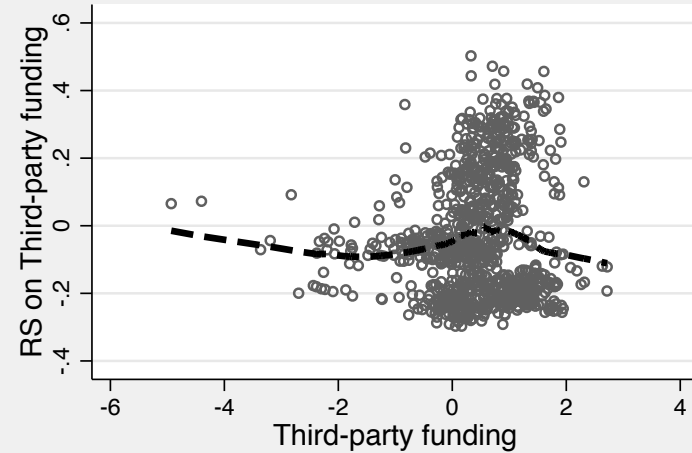
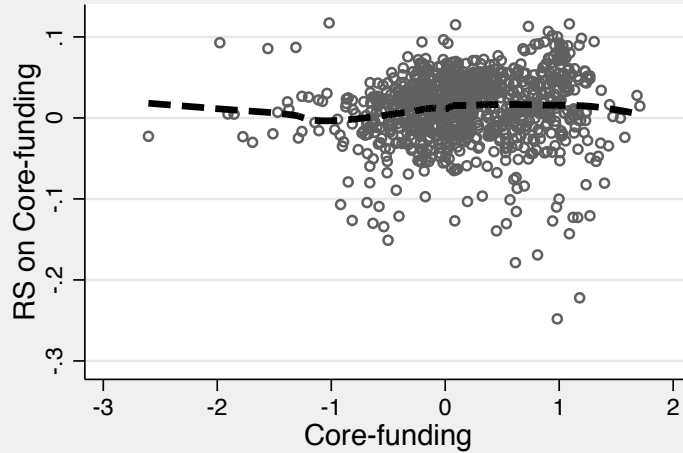
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Outcome = Mean Normalized Citation Score

Returns to factor accumulation

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Outcome = Share Top10% cited

- Policies increasing the level of core funding are likely to generate
 - a rather homogeneous and mainly positive RS of HEIs' research performance as to PhDs graduates, publications, citations and excellence
 - but negative RS as to internationalization (EU-FP participation)
 - mainly good long-term accumulated advantages
- Policies stimulating higher level of third party funding might produce
 - more heterogeneous RS with high share of negative responses as to the quality of research (citations)
 - weak long term accumulated advantages
- RS toward policies on student fees are less clear, maybe influenced by elitarian strategies and higher/lower reliance to teaching

Next steps

- RS ranking analysis at HEIs level
- Analysis of the RS temporal pattern
- Identification of the main characteristics of HEIs laying in the positive/negative side of the RS distribution
- Case-studies by cherry-picking specific HEIs with interesting RS behaviours

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AND INNOVATION POLICY STUDIES

THANK YOU!

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[RISIS2 EU PROJECT](https://www.youtube.com/RISIS2_EU_PROJECT)



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NIFU

Nordisk institutt for studier av innovasjon, forskning og utdanning

