An analysis of the Excellence Initiative and its effects on the funded universities

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Contents

0 Summary 1

1 Introduction 1

2 Data and methodology 2

2.1 Data 2

2.2 Methodology 4

3 Descriptive results 6

3.1 Basic statistics on the tracks 6

3.2 Differences between funded and non-funded universities 9

3.3 Difference before and after funding 13

4 Multivariate results 15

4.1 Nearest neighbor-matching 15

4.2 FE regressions 16

4.3 Robustness checks: using heterogeneity as a source of identification 27

5 Conclusion 29

6 References 30

7 Appendix – Analysis of the Lag Structures 31

Figures

Figure 1: Funded projects by year 7
Figure 2: Number of funded projects by university 7
Figure 3: Funded projects by field 8
Figure 4: Time trends by funding status 13

Tables

Table 1: Descriptive statistics of the main variables 4
Table 2: Correlation between funding decisions in different tracks 8
Table 3: Descriptives by funding status I 10
Table 4: Descriptives by funding status II 11
Table 5: Descriptives by funding status III 12
Table 6: Descriptives by funding status IV 12
Table 7: Descriptives before and after funding I 14
Table 8: Descriptives before and after funding II 14
Table 9: Descriptives before and after funding III 15
Table 10: Descriptives before and after funding IV 15
Table 11: Program effects on outcomes based on nearest neighbor matching for 2011 16
Table 12: Program effects on outcomes based on nearest neighbor matching for 2013 16
Table 13: Effects of Track 1 funding on performance and concentration measures 18
Table 14: Effects of Track 2 funding on performance and concentration measures 19
Table 15: Effects of Track 3 funding on performance and concentration measures 20
Table 16: Effects of Track 1 funding on student shares by field 22
Table 17: Effects of Track 2 funding on student shares by field 23
Table 18: Effects of Track 3 funding on student shares by field 24
Table 19: Effects of Track 1 funding on publication shares by field 25
Table 20: Effects of Track 2 funding on publication shares by field 26
Table 21: Effects of Track 3 funding on publication shares by field 27

Table 22: Influence on the concentration measures using heterogeneity based instrumental variables 28

Table 23: Effects of lagged Track 1 funding on performance and concentration measures 32

Table 24: Effects of lagged Track 2 funding on performance and concentration measures 33

Table 25: Effects of lagged Track 3 funding on performance and concentration measures 34

Table 26: Effects of lagged Track 1 funding on student shares by field 35

Table 27: Effects of lagged Track 2 funding on student shares by field 36

Table 28: Effects of lagged Track 3 funding on student shares by field 37

Table 29: Effects of lagged Track 1 funding on publication shares by field 38

Table 30: Effects of laggedTrack 2 funding on publication shares by field 39

Table 31: Effects of lagged Track 3 funding on publication shares by field 40

0 Summary

Within this study we provide descriptive as well as multivariate evidence on the effects of the German Excellence Initiative on universities. Thereby, we will focus on the question whether the Excellence Initiative has led to a sharpening of the participating universities' scientific profiles in terms of technology fields they are active in.

To this end, we have created an integrated panel dataset consisting of various indicators at the level of universities. The data for the panel was collected from various sources, e.g. DESTATIS, the DFG, and the Web of Science by Thomson Reuters as well as PATSTAT.

The results show the funding by the Excellence Initiative has been relatively concentrated with about half of the universities. In the group of universities having received funding, a few universities, often conceived as top-performers, have been successful in acquiring a substantial number of projects in all three tracks of the Excellence Initiative. A breakdown of the graduate schools and the excellence clusters by field/subject shows that the largest share of projects was awarded to mathematics/natural sciences.

We can further show that substantial differences between funded and non-funded universities exist in a variety of indicators. Funded universities are larger, have higher third-party funding shares, have lower teaching loads and perform higher in terms of publications, though not in terms of patents. The evidence for effects in causal impact, however, is much less conclusive.

1 Introduction

The Excellence Initiative of the Federal State in Germany is a national support program for universities which takes its root in policy initiative by the former minister of education and science Edelgard Bulmahn publicized in 2004 (Kehm 2015; Fallon 2015). The funds made available through the Excellence Initiative were planned to be allocated within a Germany-wide competition between universities within different tracks.

By emphasizing the competitive element the Excellence Initiative deliberately departed from the scattershot approach of university funding which started from the fictitious state of the equality of all universities (compare Schubert 2009). Instead, by concentrating funds on selected high-performers of universities the idea was to establish an internationally visible elite of universities (Hazelkorn 2009) by increasing research productivity and performance of the selected universities (Hur and Bessey 2013).

The Excellence Initiative has now been implemented for the third time with funding rounds in 2006, 2007/2008, and 2012. In the first two rounds in total € 1.9 bln. were allocated to three tracks, in particular graduate schools (Track 1), excellence clusters (Track 2), and future concepts (Track 3). In the last round running from 2012-2017, another € 2.7 bln. were allocated to the same tracks, where some selected projects from earlier funding rounds were continued, others were discontinued and some were newly established. At the end of 2015 45 graduate schools, 43 excellence clusters, and 11 future concepts were funded.

In particular the future concepts were aimed to radically reorganize the German university system by funding innovative concepts for the reorganization of the universities. And although the calls were carefully drafted to avoid words like “elite” Fallon (2015) notes that the general public and the media came very soon to use such labels. Today, the winners in Track 3 are often referred to as elite universities. Because of the immense financial volume of and the high hopes associated with Excellence Initiative discussions concerning its consequences – both intended and unintended – have been ongoing. Münch (2008, 2009) has argued that the Excellence Initiative would imply a detrimental tendency towards the creation of status hierarchies decoupled from actual performance as well as oligopolization of research funding. Others have emphasized the potential to performance increases through incentivization (Schubert 2008). In addition it has been highlighted that the Excellence Initiative could help to contribute to differentiation between universities and therefore to sharper and more coherent profiles (Fallon 2015; Klumpp et al. 2014).

Empirical studies on the effects of the Excellence Initiative on universities are however still in its infancy. As concerns bibliometric performance some studies indicate that the involvement in the Excellence Initiative did indeed tend to be associated with higher outputs and partly also impact (Hur and Bessey 2012; Möller 2016). These studies were however purely indicator based and thereby provide only descriptive evidence of the presumable effects of the Excellence Initiative. Furthermore, there is little, if at all, quantitative empirical material on the question of profile sharpening.

This study contributes to filling this gap by providing further evidence – both descriptive and multivariate – on the effects of the Excellence Initiative on universities. A particular focus will be placed on the question of whether the Excellence Initiative has led to a sharpening of the participating universities’ profiles, which we will identify by the degree that universities increasingly focus on specific fields of study or research.

2 Data and methodology

2.1 Data

The unit of analysis in this report is at the level of the university. Although theoretically all types of universities were eligible for funding from the Excellence Initiative we restricted the sample only to full universities, i.e. universities which possess the right to grant doctoral degrees. We retrieved the list of all full universities from DESTATIS and eventually found 104 universities meeting our selection criteria. At the level of the university we collected panel data from 2001 onwards based on various data sources.

In particular, the following variables are included in the dataset:

- Personnel and student statistics. Source: DESTATIS
  - Number of students
  - Number of students disaggregated by field of study. In particular, language/cultural sciences, sports, social sciences/economics, mathematics/natural sciences, medical sciences, engineering sciences, agricultural sciences, arts, other sciences
  - Field concentration of students (Herfindahl index). Source: DESTATIS, Fraunhofer ISI
  - Number of graduates
  - Number of university employees
- Monetary key indicators. Source: DESTATIS
  - Total investments
  - Total expenditures
  - Total third party funds
- Funding in the excellence initiative. Source: DFG, Fraunhofer ISI
  - Number of projects funded in Track 1, Track 2, and Track 3 of the Excellence Initiative
  - Number of projects funded in Track 1 and Track 2 of the Excellence Initiative disaggregated by science field (harmonized where possible with DESTATIS study field classification)
- Bibliometric data. Source: Thomson Reuters, Fraunhofer ISI
  - Number of fractionalized publications
  - Number of fractionalized publications disaggregated by science field (harmonized where possible with DESTATIS study field classification)
  - Field concentration of publications (Herfindahl index). Source: DESTATIS, Fraunhofer ISI
  - Excellence rate
  - Field-specific expected citation rate
- Patent data. Source: PATSTAT, Fraunhofer ISI
  - Number of university applied DPMA patents

All data was available at least since 2001. The most recent availability dates however depended on the type of data. Information on students was available until 2015. Monetary statistics were available until 2014. Publication information could be gathered until 2014. Patent statistics were available only until 2013. Information on past and running Excellence Initiative projects are completely up-to-date and were collected until 2015. Summary statistics on the main variables can be found in Table 1.

Table 1: Descriptive statistics of the main variables

Variable	Obs	Mean	Std. Dev.	Min	Max
#Graduates	2050	1,896.04	1,638.60	0.00	9,735.00
#Students	2200	14,611.30	13,195.40	0.00	80,464.00
Total investments in TEUR	1452	29,446.20	38,416.30	-4,227.00	329,040.00
Total expenditures in TEUR	1452	305,726.00	328,775.00	125.00	1,500,000.00
#Employees	1416	4,538.42	4,544.18	6.00	20,225.00
Third party funds in TEUR	677	60,241.10	58,068.10	0.00	311,409.00
Graduates per employee	1395	0.68	0.51	0.00	4.96
Total expenditures per employee in TEUR	1391	81.10	156.04	6.40	2,201.05
Students per employee	1409	4.61	4.30	0.00	59.82
Third party funds per total funds	672	0.18	0.11	0.00	0.97
Publications per employee	1081	0.09	0.07	0.00	0.77
Excellence rate	1118	0.11	0.07	0.00	1.00
Expected citation rate	1118	0.94	0.45	0.00	9.66
Patents per employee	755	0.00	0.00	0.00	0.02
Students in language and cultural sciences in %	2143	0.25	0.21	0.00	1.00
Students in sports in %	2134	0.02	0.10	0.00	1.00
Students in economic and social sciences in %	2144	0.32	0.26	0.00	1.00
Students in mathematics and natural sciences in %	2144	0.17	0.11	0.00	0.60
Students in medical sciences in %	2144	0.08	0.17	0.00	1.00
Students in agricultural sciences in %	2144	0.01	0.04	0.00	0.41
Students in engineering sciences in %	2143	0.12	0.20	0.00	1.00
Students in arts in %	2142	0.02	0.05	0.00	0.50
Students in other sciences in %	2143	0.00	0.00	0.00	0.06
# different teaching fields	2392	5.44	2.49	0.00	9.00
Field concentration students	2392	0.38	0.27	0.00	1.00
Publications in language and cultural sciences in %	1118	0.00	0.02	0.00	0.33
Publications in economic and social sciences in %	1118	0.05	0.11	0.00	1.00
Publications in mathematics and natural sciences in %	1118	0.46	0.16	0.00	1.00
Publications in medical sciences in %	1118	0.22	0.20	0.00	1.00
Publications in engineering sciences in %	1118	0.25	0.17	0.00	1.00
Publications in other sciences in %	1118	0.02	0.04	0.00	0.30
# different publication fields	1118	5.08	1.14	1.00	6.00
Field concentration publications	1118	0.43	0.11	0.23	1.00
EI: #projects funded by track 1	2392	0.20	0.68	0.00	7.00
EI: #projects funded by track 2	2392	0.20	0.63	0.00	5.00
EI: funded by track 3	2392	0.04	0.20	0.00	1.00

2.2 Methodology

The first part of the empirical analysis will mainly rely on the presentation of descriptive statistics. In this part we will first present general statistics on the characteristics and the distribution of funding in the Excellence Initiative. A key contribution is also an analysis of the decomposition of the funding by field classifications. In order to harmonize field classifications between the different data sources we decided to classify both publications and Track 1 and Track 2 funding in the Excellence Initiative according to the DESTATIS classification in study fields. While the DFG provides a classification into Social Sciences and Economics, Mathematics and Natural Sciences, Life Sciences, and Engineering, we have created a somewhat different classification based on the subject field classification provided by DESTATIS in order to harmonize data in later analyses. The classification used by DESTATIS includes Language and Cultural Sciences, Sports, Social Sciences and Economics, Mathematics and Natural Sciences (including biology and some parts of life sciences), Medical Sciences and Pharmaceutical Sciences, Engineering,

Agricultural Sciences, Arts, and other sciences. Based on topic and departmental affiliation of the projects funded in Track 1 and Track 2 we assigned each project to the DESTATIS fields. If a project was cross-disciplinary a project could be assigned to more than one discipline. Multiple assignments were counted on a fractionalized basis, implying that the total of the fractionalized figures still equals the number of existing projects.

We move then on and analyze structural differences between universities having received funding by the Excellence Initiative and those that did not. We analyze both cross-sectional differences and differences in time trends.

Finally, to come closer to a more structural interpretation we implement multivariate analyses. In a first step, we will use methods matching methods in counterfactual analysis, where for each university funded in the context of the Excellence Initiative we define a non-funded statistical twin closely resembling the funded units in terms of observable control characteristics. By comparing the outcomes of the funded universities with their respective twins it is possible to obtain an estimate of the causal effects of Excellence Initiative under certain conditions. In order to implement the matching procedure, we use nearest neighbor matching based on the Mahalanobis distance. We use standard errors that explicitly consider the randomness of the first stage matching procedure (Abadie and Imbens 2006). The great advantage of the matching approaches to estimating causal program effects is the flexibility in functional forms since only weak parametric assumptions are necessary. Two major problems in our context are that consistency of the matching requires that selection must be based on observables. If unobservables affect the selection process, the estimates of the causal effects will be biased. Furthermore, it is not easy to implement matching estimators for panel data. Therefore, we have relied using only a single year as the basis for the estimation. We have run one model for the evaluation of the first and second round (2006/2007) and one for the third round (2012). We have used the longest possible time lag between start of funding and evaluation allowed by our data and have tested for program effects in 2011 (for fund round 1 and 2) and 2013 (for funding round 3).

If we are willing to make stronger functional form assumptions, there are alternative regression-based ways of estimating the effects of the Excellence Initiative which can account both the panel data structure and to some degree for the issue of unobservables. In specific, we rely on the panel structure of our dataset and run a set of fixed effects (FE) regressions. FE allows us to control for correlated unobserved heterogeneity to some degree. Unobserved heterogeneity is likely to be an important feature of our data. Many unobserved factors (e.g. research capacity of the university) can be expected to be both correlated with the with the outcome variables and (because selection into the Excellence Initiative was performance-based) with the funding dummies. Thus unobserved heterogeneity will usually imply (most likely upward) biased estimates, if not accounted for. However, it should be noted that FE controls out only time-constant heterogeneity. To the degree that for example the research capacities of the universities changes over time, which is a reasonable assumption given the lengths of our panel data, FE regressions will only imperfectly account for the unobserved heterogeneity, again leading to biased estimates. This

also means that the results from the FE regressions may still not fully reflect causal relationships between funding in the Excellence Initiative and outcomes.

Nonetheless, to check the robustness of our analyses (both in terms of matching and FE) we have complemented the most important results by using instrumentation techniques building on the exploitation of heterogeneity for providing exogenous variation. The methodology follows the idea of using covariance restrictions to identify endogenous parameters. The estimation approach is explained in Lewbel (2012) and will for the sake of brevity not be described here in detail. What should be mentioned is however that estimation technique is robust to panel data settings. Also heterogeneity could be proved to be sufficiently present to warrant identification.

3 Descriptive results

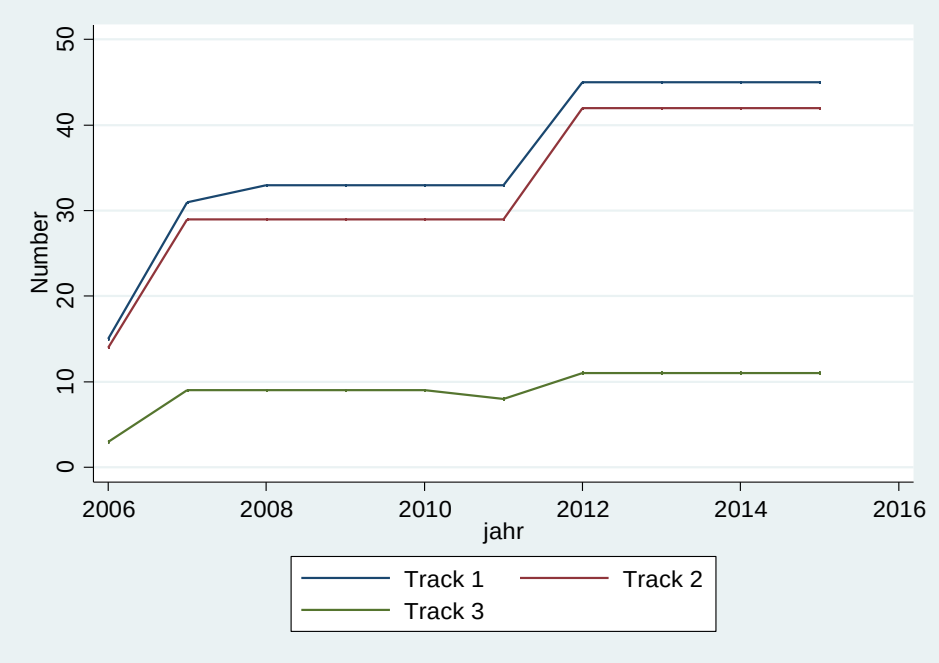
3.1 Basic statistics on the tracks

Figure 1 presents the number of projects/funding cases since 2006 when the Excellence Initiative started by track. In its first year of its existence three universities were funded under Track 3 "Zukunftskonzepte". These were the KIT emerging as the merger of the TH Karlsruhe and the Forschungszentrum Karlsruhe, TU München, and LMU München. The number of funded projects in Tacks 1 and 2 were also still relatively low with less than 20 projects. In later funding rounds in 2007 and in 2012 the numbers of projects/cases continuously rose in each of the three tracks. By 2015, there were 11 funded universities in Track 3,[1] and above 40 projects in each of the cases in Track 1 and Track 2.[2]

1 It should be noted that in 2011 U Freiburg, KIT, and U Göttingen were not evaluated favourably in Track 3 and lost their status as so-called Excellence University. The full list of universities listed under Track 3 in 2015 included the RWTH Aachen, FU Berlin, HU Berlin, U Bremen, TU Dresden, U Heidelberg, U Köln, U Konstanz, LMU München, TU München, and U Tübingen.

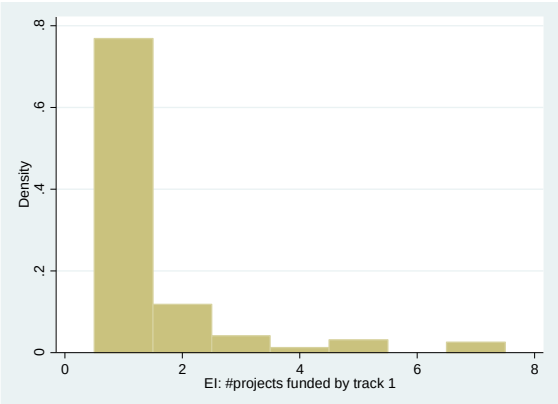
2 The full lists of funded projects in Track 1 and Track 2 can be found here: http://www.dfg.de/foerderung/programme/listen/index.jsp?id=GSC http://www.dfg.de/foerderung/programme/listen/index.jsp?id=EXC

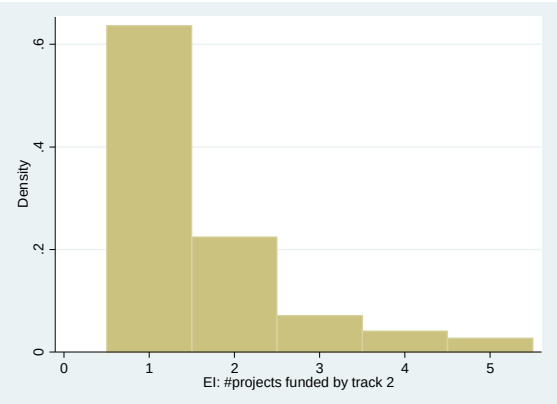
Figure 1: Funded projects by year



Because Track 3 comprises non-disciplinary strategic projects that usually span the whole organization or at least large parts of it, a university cannot be funded more than once in Track 3. As concerns Track 1 and Track 2 a university can have more than one funded project simultaneously. As we see from Figure 2, while the largest part of universities received only one graduate school (almost 80%), slightly above 10% had 2 graduate schools. The remaining 10% had even more than that reaching a maximum of 7 schools for the FU Berlin and the HU Berlin. In the case of Track 2 “Exzellenzcluster” figures look similarly. Approximately, 60% had one Excellence Cluster, while more than 20% had two. The maximum number of 5 was reached by TU München und LMU München. We can therefore conclude that the concentration of the projects was relatively high even in 2015. In fact, out of the 104 universities in our sample 58 had not attracted projects in any of the tracks. 46 were successful in at least one of the tracks and 12 were successful in all of them simultaneously.

Figure 2: Number of funded projects by university (Track 1: left, Track 2: right)





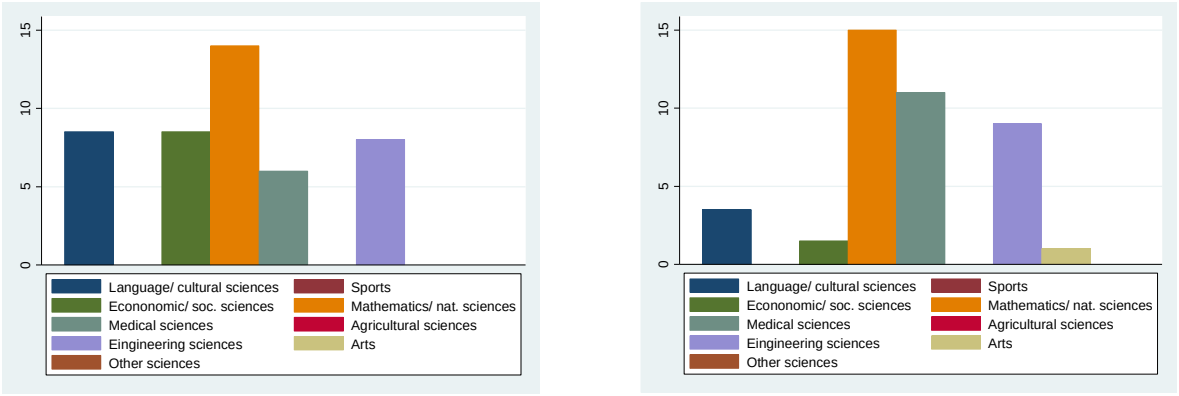
The impression of relatively high concentration of projects is further corroborated by the correlation between co-occurrence between the tracks (Table 2). For Track 1 and Track 2 the correlation is lowest with 0.34. It is 0.49 for Track 1 and Track 3 and 0.54 for Track 2 and Track 3. The higher correlations with Track 3 are however also partly built into the selection procedure because being successful in Track 3 required the successful acquisitions of both graduate schools and Excellence Clusters.

Table 2: Correlation between funding decisions in different tracks

	Track 1	Track 2	Track 3
Track 1	1		
Track 2	0.3408***	1	
Track 3	0.4905***	0.5438***	1

As argued because Track 3 usually applies to the university as whole, disciplinary distinctions are usually at least ambiguous but mostly impossible to implement. However, for Track 1 and Track 2 it is possible to derive the disciplinary breakdowns. We use the classification as described in Section 2.2. The results can be found in Figure 3.

Figure 3: Funded projects by field (Track 1: left, Track 2: right)



We see that the majority graduate schools fell into the broad field of natural sciences. This breakdown differs considerably from the DFG provided figures, which list the life sciences as more important than mathematics and natural sciences. The reason for the divergence is that we assign graduate schools referring to biological sciences as belonging to natural sciences, while the DFG classification subsumes biology under the field of life sciences together with medical sciences. Mathematics and natural sciences in the here used definition are followed by economics and social sciences as well as language and cultural sciences each accounting for the same number of projects. Thus, social sciences/economics/humanities account for almost half of all graduate schools and taken together represent the highest share of all projects under Track 1. Finally, engineering ranks fourth followed by medical sciences. No projects were assigned to sports, agricultural sciences and arts.

A very notable difference in terms of disciplinary breakdown with respect to Track 2 is the vastly diminishing importance of humanities and the social sciences/economics. While both fields taken together were the largest group among the graduate schools, even their aggregate in terms of Excellence Clusters makes it only on place 4 after mathematics and natural sciences (15), medical sciences (11) and engineering (9). In that respect, while the social sciences and humanities were indeed relatively successful in Track 1, their weight in Track 2 is very low. Interestingly, although there was no graduate school assigned in the field of arts, there was an excellence cluster (Bild, Wissen, Gestaltung) assigned jointly run by FU Berlin, TU Berlin, and HU Berlin (as well as a number of non-university partners and art colleges not in the sample).

3.2 Differences between funded and non-funded universities

Considerable attention has been directed to the question whether how universities are selected into funding by the Excellence Initiative and what the effects of the funding on the universities were. In this chapter we intend to give some guidance on the first question by showing how universities with and without funding differ in terms of key characteristics. Although we will also include performance measures in the descriptive analysis of the differences, such differences should in no means be interpreted as (causal) effects of the funding on the university performance, because of the inherent performance-based selection during the evaluation. In particular, the list of universities successful in Track 3 shows that universities already prestigious (and high-performing) before the funding event were selected. While such a performance based selection is allocatively desirable because it directs money to high-performing units presumably making the best possible use of the resources, the presence of performance-based selection makes differences between funded and non-funded universities difficult to interpret. In particular, it is impossible to tell apart whether observed differences are effects of the project or purely the result of project selection. In order to obtain some initial insights into the distinction between selection and causal program effects we will in the Section 0 present the results of fixed effects (FE) regression. While FE regressions will still not be able to control for general endogeneity (in particular simultaneity between funding and performance/effects), they rule out that a selection issues based on (time-constant) unobservables. Nonetheless, we will report results on some models trying to correct also for such biases.

In Table 3 to Table 6 we present mean value comparisons for a variety of different key-characteristics differentiated by funding status of the universities. In the four tables the first column lists the average values for universities with at least one Track 1 project. The second column contains the average values for universities with Track 2 projects, while the third column contains information on universities successful in Track 3. The last column shows the same values for universities without any project in each of the tracks. Table 3 shows statistics for a set of variables not normalized by size. The results show that all variables are by far lowest for non-funded universities and are largest for Track 3 universities. For example the average number of students was 6,862 for universities without funding while it was about four times larger (28,414) for universities having been successful in Track 3. Likewise in terms of publications, not funded universities reach a number of 154 publications (fractional count) while Track 3 universities

reached 950 publications. Total expenditures were about € 118 mln. for not funded universities and € 647 mln. for universities in Track 3. Interestingly, the differences between universities in Track 1, 2, and 3 are relatively mild. The number of students for example in Track 1 universities was 22,970 as compared to 26,199 for Track 2 and 28,414 in Track 3. In summary, universities funded by the Excellence Initiative are much larger than non-funded universities. Track 3 funding is on average associated with the largest universities, but the difference in size between Track 1, 2, and 3 is not very drastic.[3]

Table 3: Descriptives by funding status I

	Track 1		Track 2		Track 3		Not funded	
Variable	Obs	Mean	Obs	Mean	Obs	Mean	Obs	Mean
#Graduates	758	3,003	758	3,297	308	3,751	1,050	870
#Students	791	22,970	791	26,199	321	28,414	1,156	6,862
Total investments in 1000€	512	49,908	513	52,295	209	62,743	775	12,775
Total expenditures in 1000€	512	519,518	513	589,158	209	647,627	775	118,761
#Employees	510	7,937	521	8,548	210	10,349	741	1,672
Third party funds in 1000€	279	100,243	279	104,073	111	138,370	310	21,209
#Publications	455	753	455	789	182	950	520	154

In Table 4 we present a set of size normalized measures which help us to further understand the differences between funded and non-funded universities. In the group of non-funded universities we observe that the teaching load as measured both by students per employee and by graduates per employee is considerably higher than in the universities funded by the Excellence Initiative. The number of graduates per employee was 0.84 for the non-funded universities while it was with 0.44 only slightly more than half for universities in Track 3. The respective numbers in Track 1 and Track 2 were with 0.49 and 0.48 relatively close. As concerns students the figures are a little bit closer but still point in the same direction. Track 1 and Track 2 universities had on average 3.6 students per employee. Track 3 universities had slightly below 3.3 students per employee, while the figure for the non-funded universities was 5.4. In terms of research output measured by the publications per employee, the expected citation rate, and the excellence rate the universities funded by the Excellence Initiative performed somewhat better than the non-funded universities, although the differences are not excessively large. The publications per employee were for example 0.075 for non-funded universities. In Track 3 universities the figure was about 25% higher and reached 0.095. It was roughly of the same magnitude for Track 1 universities (0.098) and Track 2 universities (0.096). The excellence rate, i.e. the share of publications in the top-10-cited papers was 9.33% for non-funded universities and between 11.99% for Track 1 universities and 12.49% for Track 3 universities. Also in terms of third-party funds as a share of total funding Track 3 universities performed best with a value of about 24%. Non-funded universities reached only 15% while Track 1 and Track 2 universities had values of 21% and 20%. Quite unlike the results from the third-party funding attraction and the publication performance, patenting rates (patents per employee) were highest for non-funded universities, which

3 The differences become somewhat more pronounced when the Track 3 universities are excluded from the Track 1 and Track 2 sample.

reached a value of 0.0033. Track 3 universities where with 0.0027 slightly lower, while Track 1 universities reached 0.0020 and Track 2 universities reached 0.0017 (thus only slightly more than half of the value of the non-funded universities). A last notable observation is that the expenditures per employee were highest in the non-funded universities as well. In non-funded universities the approximately € 93,000 were spent per employee, while it was only between € 64,000 and € 71,000 in universities funded in either of the tracks of the Excellence Initiative. It is unclear what the reasons for the divergence in the per-employee expenditures are. One explanation could be the vastly diverging teaching loads, which may be driven by a relatively lower endowment of staff. In either case, the results indicate that universities funded by the excellence initiative have lower teaching loads, higher and more impactful publication output, higher shares of third party funds, but lower patenting intensities and lower expenditures per employee.

Table 4: Descriptives by funding status II

	Track 1		Track 2		Track 3		Not funded	
Variable	Obs	Mean	Obs	Mean	Obs	Mean	Obs	Mean
Graduates per employee	509	0.4976	520	0.4832	225	0.4486	721	0.8421
Total expenditures per employee in 1000€	501	67.0072	513	70.6406	224	64.9553	725	93.3409
Students per employee	509	3.6117	520	3.6375	225	3.2547	735	5.4306
Third party funds per total funds	275	0.2096	275	0.1963	119	0.2420	309	0.1538
Publications per employee	442	0.0987	452	0.0964	195	0.0950	496	0.0757
Excellence rate	455	0.1199	455	0.1168	195	0.1249	520	0.0933
Expected citation rate	455	1.0703	455	1.0703	195	1.1283	520	0.7981
Patents per employee	394	0.0020	422	0.0017	192	0.0027	233	0.0031

As already indicated the largest share of Track 1 and Track 2 projects fell into the field of mathematics and natural sciences. Thus, there seems some focus on particular disciplines. This could suggest that funded and non-funded universities differ also by their disciplinary focus. We measure the disciplinary focus by student shares (Table 5) and publication shares (Table 6). Our results indeed indicate that there are notable differences between funded and non-funded universities. In the non-funded universities the share of students enrolled in social science/economics was 39% in universities without funding by the Excellence Initiative, while the respect shares were 25% (Track 1), 24% (Track 2), and 24% (Track 3). On the contrary, the share of students in mathematics and natural sciences was 22% (Track 1), 21% (Track 2), and 22% (Track 3). It was with slightly below 12% much less in non-funded universities. The share of students in medical science was in the non-funded universities slightly above 6% and about 11% in Track 2 universities. However, the Track 3 universities did not differ from the non-funded universities by much. They had about 8% students enrolled in medical sciences. In all other fields, funded and non-funded universities do not seem to differ greatly. However, we see that funded universities usually offer a much broader range of subjects. While non-funded universities reach only 4.6 different subjects, the funded universities average on above 6 in all three tracks. Thus, funded universities have higher shares of social science students, lower shares of mathematics and natural sciences students as well as lower shares of medical students. Non-funded universities also tend to offer fewer subjects than funded universities and have accordingly higher concentration ratios as measured by the Herfindahl index.

Table 5: Descriptives by funding status III

	Track 1		Track 2		Track 3		Not funded	
Variable	Obs	Mean	Obs	Mean	Obs	Mean	Obs	Mean
Students in language and cultural sciences in %	791	0.2609	780	0.2804	344	0.2659	1110	0.2373
Students in sports in %	791	0.0157	780	0.0160	344	0.0137	1101	0.0278
Students in economic and social sciences in %	791	0.2524	780	0.2421	344	0.2338	1111	0.3878
Students in mathematics and natural sciences in %	791	0.2242	780	0.2059	344	0.2171	1111	0.1159
Students in medical sciences in %	791	0.0911	780	0.1104	344	0.0774	1111	0.0557
Students in agricultural sciences in %	791	0.0196	780	0.0209	344	0.0259	1111	0.0113
Students in engineering sciences in %	791	0.1155	780	0.1006	344	0.1435	1110	0.1401
Students in arts in %	791	0.0199	780	0.0229	344	0.0213	1109	0.0240
Students in other sciences in %	791	0.0008	780	0.0008	344	0.0013	1110	0.0007
# different teaching fields	805	6.4497	805	6.6547	345	6.5942	1334	4.6417
Field concentration students	805	0.2872	805	0.2852	345	0.2757	1334	0.4482

Although somewhat less pronounced the same results can be found when the university portfolios are measured by the publication shares. Again we find that the shares of mathematical/natural science publications are higher for funded universities (between 48% and 49%) as compared to non-funded universities (42%). The shares of social science/economics publications is about three to four times higher for non-funded universities totaling about 8%, while medical publications account for 17%. In the funded universities the medical publications hover between 27% and 29%. We also find evidence that the number of covered fields is greater in funded universities than in non-funded universities, again implying that the absolute field concentration as measured by the Herfindahl index is higher in non-funded universities.

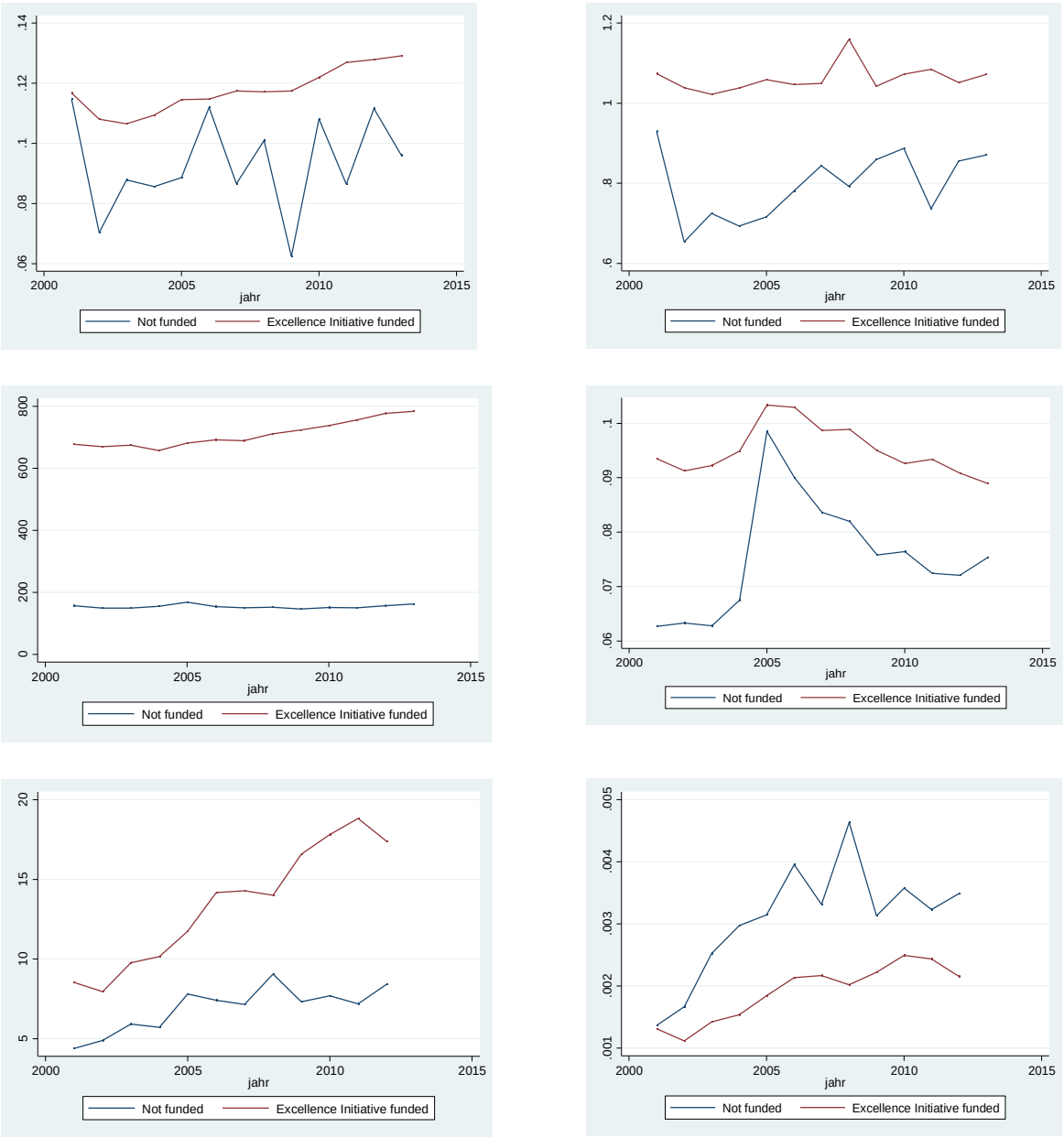
Table 6: Descriptives by funding status IV[4]

	Track 1		Track 2		Track 3		Not funded	
Variable	Obs	Mean	Obs	Mean	Obs	Mean	Obs	Mean
Publications in language and cultural sciences in %	455	0.0017	455	0.0015	195	0.0016	520	0.0050
Publications in economic and social sciences in %	455	0.0296	455	0.0211	195	0.0220	520	0.0803
Publications in mathematics and natural sciences in %	455	0.4809	455	0.4811	195	0.4948	520	0.4237
Publications in medical sciences in %	455	0.2729	455	0.2932	195	0.2651	520	0.1684
Publications in engineering sciences in %	455	0.1991	455	0.1866	195	0.1969	520	0.2973
Publications in other sciences in %	455	0.0158	455	0.0165	195	0.0195	520	0.0253
# different publication fields	455	5.73407	455	5.73846	195	5.86667	520	4.40577
Field concentration publications	455	0.4036	455	0.4120	195	0.3975	520	0.4558

One way to obtain further descriptive insights into the likely effects of the Excellence Initiative on universities is to analyze the differences in time trends between funded and non-funded universities. An analysis of difference in time trends still does not yet control simultaneity and also leaves unaccounted heterogeneity issues, but it gives insights into how funded and non-funded universities differed before the excellence initiative and how they differ after funding. The results can be found in Figure 4.

4 Publications which could not be unambiguously assigned to any of the fields (e.g. publications classified as multidisciplinary) where dropped from this analysis.

Figure 4: Time trends by funding status (top left: Excellence rate. top right: citation rate. Middle left: #Publications. Middle right: Publications per employee. Bottom left: Patents. Bottom right: Patents per employee.)



3.3 Difference before and after funding

Further descriptives on the evolution of the core variables since the implementation of the Excellence Initiative can be computed by comparing how the average values differed for the universities before and after receiving funding. While these figures still do not imply any causality, they tell at least whether the sample averages were higher or lower before and after the funding decisions. The results can be found in Table 7-Table 10, where the values in the cells represent the difference between post-funding and pre-funding averages. A positive value thus indicates that the respective means were higher before than after funding. As a general summary of the results

we find that funded universities in all of the three tracks have considerably increased their size as measures by almost all variables. We also find some descriptive evidence that the relative performance measures in Table 8 are mostly higher after as compared to before the funding, although the results are not significant for all variables (e.g. publications per employee). Interestingly, we do observe that the teaching load as measured by students per employee has decreased for Track 2 and Track 3 universities. The results in Table 9 further show that universities successful in the Excellence Initiative have experienced an increase in the share of students from mathematics and natural sciences while in particular the share of students from economics/social sciences, language/cultural sciences, and arts have decreased. We also observe that the field concentration in terms of students has increased for all three tracks. Weakest are the results for variables relating to a disciplinary breakdown of the publications. One of the few consistent observations is that despite the share of students has decreased the share of publications in economics and social sciences increased. Another observation is that the total number of disciplinary categories increased. Thus, there is some indication that publication activities have actually become broader.

Table 7: Descriptives before and after funding I

	Track 1		Track 2		Track 3	
Variable	Obs	erence (post-pre)	Obs	ifference (post-pre)	Obs	ifference (post-pre)
#Graduates	758	1,327 ***	758	1,307 ***	308	1,530 ***
#Students	791	1,805 **	791	76	321	477 ***
Total investments in 1000€	512	14,965 ***	513	19,308 ***	209	19,827 ***
Total expenditures in 1000€	512	144,758 ***	513	180,644 ***	209	132,646 ***
#Employees	510	1,159 ***	521	1,678 ***	210	2,008 ***
Third party funds in 1000€	279	48,205 ***	279	52,332 ***	111	44,519 ***
#Publications	455	110 ***	455	159 ***	182	244 ***

Table 8: Descriptives before and after funding II

	Track 1		Track 2		Track 3	
Variable	Obs	difference (post-pre)	Obs	difference (post-pre)	Obs	difference (post-pre)
Graduates per employee	509	0.1434 ***	520	0.1008 ***	225	0.0787 ***
Total expenditures per employee in 1000€	501	6.5680 **	513	2.5300	224	-2.0371
Students per employee	509	-0.2011	520	-0.5875 ***	225	-0.4956 **
Third party funds per total funds	275	0.0498 ***	275	0.0405 ***	119	0.0304 *
Publications per employee	442	0.0037	452	-0.0005	195	0.0028
Excellence rate	455	0.0105 ***	455	0.0171 ***	195	0.0187 ***
Expected citation rate	455	0.0496 **	455	0.0706 ***	195	0.1327 ***
Patents per employee	394	0.0001 ***	422	0.0006 ***	192	0.0000

Table 9: Descriptives before and after funding III

	Track 1		Track 2		Track 3	
Variable	Obs	difference (post-pre)	Obs	difference (post-pre)	Obs	difference (post-pre)
Students in language and cultural sciences (share)	791	-0.1812 *	780	-0.0277 ***	344	-0.0198
Students in sports (share)	791	0.0001	780	-0.0022 **	344	0.0009
Students in economic and social sciences (share)	791	-0.0281 ***	780	-0.0245 ***	344	-0.0302 **
Students in mathematics and natural sciences (share)	791	0.0145 ***	780	0.0195 ***	344	0.0336 ***
Students in medical sciences (share)	791	0.0128	780	0.0219	344	-0.0037
Students in agricultural sciences (share)	791	0.0021	780	0.0039	344	-0.0055
Students in engineering sciences(share)	791	0.0200	780	0.0140	344	0.0258
Students in arts (share)	791	-0.0052 ***	780	-0.0061 ***	344	-0.0037 *
Students in other sciences (share)	791	0.0012 ***	780	0.0012 ***	344	0.0027 ***
# different teaching fields	805	-0.0277	805	-0.3079 ***	345	-0.3696 ***
Field concentration students	805	0.0178 **	805	0.0328 ***	345	0.1658 ***

Table 10: Descriptives before and after funding IV

	Track 1		Track 2		Track 3	
Variable	Obs	difference (post-pre)	Obs	difference (post-pre)	Obs	difference (post-pre)
Publications in language and cultural sciences (share)	455	0.0006 **	455	0.0005 ***	195	0.0022
Publications in economic and social sciences (share)	455	0.0072 *	455	0.0089 ***	195	0.0059 ***
Publications in mathematics and natural sciences (shar	455	0.0213 *	455	0.0011	195	0.0022
Publications in medical sciences (share)	455	-0.0248	455	0.0032	195	0.0053
Publications in engineering sciences (share)	455	-0.0067	455	-0.0177 **	195	-0.0129
Publications in other sciences (share)	455	0.0021	455	0.0039 **	195	-0.0007
# different publication fields	455	0.2679 ***	455	0.2448 ***	195	0.1423 ***
Field concentration publications	455	-0.0017	455	-0.0075	195	-0.0044

4 Multivariate results

4.1 Nearest neighbor-matching

The descriptive results have indicated that there are considerable differences between universities having received funding by the Excellence Initiative and those which did not. We have also provided evidence that the differences between the universities in the different tracks were often not very marked.

As already argued descriptively observable differences can be the result of both the selection mechanisms and of causal effects. Thus, observing that Track 3 universities on average have a higher excellence rate and higher publications per employee says fairly little on whether the difference was a result of the funding or whether the funding event was a response to a priori existing differences. Also the comparisons over time may be confounded by autonomous time-trends. If we are interested in telling apart selection from program effects, we therefore have to consider more structural econometric approaches. We start our analysis with the presentation of the results from the nearest neighbor matching, which assumes that the selection is based on observable characteristics. As control variables we use the number of employees as a measure of size, the investment per employee, the students per employee, and the expenditure per employee. Furthermore, we control for field shares as measured by students.

The results are presented in Table 11 (rounding round 1 and 2) and Table 12 (funding round 3). The effects for funding round 1 and 2, while mostly positive, appear to be fairly unsystematic as

concerns significance. Only relatively few effects and these are not consistent over the tracks appear (patents per employees in Track 1; field concentration for students in Track 2; publications and publications per employee in Track 3). A little bit more pronounced are the effects after funding round 3 in 2012 took place. Overall we see that all estimates are positive indicating that even after controlling for the program selection (on observables) the effects of the Excellence Initiative are positive. While, most effects are non significant, we see some effects that remain consistent over the funding rounds. For the publications per employee (Tracks 1 and 2) and for the patents per employee (all tracks) we observe significant performance increases. In addition, we observe an increase of the field concentration in terms of students (Track 2 and 3) and slight increase in field concentration in terms of publications (Track 2). Overall, we can, however, conclude that the strong descriptive differences observables in Table 3-Table 9 do not appear to the same degree in the matching approach. One reason can be that the descriptive differences are indeed mainly driven by the selection rather than actual effects. An alternative explanation could be that the results in Table 12 are based only on the year 2013, implying a considerably lower number of observations.

Table 11: Program effects on outcomes based on nearest neighbor matching for 2011

	Track 1		Track 2		Track 3	
	Obs	difference	Obs	difference	Obs	difference
Expected citation rate	87	0.0045	87	-0.0157	87	-0.0144
Excellence rate	87	-0.0012	87	-0.0085	87	-0.0011
#Publications	87	1.8528	87	122.1128	87	289.5355 *
Publications per employee	87	0.0120	87	0.0095	87	0.0164 ***
Patents per employee	87	0.0012 **	87	0.0007	87	0.0009
Field concentration students	87	0.0298	87	0.0579 *	87	0.0245
Field concentration publications	87	0.0255	87	0.0309	87	0.0216

Table 12: Program effects on outcomes based on nearest neighbor matching for 2013

	Track 1		Track 2		Track 3	
	Obs	difference	Obs	difference	Obs	difference
Expected citation rate	88	0.1051	88	0.1317	88	0.0825
Excellence rate	88	0.0143	88	0.0166	88	0.0108
#Publications	88	19.1582	88	67.3090	88	224.5525
Publications per employee	88	0.0135 *	88	0.0121 **	88	0.0117
Patents per employee	88	0.0015 ***	88	0.0012 ***	88	0.0013 **
Field concentration students	88	0.0102	88	0.0403 *	88	0.0408 ***
Field concentration publications	88	0.0017	88	0.0255 *	88	0.0153

4.2 FE regressions

A drawback of using counterfactual analysis is that it is restricted to cross-section data and that selection occurs on observables. If we are, however, ready to assume that this heterogeneity driving the selection is at least roughly time-constant, FE regressions are expected to be able to account for at least some of the purely selection-induced differences. It should however be noted that even the FE results should not necessarily reflect true causal program effects. Most importantly, if unobserved heterogeneity is time-varying the correction implemented by FE models is

not complete. Also the performance-funding relationship is simultaneous, which can be expected, because of the inherent selection process, then endogeneity issues are likely to remain.

In Table 13 we present the FE regressions analyzing the influence of the number of Track 1 projects on a variety of performance and concentration measures. Very interestingly we find, as concerns performance, in no case any significant effects of Track 1 funding. Taking into account that we however did observe descriptive differences between the funded and the non-funded group (see Table 4), the absence of any significant results indicates that the difference was largely driven by the selection and not by genuine program effects. It is fairly likely that this conclusion would prevail when trying to control for other sources of endogeneity by IV-approaches, because endogeneity issues remaining in the FE regressions are likely to bias the estimates upwards instead of downwards.

Contrary to the funding effects on performance measures we do see strong effects on the Herfindahl concentration measures both for students and for publications. The positive effect on concentration indicates that the funding in the first track of the Excellence Initiative has considerably concentrated student enrollment and publication output. This observation is interesting in several respects. First, although we found that funded universities show lower concentration rates in terms of teaching subject and publication field coverage, Track 1 funding in the Excellence Initiative nonetheless appears to have increased concentration for the funded universities. Second, high concentration ratios can be interpreted as being indicative of sharper profiles. In that respect, although there seems little evidence that the Excellence Initiative has – at least until now – considerably increased performance, it indeed contributed to more focused activity portfolios. The conclusion of increased publication and student concentration also holds for Track 2 funding (Table 14) where again in both regressions the number of Track 2 projects is significantly positive. We also note that in the Track 2 models the effect of funding is about 50% larger for the publication concentration, whereas both effects were of about equal size for Track 1. A relatively larger effect of Track 2 funding for publication concentration is in any case reasonable because Track 2 funds thematically focused clusters of research excellence. With respect to Track 3 (Table 15) we see that the positive effect on student concentration prevails. The effect on publication concentration however disappears.

It should also be noted that unlike the conclusion that there was no performance effect of Track 1 funding, we do observe some effects as concerns Track 2 and Track 3 funding. The Excellence Clusters seem to be associated with higher numbers of publications and also higher numbers of publications per employee. For the Future Concepts at least the number of publications is positively affected. Nonetheless, whether these effects are truly causal program effects or the result of unaccounted endogeneity remains speculative. Furthermore, since no effects of Track 2 and Track 3 funding are observable for any of the other output measures – in fact for patents Track 3 funding the effect is even negative – the performance effects are fairly likely very limited at the level of the university.

Table 13: Effects of Track 1 funding on performance and concentration measures

	(1) Expected citation rate	(2) Excellence rate	(3) #Publications	(4) Publications per employee	(5) Patents per employee	(6) Field concentration students	(7) Field concentration publications
EI: #projects funded by track 1	-0.0103	0.0014	3.4608	-0.0002	0.0001	0.0106***	0.0105**
	(-0.39)	(0.36)	(1.10)	(-0.13)	(0.51)	(7.39)	(2.21)
#Employees	0.0000	0.0000*	0.0473***	-0.0000***	-0.0000	-0.0000**	-0.0000
	(0.66)	(1.91)	(26.77)	(-8.15)	(-0.21)	(-2.48)	(-1.18)
Students per employee	0.0286*	0.0075***	7.9707***	0.0046***	0.0002*	-0.0006	-0.0013
	(1.94)	(3.52)	(4.53)	(5.29)	(1.87)	(-1.36)	(-0.48)
Investments per total expenditures	0.7385***	0.0719*	-16.7657	-0.0492***	0.0046***	0.0634***	-0.0541
	(2.80)	(1.87)	(-0.53)	(-3.13)	(3.75)	(4.81)	(-1.13)
Total expenditures per employee in TEUR	-0.0000	-0.0000	0.0617***	0.0002***	0.0000***	-0.0000***	0.0000
	(-0.25)	(-0.25)	(3.68)	(22.15)	(2.69)	(-5.22)	(0.78)
Constant	0.3612	0.2812	-891.4501	-0.0716	0.0066	-0.1478	2.1328**
	(0.06)	(0.34)	(-1.33)	(-0.21)	(0.53)	(-0.47)	(2.10)
Year dummies	YES	YES	YES	YES	YES	YES	YES
Field shares	YES	YES	YES	YES	YES	YES	YES
Observations	1056	1056	1056	1056	741	1361	1056
#Groups	89.0000	89.0000	89.0000	89.0000	77.0000	101.0000	89.0000
R2	0.0321	0.0478	0.5704	0.5316	0.1890	0.4926	0.0596
F-stat	1.2487	1.8925	50.0339	42.7664	5.9554	44.3432	2.3866

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 14: Effects of Track 2 funding on performance and concentration measures

	(1) Expected citation rate	(2) Excellence rate	(3) #Publications	(4) Publications per employee	(5) Patents per employee	(6) Field concentration students	(7) Field concentration publications
EI: #projects funded by track 2	-0.0042	0.0040	24.4884***	0.0034**	0.0001	0.0079***	0.0113**
	(-0.16)	(1.01)	(7.79)	(2.11)	(0.51)	(5.16)	(2.31)
#Employees	0.0000	0.0000*	0.0450***	-0.0000***	-0.0000	-0.0000***	-0.0000*
	(0.71)	(1.71)	(26.05)	(-8.42)	(-0.32)	(-3.89)	(-1.73)
Students per employee	0.0286*	0.0074***	6.9856***	0.0045***	0.0002*	-0.0005	-0.0016
	(1.94)	(3.44)	(4.08)	(5.12)	(1.81)	(-1.13)	(-0.62)
Investments per total expenditures	0.7311***	0.0689*	-40.7007	-0.0534***	0.0046***	0.0671***	-0.0545
	(2.77)	(1.80)	(-1.33)	(-3.41)	(3.76)	(5.03)	(-1.14)
Total expenditures per employee in TEUR	-0.0000	-0.0000	0.0736***	0.0002***	0.0000***	-0.0000***	0.0000
	(-0.19)	(-0.20)	(4.59)	(22.84)	(2.69)	(-6.07)	(0.61)
Constant	-0.3099	0.3038	-1119.4439*	-0.1535	0.0070	0.5073*	2.6839***
	(-0.06)	(0.39)	(-1.83)	(-0.49)	(0.56)	(1.70)	(2.81)
Year dummies	YES	YES	YES	YES	YES	YES	YES
Field shares	YES	YES	YES	YES	YES	YES	YES
Observations	1056	1056	1056	1056	741	1361	1056
#Groups	89.0000	89.0000	89.0000	89.0000	77.0000	101.0000	89.0000
R2	0.0319	0.0487	0.5959	0.5338	0.1890	0.4814	0.0600
F-stat	1.2435	1.9302	55.5588	43.1443	5.9555	42.3876	2.4059

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 15: Effects of Track 3 funding on performance and concentration measures

	(1) Expected citation rate	(2) Excellence rate	(3) #Publications	(4) Publications per employee	(5) Patents per employee	(6) Field concentration students	(7) Field concentration publications
EI: funded by track 3	0.0659	0.0044	30.3055***	0.0024	-0.0005*	0.0214***	0.0079
	(0.96)	(0.44)	(3.71)	(0.60)	(-1.95)	(5.45)	(0.63)
#Employees	0.0000	0.0000*	0.0461***	-0.0000***	0.0000	-0.0000***	-0.0000
	(0.54)	(1.80)	(26.04)	(-8.17)	(0.21)	(-3.87)	(-1.47)
Students per employee	0.0275*	0.0075***	7.5692***	0.0046***	0.0002**	-0.0005	-0.0013
	(1.86)	(3.49)	(4.32)	(5.24)	(2.22)	(-1.09)	(-0.48)
Investments per total expenditures	0.7107***	0.0725*	-19.8174	-0.0500***	0.0048***	0.0711***	-0.0434
	(2.71)	(1.90)	(-0.64)	(-3.20)	(3.97)	(5.37)	(-0.91)
Total expenditures per employee in TEUR	-0.0000	-0.0000	0.0608***	0.0002***	0.0000**	-0.0000***	0.0000
	(-0.12)	(-0.31)	(3.73)	(22.71)	(2.51)	(-6.48)	(0.35)
Constant	-1.2507	0.3252	-1030.9810	-0.1184	0.0066	0.3782	2.8046***
	(-0.23)	(0.42)	(-1.63)	(-0.37)	(0.53)	(1.26)	(2.90)
Year dummies	YES	YES	YES	YES	YES	YES	YES
Field shares	YES	YES	YES	YES	YES	YES	YES
Observations	1056	1056	1056	1056	741	1361	1056
#Groups	89.0000	89.0000	89.0000	89.0000	77.0000	101.0000	89.0000
R2	0.0329	0.0479	0.5761	0.5318	0.1934	0.4826	0.0551
F-stat	1.2804	1.8952	51.1988	42.7954	6.1302	42.6002	2.1972

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

In summary, our results do not show strong evidence that funding in the Excellence Initiative has had strong effects on publication related performance. However, the effects on concentration both in terms of enrollment in educational subjects as well as in terms of thematic publication portfolios are large. We now intend to dig deeper into the causes of the increased concentration by analyzing fields. The results for student enrollment can be found in Table 16 (Track 1), Table 17 (Track 2), and Table 18 (Track 3) and can be summarized as follows: either of the Track 1, Track 2, and Track 3 funding have considerably increased the share of mathematical and natural science students as well as engineering students. Funding by the Excellence Initiative has also contributed to reducing the share of students in social sciences and economics and (because of the relatively high importance of projects in medical sciences) also the share of enrollment in medicine. Thus, it appears that funding by the Excellence Initiative has led to refocusing of teaching activities towards mathematics/natural sciences and engineering. The reasons for this observation must remain speculative. One reason may indeed be a strategic reorientation away from social sciences toward hard sciences. Another reason could be the research-oriented Track 2 funding which had a strong weight on natural sciences/engineering projects increased the prestige and visibility of the funded universities implying a rise in student numbers.

In parts the results remain stable when analyzing the publication shares by discipline (Table 19-Table 21). Throughout medical science publications are associated with a decrease in the funding by the Excellence Initiative. The share of engineering publications rises. We observe a positive effect on mathematics/natural sciences only for Track 1 funding. No effect can be discerned for the publication share of social sciences/economics for neither of the funding tracks.

Table 16: Effects of Track 1 funding on student shares by field

	(1) Students in language and cultural sciences in %	(2) Students in sports in %	(3) Students in economic and social sciences in %	(4) Students in mathematics and natural sciences in %	(5) Students in medical sciences in %	(6) Students in engineering sciences in %	(7) Students in arts in %
EI: #projects funded by track 1	-0.0020	0.0009**	-0.0032*	0.0090***	-0.0097***	0.0042**	0.0000
	(-1.16)	(1.97)	(-1.67)	(7.06)	(-8.75)	(2.55)	(0.07)
#Employees	-0.0000	0.0000	-0.0000***	0.0000	0.0000***	0.0000	0.0000
	(-1.17)	(0.30)	(-4.14)	(1.54)	(6.84)	(1.51)	(0.57)
Students per employee	-0.0016***	0.0004***	-0.0056***	-0.0005	0.0059***	-0.0002	0.0014***
	(-3.49)	(3.52)	(-10.99)	(-1.43)	(20.48)	(-0.41)	(17.92)
Investments per total expenditures	-0.0262	-0.0032	0.0153	0.0108	0.0152	0.0015	-0.0117***
	(-1.48)	(-0.69)	(0.76)	(0.82)	(1.32)	(0.09)	(-3.68)
Total expenditures per employee in TEUR	0.0000	0.0000	0.0000	0.0001***	-0.0001***	0.0000***	-0.0000
	(0.31)	(0.28)	(0.80)	(7.82)	(-15.26)	(3.39)	(-0.86)
Constant	0.2652***	0.0212***	0.3841***	0.1436***	0.0421***	0.1060***	0.0187***
	(39.53)	(11.84)	(50.46)	(28.83)	(9.68)	(16.63)	(15.54)
Year dummies	YES	YES	YES	YES	YES	YES	YES
Observations	1371	1363	1371	1371	1371	1370	1371
#Groups	102.0000	101.0000	102.0000	102.0000	102.0000	102.0000	102.0000
R2	0.0499	0.0409	0.1226	0.1459	0.3709	0.1197	0.2768
F-stat	3.4559	2.7877	9.1896	11.2409	38.7820	8.9420	25.1820

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 17: Effects of Track 2 funding on student shares by field

	(1) Students in language and cultural sciences in %	(2) Students in sports in %	(3) Students in economic and social sciences in %	(4) Students in mathematics and natural sciences in %	(5) Students in medical sciences in %	(6) Students in engineering sciences in %	(7) Students in arts in %
EI: #projects funded by track 2	-0.0046**	0.0006	-0.0056**	0.0110***	-0.0078***	0.0066***	0.0002
	(-2.38)	(1.23)	(-2.57)	(7.76)	(-6.15)	(3.61)	(0.58)
#Employees	-0.0000	-0.0000	-0.0000***	-0.0000	0.0000***	0.0000	0.0000
	(-0.65)	(-0.18)	(-3.52)	(-0.67)	(8.98)	(0.60)	(0.48)
Students per employee	-0.0016***	0.0004***	-0.0056***	-0.0005	0.0060***	-0.0002	0.0014***
	(-3.49)	(3.48)	(-10.98)	(-1.56)	(20.36)	(-0.45)	(17.93)
Investments per total expenditures	-0.0234	-0.0028	0.0178	0.0094	0.0119	-0.0009	-0.0119***
	(-1.32)	(-0.60)	(0.89)	(0.72)	(1.02)	(-0.05)	(-3.74)
Total expenditures per employee in TEUR	0.0000	0.0000	0.0000	0.0000***	-0.0001***	0.0000***	-0.0000
	(0.37)	(0.09)	(0.91)	(7.34)	(-14.33)	(3.25)	(-0.86)
Constant	0.2626***	0.0217***	0.3806***	0.1511***	0.0358***	0.1102***	0.0188***
	(38.96)	(12.05)	(49.76)	(30.28)	(8.07)	(17.23)	(15.52)
Year dummies	YES	YES	YES	YES	YES	YES	YES
Observations	1371	1363	1371	1371	1371	1370	1371
#Groups	102.0000	101.0000	102.0000	102.0000	102.0000	102.0000	102.0000
R2	0.0532	0.0390	0.1252	0.1527	0.3520	0.1243	0.2770
F-stat	3.6950	2.6585	9.4183	11.8526	35.7312	9.3303	25.2059

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 18: Effects of Track 3 funding on student shares by field

	(1) Students in language and cultural sciences in %	(2) Students in sports in %	(3) Students in economic and social sciences in %	(4) Students in mathematics and natural sciences in %	(5) Students in medical sciences in %	(6) Students in engineering sciences in %	(7) Students in arts in %
EI: funded by track 3	-0.0018	0.0004	-0.0197***	0.0154***	-0.0128***	0.0207***	-0.0001
	(-0.35)	(0.32)	(-3.48)	(4.10)	(-3.84)	(4.38)	(-0.09)
#Employees	-0.0000	-0.0000	-0.0000***	-0.0000	0.0000***	0.0000	0.0000
	(-0.94)	(-0.05)	(-3.42)	(-0.13)	(8.56)	(0.52)	(0.58)
Students per employee	-0.0015***	0.0004***	-0.0055***	-0.0005	0.0060***	-0.0002	0.0014***
	(-3.46)	(3.47)	(-10.95)	(-1.63)	(20.26)	(-0.52)	(17.92)
Investments per total expenditures	-0.0283	-0.0022	0.0159	0.0187	0.0058	0.0019	-0.0117***
	(-1.61)	(-0.47)	(0.80)	(1.41)	(0.49)	(0.11)	(-3.69)
Total expenditures per employee in TEUR	0.0000	0.0000	0.0000	0.0000***	-0.0001***	0.0000***	-0.0000
	(0.45)	(0.05)	(0.99)	(6.96)	(-14.00)	(3.15)	(-0.88)
Constant	0.2644***	0.0215***	0.3801***	0.1484***	0.0374***	0.1104***	0.0187***
	(39.22)	(11.95)	(49.90)	(29.30)	(8.37)	(17.33)	(15.46)
Year dummies	YES	YES	YES	YES	YES	YES	YES
Observations	1371	1363	1371	1371	1371	1370	1371
#Groups	102.0000	101.0000	102.0000	102.0000	102.0000	102.0000	102.0000
R2	0.0490	0.0380	0.1291	0.1236	0.3401	0.1285	0.2768
F-stat	3.3886	2.5814	9.7489	9.2806	33.9116	9.6946	25.1822

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 19: Effects of Track 1 funding on publication shares by field

	(1) Publications in language and cultural sciences in %	(2) Publications in economic and social sciences in %	(3) Publications in mathematics and natural sciences in %	(4) Publications in medical sciences in %	(5) Publications in engineering sciences in %
EI: #projects funded by track 1	-0.0002	-0.0002	0.0083*	-0.0215***	0.0121**
	(-0.35)	(-0.06)	(1.71)	(-6.04)	(2.49)
#Employees	-0.0000	0.0000	-0.0000***	0.0000***	0.0000
	(-1.44)	(0.52)	(-3.59)	(3.22)	(1.34)
Students per employee	-0.0010**	0.0036	0.0005	0.0018	-0.0041
	(-2.43)	(1.55)	(0.16)	(0.85)	(-1.40)
Investments per total expenditures	-0.0037	0.1175***	-0.1711***	0.0803**	-0.0022
	(-0.49)	(2.75)	(-3.15)	(2.03)	(-0.04)
Total expenditures per employee in TEUR	0.0000	-0.0000	-0.0000	-0.0000	0.0000
	(0.02)	(-0.29)	(-0.95)	(-0.52)	(1.60)
Constant	0.0089**	0.0102	0.5427***	0.1821***	0.2294***
	(2.53)	(0.51)	(21.36)	(9.87)	(9.08)
Year dummies	YES	YES	YES	YES	YES
Observations	1073	1073	1073	1073	1073
#Groups	90.0000	90.0000	90.0000	90.0000	90.0000
R2	0.0227	0.0323	0.0466	0.0721	0.0578
F-stat	1.3198	1.8962	2.7775	4.4137	3.4889

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 20: Effects of Track 2 funding on publication shares by field

	(1) Publications in language and cultural sciences in %	(2) Publications in economic and social sciences in %	(3) Publications in mathematics and natural sciences in %	(4) Publications in medical sciences in %	(5) Publications in engineering sciences in %
EI: #projects funded by track 2	-0.0003	-0.0037	0.0084	-0.0209***	0.0157***
	(-0.36)	(-0.88)	(1.56)	(-5.31)	(2.92)
#Employees	-0.0000	0.0000	-0.0000***	0.0000***	0.0000
	(-1.35)	(0.65)	(-4.06)	(4.82)	(0.58)
Students per employee	-0.0010**	0.0037	0.0003	0.0022	-0.0045
	(-2.41)	(1.60)	(0.10)	(1.04)	(-1.53)
Investments per total expenditures	-0.0037	0.1211***	-0.1706***	0.0785**	-0.0050
	(-0.49)	(2.83)	(-3.14)	(1.98)	(-0.09)
Total expenditures per employee in TEUR	0.0000	-0.0000	-0.0000	-0.0000	0.0000
	(0.05)	(-0.33)	(-1.10)	(-0.02)	(1.45)
Constant	0.0087**	0.0077	0.5506***	0.1623***	0.2430***
	(2.44)	(0.38)	(21.50)	(8.69)	(9.56)
Year dummies	YES	YES	YES	YES	YES
Observations	1073	1073	1073	1073	1073
#Groups	90.0000	90.0000	90.0000	90.0000	90.0000
R2	0.0227	0.0331	0.0461	0.0643	0.0601
F-stat	1.3202	1.9433	2.7477	3.9067	3.6343

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 21: Effects of Track 3 funding on publication shares by field

	(1) Publications in language and cultural sciences in %	(2) Publications in economic and social sciences in %	(3) Publications in mathematics and natural sciences in %	(4) Publications in medical sciences in %	(5) Publications in engineering sciences in %
EI: funded by track 3	-0.0003	-0.0046	0.0070	-0.0282***	0.0254*
	(-0.14)	(-0.42)	(0.50)	(-2.75)	(1.83)
#Employees	-0.0000	0.0000	-0.0000***	0.0000***	0.0000
	(-1.37)	(0.59)	(-3.92)	(4.46)	(0.70)
Students per employee	-0.0010**	0.0036	0.0005	0.0019	-0.0043
	(-2.42)	(1.57)	(0.17)	(0.87)	(-1.45)
Investments per total expenditures	-0.0039	0.1182***	-0.1635***	0.0628	0.0058
	(-0.52)	(2.78)	(-3.01)	(1.57)	(0.11)
Total expenditures per employee in TEUR	0.0000	-0.0000	-0.0000	0.0000	0.0000
	(0.07)	(-0.29)	(-1.18)	(0.24)	(1.31)
Constant	0.0088**	0.0090	0.5468***	0.1690***	0.2391***
	(2.47)	(0.45)	(21.34)	(8.96)	(9.38)
Year dummies	YES	YES	YES	YES	YES
Observations	1073	1073	1073	1073	1073
#Groups	90.0000	90.0000	90.0000	90.0000	90.0000
R2	0.0226	0.0325	0.0440	0.0445	0.0551
F-stat	1.3135	1.9068	2.6139	2.6481	3.3126

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

4.3 Robustness checks: using heterogeneity as a source of identification

The previous section has shown that the largest effects of the Excellence Initiative were related to an increase in the concentrations as measured by students and publications. The effects on performance measures instead were mostly small and if significant instable. In order to assess the robustness of the results relating to the concentration measures we reran the analyses relating to them in Table 13-Table 15 using heterogeneity-based instruments. The need to use instrumental variables to obtain consistent estimates can in our context be argued to arise from the nature of the selection process, i.e. more capable universities are more likely to be selected into participation in the Excellence Initiative. But to the degree that the universities capabilities and their concentration both in terms of publications and students are correlated, the funding becomes endogenous. Although it is hard to find ordinary exclusion restrictions Lewbel (2012) shows how heterogeneity in the data generating process can be exploited to derive covariance restrictions identifying the endogenous variables. The results are presented in Table 22, where we indeed find great stability of the results. In all cases funding was significant and positive on both concentration measures. Furthermore, the coefficients appear to be roughly of magnitude comparable to the results in the FE regressions. We note heteroegeneity was in all cases sufficient to warrant strong instruments. Thus the identification can be assumed to be of reasonable quality

Table 22: Influence on the concentration measures using heterogeneity based instrumental variables

	(1) Field concentration students	(2) Field concentration students	(3) Field concentration students	(4) Field concentration publications	(5) Field concentration publications	(6) Field concentration publications
EI: #projects funded by track 1	0.00868***			0.00474**		
	(2.92)			(2.06)		
EI: #projects funded by track 2		0.0204***			0.00614*	
		(4.80)			(1.76)	
EI: funded by track 3			0.0552***			0.0123**
			(5.94)			(1.96)
#Employees	-0.0000157***	-0.0000170***	-0.0000185***	-0.00000824***	-0.00000892***	-0.0000101***
	(-10.57)	(-10.04)	(-13.79)	(-8.94)	(-8.76)	(-13.21)
Students per employee	-0.0112***	-0.0114***	-0.0111***	-0.00111	-0.00167	-0.00280**
	(-6.81)	(-6.90)	(-6.92)	(-0.91)	(-1.35)	(-2.15)
Investments per total expenditures	-0.290***	-0.276***	-0.245***	-0.144***	-0.162***	-0.190***
	(-3.47)	(-3.45)	(-3.28)	(-3.72)	(-4.04)	(-4.73)
Total expenditures per employee in TEUR	0.00000488	-0.00000257	-0.0000135	0.0000250**	0.0000321***	0.0000191**
	(0.26)	(-0.13)	(-0.72)	(2.31)	(3.15)	(2.04)
Publications in language and cultural sciences in %	-0.691*	-0.620*	-0.451	-0.687***	-0.598**	-0.452*
	(-1.93)	(-1.83)	(-1.20)	(-2.73)	(-2.31)	(-1.71)
Publications in economic and social sciences in %	0.794***	0.635***	0.651***	0.207*	0.135	0.158*
	(5.33)	(4.34)	(4.75)	(1.90)	(1.40)	(1.83)
Publications in mathematics and natural sciences in %	-0.141	-0.247*	-0.216*	0.523***	0.509***	0.605***
	(-1.06)	(-1.89)	(-1.74)	(6.40)	(6.13)	(7.58)
Publications in medical sciences in %	0.217*	0.134	0.178	0.408***	0.372***	0.481***
	(1.78)	(1.14)	(1.52)	(5.46)	(4.99)	(6.65)
Publications in engineering sciences in %	0.272**	0.178	0.189	0.472***	0.487***	0.543***
	(2.17)	(1.47)	(1.64)	(7.55)	(7.76)	(8.63)
Constant	0.438***	0.537***	0.524***	0.00996	0.0401	-0.0245
	(3.46)	(4.33)	(4.48)	(0.14)	(0.58)	(-0.36)
Observations	1073	1073	1073	1073	1073	1073

5 Conclusion

The study has uncovered a couple of key findings. First, as intended by the Excellence Initiative, funding has been relatively concentrated with about half of the universities not having received any funding. In the group of universities having received funding a few universities often conceived as top-performers have been successful in acquiring a substantial number of projects in all three tracks of the Excellence Initiative. The FU Berlin and the HU Berlin have for example jointly acquired 7 doctoral schools and 3 excellence clusters. The TU München and LMU München acquired 4 doctoral schools and 5 excellence clusters. All of the four universities were also successful in Track 3 “Future Concepts”.

A breakdown of the graduate schools and the excellence clusters by field/subject shows that the largest share of projects was awarded to mathematics/natural sciences. The importance of mathematics/natural sciences holds both for Track 1 and Track 2. An interesting observation is that in particular in Track 1 (“Graduate Schools”) humanities and the social sciences have been quite successful. About 40% of all graduate schools have a background in either humanities or social sciences. At the same time humanities/social sciences play only a very minor role as concerns the excellence clusters.

We can show that substantial differences between funded and non-funded universities exist in a variety of indicators. Funded universities are larger, have higher third-party funding shares, have lower teaching loads and perform higher in terms of publications, though not in terms of patents. From the descriptive differences it is however unclear whether causal effects of the Excellence Initiative can be deduced in particular selection into funding was highly performance-based. The analysis of the differences in time trends gives little evidence of strong causal performance effects. If at all, publications have increased in number. The evidence for effects in impact is much less conclusive.

A clear effect however seems to be related to changes in terms of concentration of both teaching and publications activities. Although the funded universities tended to be less concentrated offering a wider portfolio of teaching activities (mainly as a result of their larger size), there is clear evidence that funding by the Excellence Initiative led to growing concentration rates both in teaching and publication activities. Moreover, our results provide some indication that funding in the Excellence Initiative was associated with shifting focus towards engineering and mathematics/natural sciences, while both medical sciences and – as concerns teaching activities – social sciences/economics have lost weight.

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7 Appendix – Analysis of the Lag Structures

In this appendix we copy the results for regression Table 14-Table 21 introducing a one period time lag between funding events and outcome variables. The results are almost identical.

Table 23: Effects of lagged Track 1 funding on performance and concentration measures

	(1) Expected citation rate	(2) Excellence rate	(3) #Publications	(4) Publications per employee	(5) Patents per employee	(6) Field concentration students	(7) Field concentration publications
L.EI: #projects funded by track 1	-0.0002	0.0028	5.6065*	0.0005	0.0000	0.0106***	0.0099**
	(-0.01)	(0.71)	(1.70)	(0.32)	(0.07)	(7.13)	(1.98)
#Employees	0.0000	0.0000*	0.0473***	-0.0000***	-0.0000	-0.0000***	-0.0000
	(0.70)	(1.91)	(26.86)	(-8.16)	(-0.24)	(-2.88)	(-1.31)
Students per employee	0.0285*	0.0075***	7.9291***	0.0046***	0.0002*	-0.0005	-0.0013
	(1.93)	(3.51)	(4.51)	(5.28)	(1.89)	(-1.29)	(-0.49)
Investments per total expenditures	0.7265***	0.0708*	-18.0513	-0.0500***	0.0047***	0.0657***	-0.0512
	(2.76)	(1.85)	(-0.57)	(-3.19)	(3.80)	(4.98)	(-1.07)
Total expenditures per employee in TEUR	-0.0000	-0.0000	0.0629***	0.0002***	0.0000***	-0.0000***	0.0000
	(-0.17)	(-0.20)	(3.78)	(22.37)	(2.59)	(-5.47)	(0.68)
Constant	-0.3779	0.1528	-1089.4420	-0.1292	0.0188	-0.2184	2.1063**
	(-0.07)	(0.18)	(-1.60)	(-0.38)	(0.91)	(-0.68)	(2.04)
Year dummies	YES	YES	YES	YES	YES	YES	YES
Field shares	YES	YES	YES	YES	YES	YES	YES
Observations	1056	1056	1056	1056	741	1361	1056
#Groups	89.0000	89.0000	89.0000	89.0000	77.0000	101.0000	89.0000
R2	0.0319	0.0482	0.5712	0.5317	0.1886	0.4911	0.0586
F-stat	1.2425	1.9080	50.1893	42.7737	5.9430	44.0768	2.3464

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 24: Effects of lagged Track 2 funding on performance and concentration measures

	(1) Expected citation rate	(2) Excellence rate	(3) #Publications	(4) Publications per employee	(5) Patents per employee	(6) Field concentration students	(7) Field concentration publications
L.EI: #projects funded by track 2	-0.0020	0.0050	27.3669***	0.0038**	0.0000	0.0082***	0.0118**
	(-0.07)	(1.23)	(8.51)	(2.29)	(0.44)	(5.30)	(2.34)
#Employees	0.0000	0.0000	0.0444***	-0.0000***	-0.0000	-0.0000***	-0.0000*
	(0.70)	(1.63)	(25.71)	(-8.48)	(-0.33)	(-4.04)	(-1.80)
Students per employee	0.0286*	0.0073***	6.6250***	0.0044***	0.0002*	-0.0005	-0.0018
	(1.93)	(3.39)	(3.89)	(5.06)	(1.78)	(-1.13)	(-0.66)
Investments per total expenditures	0.7286***	0.0678*	-43.9168	-0.0538***	0.0046***	0.0672***	-0.0550
	(2.76)	(1.77)	(-1.44)	(-3.43)	(3.75)	(5.05)	(-1.15)
Total expenditures per employee in TEUR	-0.0000	-0.0000	0.0714***	0.0002***	0.0000***	-0.0000***	0.0000
	(-0.18)	(-0.21)	(4.50)	(22.88)	(2.68)	(-6.18)	(0.55)
Constant	-0.3519	0.2799	-1200.2913**	-0.1648	0.0072	0.4920*	2.6643***
	(-0.07)	(0.36)	(-1.97)	(-0.52)	(0.57)	(1.65)	(2.78)
Year dummies	YES	YES	YES	YES	YES	YES	YES
Field shares	YES	YES	YES	YES	YES	YES	YES
Observations	1056	1056	1056	1056	741	1361	1056
#Groups	89.0000	89.0000	89.0000	89.0000	77.0000	101.0000	89.0000
R2	0.0319	0.0492	0.6006	0.5342	0.1889	0.4820	0.0602
F-stat	1.2427	1.9506	56.6597	43.2145	5.9522	42.4893	2.4118

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 25: Effects of lagged Track 3 funding on performance and concentration measures

	(1) Expected citation rate	(2) Excellence rate	(3) #Publications	(4) Publications per employee	(5) Patents per employee	(6) Field concentration students	(7) Field concentration publications
L.EI: funded by track 3	0.0842	0.0043	43.0106***	0.0039	-0.0007**	0.0222***	0.0086
	(1.15)	(0.40)	(4.96)	(0.89)	(-2.36)	(5.44)	(0.64)
#Employees	0.0000	0.0000*	0.0453***	-0.0000***	0.0000	-0.0000***	-0.0000
	(0.44)	(1.76)	(25.43)	(-8.18)	(0.54)	(-4.08)	(-1.49)
Students per employee	0.0268*	0.0075***	7.1592***	0.0046***	0.0003**	-0.0005	-0.0013
	(1.81)	(3.47)	(4.10)	(5.18)	(2.45)	(-1.16)	(-0.50)
Investments per total expenditures	0.7091***	0.0726*	-21.4261	-0.0503***	0.0049***	0.0717***	-0.0433
	(2.70)	(1.90)	(-0.69)	(-3.22)	(4.01)	(5.41)	(-0.91)
Total expenditures per employee in TEUR	-0.0000	-0.0000	0.0605***	0.0002***	0.0000**	-0.0001***	0.0000
	(-0.13)	(-0.32)	(3.74)	(22.73)	(2.49)	(-6.55)	(0.34)
Constant	-1.5140	0.3259	-1209.1009*	-0.1385	0.0262	0.3561	2.7932***
	(-0.28)	(0.42)	(-1.91)	(-0.43)	(1.35)	(1.18)	(2.88)
Year dummies	YES	YES	YES	YES	YES	YES	YES
Field shares	YES	YES	YES	YES	YES	YES	YES
Observations	1056	1056	1056	1056	741	1361	1056
#Groups	89.0000	89.0000	89.0000	89.0000	77.0000	101.0000	89.0000
R2	0.0333	0.0479	0.5808	0.5320	0.1957	0.4826	0.0551
F-stat	1.2970	1.8937	52.2135	42.8332	6.2177	42.5902	2.1978

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 26: Effects of lagged Track 1 funding on student shares by field

	(1) Students in language and cultural sciences in %	(2) Students in sports in %	(3) Students in economic and social sciences in %	(4) Students in mathematics and natural sciences in %	(5) Students in medical sciences in %	(6) Students in engineering sciences in %	(7) Students in arts in %
L.EI: #projects funded by track 1	-0.0025	0.0009*	-0.0031	0.0086***	-0.0092***	0.0041**	0.0001
	(-1.43)	(1.85)	(-1.57)	(6.62)	(-8.08)	(2.47)	(0.19)
#Employees	-0.0000	0.0000	-0.0000***	0.0000	0.0000***	0.0000	0.0000
	(-1.16)	(0.20)	(-4.07)	(1.18)	(7.32)	(1.40)	(0.59)
Students per employee	-0.0016***	0.0004***	-0.0056***	-0.0005	0.0059***	-0.0002	0.0014***
	(-3.50)	(3.52)	(-10.98)	(-1.44)	(20.42)	(-0.41)	(17.92)
Investments per total expenditures	-0.0261	-0.0030	0.0145	0.0131	0.0126	0.0024	-0.0117***
	(-1.48)	(-0.64)	(0.73)	(0.99)	(1.10)	(0.14)	(-3.70)
Total expenditures per employee in TEUR	0.0000	0.0000	0.0000	0.0001***	-0.0001***	0.0000***	-0.0000
	(0.30)	(0.24)	(0.84)	(7.66)	(-15.01)	(3.35)	(-0.85)
Constant	0.2651***	0.0213***	0.3838***	0.1445***	0.0411***	0.1064***	0.0187***
	(39.58)	(11.90)	(50.48)	(28.99)	(9.42)	(16.72)	(15.55)
Year dummies	YES	YES	YES	YES	YES	YES	YES
Observations	1371	1363	1371	1371	1371	1370	1371
#Groups	102.0000	101.0000	102.0000	102.0000	102.0000	102.0000	102.0000
R2	0.0504	0.0405	0.1223	0.1420	0.3655	0.1195	0.2768
F-stat	3.4942	2.7638	9.1712	10.8852	37.8899	8.9176	25.1841

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 27: Effects of lagged Track 2 funding on student shares by field

	(1) Students in language and cultural sciences in %	(2) Students in sports in %	(3) Students in economic and social sciences in %	(4) Students in mathematics and natural sciences in %	(5) Students in medical sciences in %	(6) Students in engineering sciences in %	(7) Students in arts in %
L.EI: #projects funded by track 2	-0.0046**	0.0005	-0.0055**	0.0116***	-0.0077***	0.0056***	0.0003
	(-2.36)	(0.98)	(-2.48)	(8.00)	(-5.96)	(3.00)	(0.86)
#Employees	-0.0000	-0.0000	-0.0000***	-0.0000	0.0000***	0.0000	0.0000
	(-0.59)	(-0.17)	(-3.45)	(-0.91)	(9.06)	(0.61)	(0.41)
Students per employee	-0.0016***	0.0004***	-0.0056***	-0.0005	0.0060***	-0.0002	0.0014***
	(-3.47)	(3.47)	(-10.97)	(-1.60)	(20.38)	(-0.47)	(17.93)
Investments per total expenditures	-0.0237	-0.0027	0.0173	0.0095	0.0112	0.0007	-0.0120***
	(-1.34)	(-0.57)	(0.86)	(0.73)	(0.96)	(0.04)	(-3.78)
Total expenditures per employee in TEUR	0.0000	0.0000	0.0000	0.0000***	-0.0001***	0.0000***	-0.0000
	(0.41)	(0.07)	(0.96)	(7.22)	(-14.21)	(3.17)	(-0.86)
Constant	0.2623***	0.0217***	0.3804***	0.1520***	0.0355***	0.1100***	0.0189***
	(38.82)	(12.01)	(49.59)	(30.42)	(7.96)	(17.13)	(15.54)
Year dummies	YES	YES	YES	YES	YES	YES	YES
Observations	1371	1363	1371	1371	1371	1370	1371
#Groups	102.0000	101.0000	102.0000	102.0000	102.0000	102.0000	102.0000
R2	0.0531	0.0386	0.1249	0.1551	0.3508	0.1215	0.2772
F-stat	3.6895	2.6286	9.3913	12.0766	35.5492	9.0901	25.2359

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 28: Effects of lagged Track 3 funding on student shares by field

	(1) Students in language and cultural sciences in %	(2) Students in sports in %	(3) Students in economic and social sciences in %	(4) Students in mathematics and natural sciences in %	(5) Students in medical sciences in %	(6) Students in engineering sciences in %	(7) Students in arts in %
L.EI: funded by track 3	-0.0041	0.0006	-0.0161***	0.0179***	-0.0145***	0.0159***	0.0002
	(-0.77)	(0.45)	(-2.72)	(4.55)	(-4.17)	(3.21)	(0.20)
#Employees	-0.0000	-0.0000	-0.0000***	-0.0000	0.0000***	0.0000	0.0000
	(-0.85)	(-0.08)	(-3.41)	(-0.34)	(8.71)	(0.56)	(0.53)
Students per employee	-0.0015***	0.0004***	-0.0055***	-0.0006*	0.0060***	-0.0002	0.0014***
	(-3.45)	(3.46)	(-10.92)	(-1.67)	(20.32)	(-0.53)	(17.91)
Investments per total expenditures	-0.0279	-0.0022	0.0145	0.0187	0.0057	0.0035	-0.0117***
	(-1.59)	(-0.48)	(0.73)	(1.41)	(0.49)	(0.21)	(-3.70)
Total expenditures per employee in TEUR	0.0000	0.0000	0.0000	0.0000***	-0.0001***	0.0000***	-0.0000
	(0.46)	(0.04)	(1.03)	(6.92)	(-13.96)	(3.10)	(-0.88)
Constant	0.2640***	0.0216***	0.3803***	0.1492***	0.0368***	0.1100***	0.0188***
	(39.05)	(11.94)	(49.69)	(29.41)	(8.22)	(17.16)	(15.46)
Year dummies	YES	YES	YES	YES	YES	YES	YES
Observations	1371	1363	1371	1371	1371	1370	1371
#Groups	102.0000	101.0000	102.0000	102.0000	102.0000	102.0000	102.0000
R2	0.0493	0.0380	0.1258	0.1263	0.3415	0.1224	0.2768
F-stat	3.4149	2.5870	9.4642	9.5091	34.1184	9.1668	25.1844

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 29: Effects of lagged Track 1 funding on publication shares by field

	(1) Publications in language and cultural sciences in %	(2) Publications in economic and social sciences in %	(3) Publications in mathematics and natural sciences in %	(4) Publications in medical sciences in %	(5) Publications in engineering sciences in %
L.EI: #projects funded by track 1	-0.0002	0.0005	0.0074	-0.0212***	0.0124**
	(-0.34)	(0.12)	(1.45)	(-5.72)	(2.45)
#Employees	-0.0000	0.0000	-0.0000***	0.0000***	0.0000
	(-1.43)	(0.54)	(-3.72)	(3.54)	(1.23)
Students per employee	-0.0010**	0.0036	0.0005	0.0018	-0.0041
	(-2.43)	(1.54)	(0.16)	(0.85)	(-1.41)
Investments per total expenditures	-0.0037	0.1169***	-0.1684***	0.0754*	0.0003
	(-0.50)	(2.74)	(-3.10)	(1.91)	(0.00)
Total expenditures per employee in TEUR	0.0000	-0.0000	-0.0000	-0.0000	0.0000
	(0.03)	(-0.26)	(-1.01)	(-0.39)	(1.56)
Constant	0.0089**	0.0101	0.5440***	0.1791***	0.2310***
	(2.52)	(0.50)	(21.43)	(9.70)	(9.15)
Year dummies	YES	YES	YES	YES	YES
Observations	1073	1073	1073	1073	1073
#Groups	90.0000	90.0000	90.0000	90.0000	90.0000
R2	0.0227	0.0323	0.0458	0.0685	0.0576
F-stat	1.3194	1.8968	2.7279	4.1811	3.4756

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 30: Effects of laggedTrack 2 funding on publication shares by field

	(1) Publications in language and cultural sciences in %	(2) Publications in economic and social sciences in %	(3) Publications in mathematics and natural sciences in %	(4) Publications in medical sciences in %	(5) Publications in engineering sciences in %
L.EI: #projects funded by track 2	-0.0003	-0.0030	0.0082	-0.0204***	0.0150***
	(-0.37)	(-0.70)	(1.48)	(-5.03)	(2.71)
#Employees	-0.0000	0.0000	-0.0000***	0.0000***	0.0000
	(-1.33)	(0.64)	(-4.08)	(4.90)	(0.53)
Students per employee	-0.0010**	0.0037	0.0002	0.0024	-0.0045
	(-2.40)	(1.60)	(0.08)	(1.10)	(-1.55)
Investments per total expenditures	-0.0037	0.1203***	-0.1703***	0.0777*	-0.0041
	(-0.48)	(2.81)	(-3.13)	(1.96)	(-0.08)
Total expenditures per employee in TEUR	0.0000	-0.0000	-0.0000	0.0000	0.0000
	(0.05)	(-0.31)	(-1.13)	(0.09)	(1.39)
Constant	0.0086**	0.0079	0.5512***	0.1608***	0.2439***
	(2.42)	(0.39)	(21.45)	(8.57)	(9.55)
Year dummies	YES	YES	YES	YES	YES
Observations	1073	1073	1073	1073	1073
#Groups	90.0000	90.0000	90.0000	90.0000	90.0000
R2	0.0227	0.0328	0.0459	0.0616	0.0589
F-stat	1.3206	1.9254	2.7327	3.7291	3.5581

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Table 31: Effects of lagged Track 3 funding on publication shares by field

	(1) Publications in language and cultural sciences in %	(2) Publications in economic and social sciences in %	(3) Publications in mathematics and natural sciences in %	(4) Publications in medical sciences in %	(5) Publications in engineering sciences in %
L.EI: funded by track 3	-0.0005	-0.0046	0.0063	-0.0332***	0.0301**
	(-0.24)	(-0.39)	(0.43)	(-3.03)	(2.03)
#Employees	-0.0000	0.0000	-0.0000***	0.0000***	0.0000
	(-1.34)	(0.60)	(-3.90)	(4.60)	(0.58)
Students per employee	-0.0010**	0.0037	0.0005	0.0021	-0.0044
	(-2.41)	(1.58)	(0.16)	(0.96)	(-1.52)
Investments per total expenditures	-0.0039	0.1181***	-0.1632***	0.0629	0.0057
	(-0.51)	(2.77)	(-3.01)	(1.58)	(0.11)
Total expenditures per employee in TEUR	0.0000	-0.0000	-0.0000	0.0000	0.0000
	(0.07)	(-0.28)	(-1.19)	(0.27)	(1.29)
Constant	0.0087**	0.0088	0.5470***	0.1662***	0.2416***
	(2.44)	(0.44)	(21.23)	(8.77)	(9.43)
Year dummies	YES	YES	YES	YES	YES
Observations	1073	1073	1073	1073	1073
#Groups	90.0000	90.0000	90.0000	90.0000	90.0000
R2	0.0226	0.0324	0.0439	0.0461	0.0558
F-stat	1.3157	1.9053	2.6097	2.7446	3.3597

t statistics in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$