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Full paper

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## “From Global Indicators to Local Applications”

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### Regional and sectorial variations in attractiveness of funding from the European Union’s Framework Programs: evidence of increasing divergence

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**Abstract:** The goal of this article is to deepen our understanding of geographical differences in the ability to attract funding from the European Union’s Framework Programs for Research and Innovation (EU FPs), by changing focus from country to a) the regional (NUTS-2) and b) sectorial level of Europe, where we explore variations between regions’ three main R&D sectors: higher education, business, and government. The study covers 57,795 EU funded projects from 2007 to 2020, showing that within each country, there are large difference in attractiveness between regions, and that within each region there are remarkable differences in comparative attractiveness of different sectors. Moreover, we observe a tendency of increasing divergence between regions in their level of EU FP funding attraction.

#### Introduction

Being the world’s largest funding program for research and innovation, succeeding in the European Union’s Framework Programs for Research and Innovation (EU FPs) is important to every European scientific community. The goal of this article is to deepen our understanding of geographical differences in the capability to attract funding from the EU FPs by addressing three notable limitations.

First, the performance of European countries in the EU FPs is typically measured by the number of granted proposals and funding received, implicitly conceptualizing “success” in terms of efficacy – namely the absolute amount of money or projects attracted. However, such indicators are heavily size-dependent – meaning that large countries will appear as very successful. To address such implicit distortion in the notion of success, we propose to conceptualize success in relation to a region’s research potential as expressed by its personnel in research and development (R&D personnel). This indicator provides a more accurate representation of how successful a region’s R&D system is in attracting funds (output) vis-à-vis its research potential (input).

A second limitation in analyses of funding success in the EU FPs is the unique focus on the country level, neglecting that large differences may exist also between regions within countries. To address this limitation in the literature, we study European regions' ability to attract funding at the NUTS-2 level, where a few, key regions' performances may strongly influence national numbers and differ from most regions within that country. To the best of our knowledge, this has never been studied before. This is a glaring gap, also considering the importance the regional dimension has in EU research policy and its internal contradictions. In fact, convergence of European regions is a high priority for EU policies (Boldrin et al., 2001; Petrakos et al., 2011) and the EU has stressed the importance of increasing the participation of new member states (EC, 2015). Nevertheless, the main goal of Horizon 2020 (H2020) was to ensure that Europe produces world-class science, making it reasonable that funding falls into the hands of more capable R&D regions.

Third, most analyses examine success by ignoring differences that might exist between R&D sectors; providing aggregate level information that hides important variations. Therefore, we explore variations between a region's three main R&D sectors: higher education, government, and business. This provides a better instrument of diagnosis of a region's performance, which is essential in the context of an increased tendency of incorporating all three sectors in regional strategies and policies (Fonseca & Nieth, 2021), since a region may – for example – be very efficient in the higher education sector and poorly efficient in the business sector, or vice versa.

In sum, the aim of this study is to propose and explore a new understanding of success in the EU FPs that complements the current size-dependent, national analyses, towards an efficiency-focus, with regional and sectorial perspectives, studying differences in success by research potential and across sectors – within and between countries in Europe.

### *Studying funding success*

The study of success in attracting research funding has been extensively explored at the individual level, in terms of the chances of an applicant to win. Studies have for example explored the effect of gender (Pohlhaus et al., 2011), quality of writing or clarity of proposals (Boyack et al., 2018), or the degree of interdisciplinarity (Bromham et al., 2016). In the context of EU FPs, studies of success have also considered the absolute capability to attract funding and focused mostly on higher education institutions, showing the importance of prior participation in EU funded projects (Enger & Castellacci, 2016), past coordination experience (Wanzenböck et al., 2020), a relative high volume of submitted proposals (Piro et al., 2020), and institutional size and reputation (Lepori et al., 2015). Beyond analyzing individual scientists and institutions, studies that have explored geographical variations, are foremost public or technical reports, more focusing on country differences, or regional differences within one country at the time. Such analyses are often produced by national agencies, with a monitoring or benchmarking perspective in mind. The literature review on findings from these reports will be included in the full version of our paper. In short, analyses at *country* level demonstrate considerable differences in countries' success in attracting public funding, which might be due to different research capabilities, where the main difference is that between old and new EU member states. Both FP7 and H2020 results point at an East-West divide of EU member states (Jurajda et al., 2017, p. 327). Available analyses of *regional* success are almost exclusively provided for one country at the time, by national agencies (often available only in national language reports or web pages), often providing evidence of high degree of skewness within countries (regions with major cities are dominating). Studies about *sectorial* differences in EU FP funding success are lacking. Only Wanzenböck et al.'s

(2020) study of consortia composition in the Societal Challenges of H2020 is with an outlook on sectors (where consortia dominated by private companies and research organizations had a higher probability of proposal success).

*Success indicator: funding by research potential*

A common indicator of funding success is the *success rate*, given by the share of successful proposals. This indicator is independent from the size of a region. However, it makes no distinction of the amount of funding being attracted (a region with 1 out of 2 proposals accepted will be treated similarly to a region with 2000 out of 4000 proposals accepted). The *funding volume* has the obvious weakness that it is strongly affected by a region's size. One common normalization is by number of inhabitants; however, it is not the people of a region who write research proposals, but its research community. Therefore, we measure success by considering the sum of funding received (€) divided by the region's number of R&D personnel (full-time equivalents, FTEs), thus expressing regional funding attracted per FTE researcher.

## Methods

Our study draws on data from the European Commission's eCORDA database, covering all projects from FP7 and H2020 in the period 2007-2020 (using the October 2020 edition of eCORDA). The study covers 24,960 funded projects in FP7 (worth 43,5 billion euro) and 32,835 funded projects in H2020 (worth 64,3 billion euro). We have limited our study to the three main sectors Higher education institutions (HES), Research institutes (non-profit) (REC) and Private companies (PRC), covering roughly 90% of both funding and participation in EU projects. The remaining sectors (*Public* (excl. research and education) and *Other*) do not carry out R&D tasks by funding and personnel that appears in national R&D statistics.

Some of the institutions listed as REC are recipients of very large grants but have missions and organizing that does not align well with R&D statistics, for example very large, multinational research organizations such as the CERN, European Space Agency (ESA) and the EC's Directorate General Joint Research Centre – JRC. Funding to such organizations will appear in eCORDA to the region where the organizations' headquarters are located, and massively inflate the respective regions' funding volume. We therefore checked all recipients of the 1,000 largest REC contributions and excluded all organizations that are multinational research organizations. NUTS-2 was chosen as the geographic level of analysis, due to more data being available (by year and sector) and better readability of the results vs sufficiently fine-grained results.

The project participants' NUTS-2 codes (using the 2010 version of NUTS-2) and corresponding project information, have been matched with Eurostat data on number of researchers (FTEs), split by sectors. In using Eurostat-data on FTEs by NUTS-2 regions a pragmatic choice had to be made, as Eurostat has incomplete information at NUTS-2 levels. Our baseline choice was to use average of available values for the period 2011-2015 where the coverage in Eurostat is most complete. For regions with no data in this period, we have used the closest year, or an average of the two closest years. One special case is the Netherlands, where FTEs by sector is only available for the years 2000-2002. The total numbers are, however, available in later years and based on the sectors' percentages of FTEs in 2000-2002 we have estimated their values in 2011-2015 as similar percentages of national numbers. Regions where Eurostat does not produce R&D numbers have been excluded.

In Eurostat, data on R&D personnel are split by the following sectors: HES (higher education sector), GOV (public sector), BES (business enterprise sector) and PNS (private non-profit sector). In matching eCORDA with Eurostat data, two sectors are directly comparable: HES and BES (corresponds to PRC in eCORDA). The Eurostat sectors GOV and PNS have been merged to equal the REC sector in eCORDA. Due to lack of Eurostat data, some countries are not included for all three sectors. The sample thus consists of 276 NUTS-2 regions from 31 countries, in addition to Serbia and Bosnia-Herzegovina being included at the national levels.

## Results

In the following sections we analyze the attractiveness of EU FP funds per unit of personnel across regions and sectors, and over time. We first explore variations between regions in the amount of funding from EU FPs attracted per researchers (FTEs) in the three sectors. Table 1 reports the results of a one-way analysis of variance (ANOVA) in all the three sectors, considering all regions (top) and excluding regions in the bottom quartile by size (bottom). The table shows statistically significant differences between countries in their regions' ability to attract EU FP funds per researcher FTE. The analysis of the sum of squares reveals that variations within the same country are as important as between country variations for the HES and the PRC, and much larger for the REC. Excluding small regions, the results are similar, except for the HES, for which differences between countries become comparatively more prominent.

Table 1. One-way Analysis of Variance (ANOVA) of regions' funds per research FTE in the higher education (HES), research center (REC) and business (PRC) sectors: within and between countries variations.

ANOVA all regions		Sum of Squares*	df	Mean Square*	F	Sig.
HES fund per FTE	Between Countries	160	32	5,0	8	,000
	Within Countries	143	238	0,6		
	Total	302	270			
REC fund per FTE	Between Countries	683	32	21,4	2	,027
	Within Countries	3103	232	13,4		
	Total	3786	264			
PRC fund per FTE	Between Countries	84	33	2,6	7	,000
	Within Countries	94	245	0,4		
	Total	179	278			
ANOVA excluding small regions		Sum of Squares*	df	Mean Square*	F	Sig.
HES fund per FTE	Between Countries	192	30	6,4	16,3	0,00
	Within Countries	72	185	0,4		
	Total	264	215			
REC fund per FTE	Between Countries	552	31	17,8	2,1	0,00
	Within Countries	1517	181	8,4		
	Total	2069	212	0,0		
PRC fund per FTE	Between Countries	35	30	1,2	8,7	0,00
	Within Countries	26	192	0,1		
	Total	61	222	0,0		

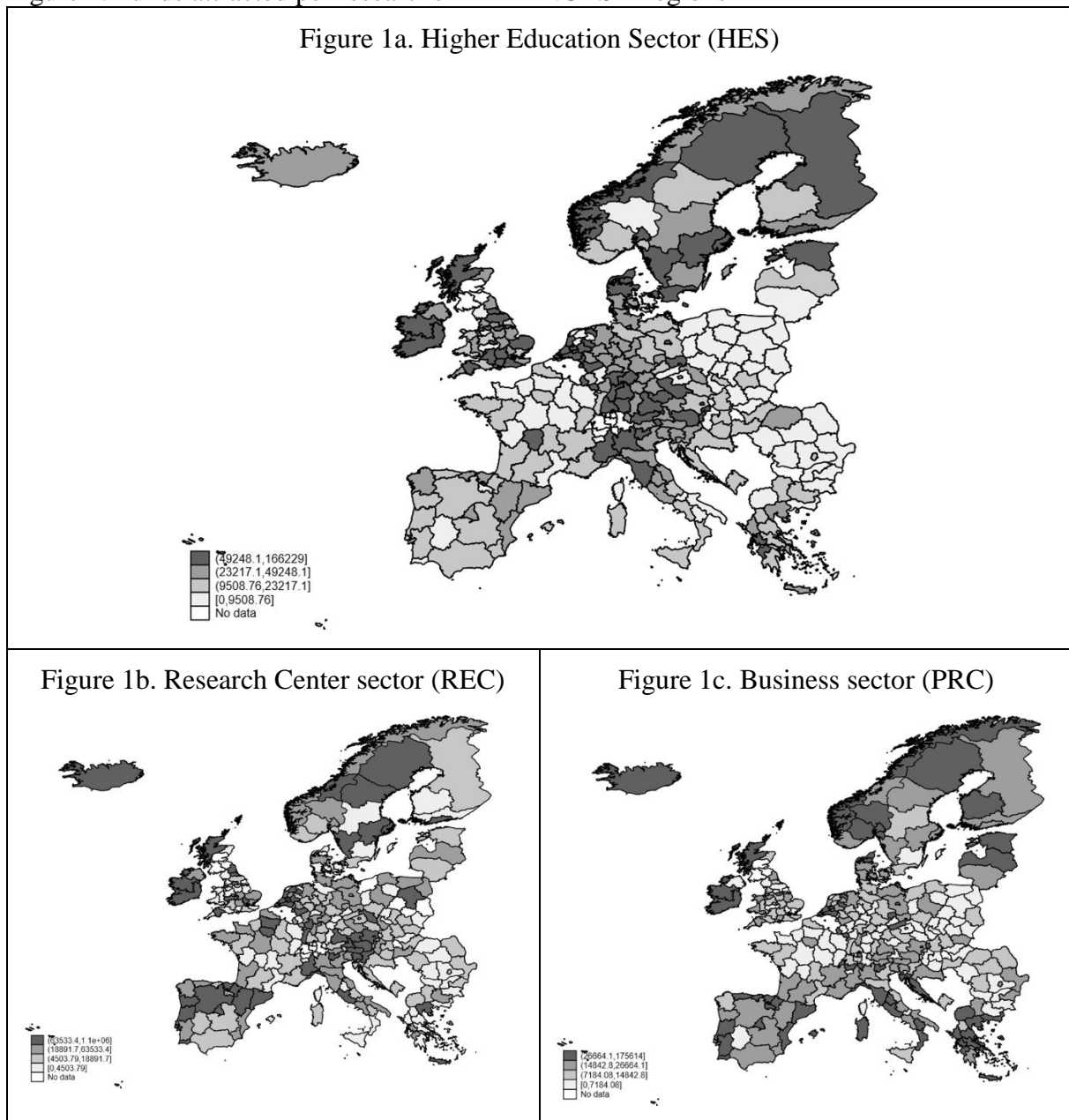
\*Values expressed in billions

Figure 1 reveals macro regions which cut across national boundaries. In the HES (1a), along with Scandinavia and Ireland, the most attractive regions occupy the central part of Europe – which is also known under the acronym of the 'Blue Banana', a geographical corridor of



highly urbanized regions spreading over Western and Central Europe, from England until Northern Italy (Faludi, 2015).

Figure 1. Funds attracted per researcher FTE – NUTS-2 regions

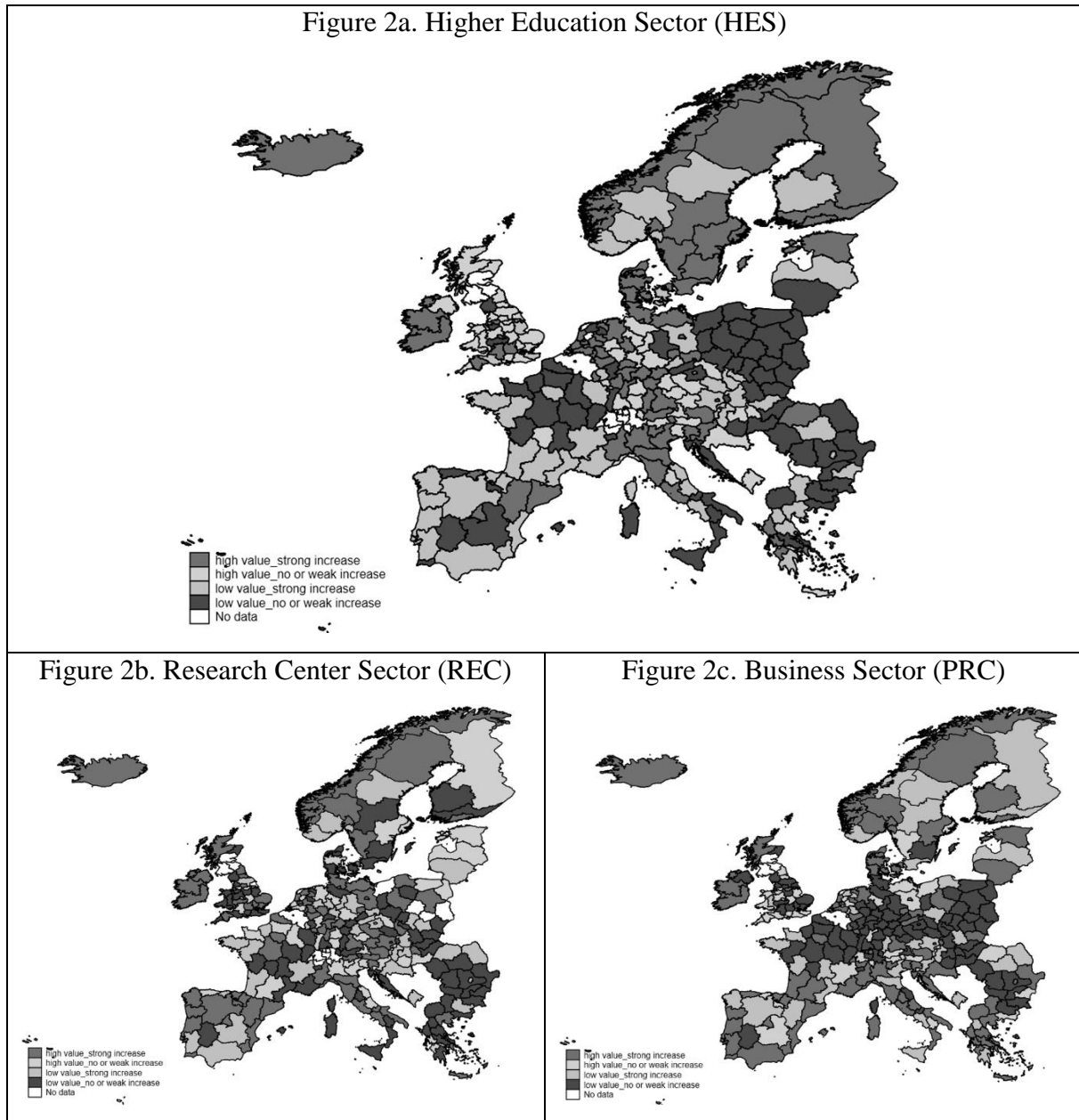


High performing regions in the PRC (1c) are mostly located in the northern and southern parts of Europe: in Scandinavia, Ireland and Baltic regions, as well as in the Mediterranean regions of Greece, Croatia, Italy and Spain. The REC (1b) appears as more dispersed, with macro groups of highly attractive regions in Austria, Spain, Scandinavia, Ireland, and the Netherlands. Opposing the expected East-West divide; French regions are among the least attractive in all three sectors.

In Figure 2 we explore changes in regional attractiveness from FP7 to H2020 through the lenses of convergence and divergence. The regions are coloured depending on whether: i) FP7 attractiveness and ii) variation in attractiveness from FP7 to H2020 are above or below the median. The two darkest colours indicate diverging regions – toward increasingly affluent

(grey) or increasingly marginalized (dark grey). In all sectors we observe a trend towards divergence, with most of the regions that were comparatively more (or less) attractive in FP7 increasing comparatively more (or less) than other regions. In the HES, 59% of the regions are diverging, 63% in the REC and 69% in PRC.

Figure 2. Convergence and divergence in the funds attracted per researcher FTE from FP7 to H2020



In the HES, negative divergence (i.e., low attractive regions becoming even less attractive) is concentrated in Eastern and Southern European regions and several French regions, whereas positive divergence (i.e., high attractive regions becoming even more attractive) is in Scandinavian countries and the “blue banana” regions, stretching towards central Italy. In the REC, divergence is scattered, but with a relative higher presence of lowly funded regions obtaining even less funding in H2020 in France and in the East/South-East of Europe (foremost in southern Poland, Romania, Bulgaria, and Greece). In the PRC there is a clear tendency of increased European divergence, with regions in the North and the South of

Europe going from high funding levels to even higher funding levels, while Central Europe (from France to Poland) have gone from low levels, to no or weak increase in funding.

### Discussion

This article has explored geographical variation in the capability to attract funds in EU FPs, demonstrating the importance of both having a regional and sectorial outlook. Using the lenses of the regional level enabled us to identify macro-regional patterns that cut across national boundaries or within national boundaries, and that could hardly be identified using only the national level perspective. Our analysis clearly points at other European differences than the expected East-West divide, i.e., there is a mixed picture of successful and unsuccessful regions in most European countries, and with strong variations also across sectors. A key implication of this result is that policies pursuing the development of ERA, and the reduction of disparities within the EU, should take into consideration the important variations existing not only between countries, but also between regions in the same country, and between sectors in the same region.

Another important aspect that we explored is the change in attractiveness from FP7 to H2020. The results reveal that differences in regional attractiveness have increased as well as diverged, with a greater share of regions that were attractive and became even more attractive; and regions that were unattractive became even more unattractive. Arguably, EU FP funds are comparatively more important for organizations in some regions than other; but this hardly explains the development towards increased divergence. A special case that accentuates future research is France (and other unattractive regions): does the low attractiveness reflect inability to win grants, or reluctance to apply for grants?

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