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Supporting the emergence of an oligarchic core: the case of the European innovation policy

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Abstract *By fostering the first transnational innovation system, the Framework Programme of the EU is a policy instrument which is unique in the world and initiated the vision of a European Research Area. Various researchers were motivated to analyze the evolving pan-European research network, but the understanding of the process that shapes the evolution of the network is still limited. More evidence concerning the process is quite urgent, since one of the first observations for the network was the emergence of a large oligarchic core, representing a bundle of central organizations that tends to reproduce itself even among consecutive Framework Programmes. This paper intends to show that to a high degree the formation of the network is affected by the EU's allocation mechanism of project grants. To disentangle the effect of network-related determinants from other factors the analysis employs a rich micro-data set on the commission's evaluation procedure cornering the prioritization of the submitted proposals for two "Knowledge Based Bio-Economy" calls of the 7th Framework Programme. The results of an OLS estimation suggest that to a large extent the commission's allocation process of projects takes into account the formation of the research network and triggers the emergence of oligopolistic network structures.*

1 Introduction

Since the early 1980s, the promotion of research networks attracted a lot of interest as a policy tool that helps to fully exploit the potential innovative performance of a region, country, or even continent by uniting firms, universities, and research centers into precompetitive collaborative research projects. At the European level, this instrument is implemented through the Framework Programme for Research and Technological Development (FP), which was initially established in the early 1980s, during a phase in which the industry competitiveness of the European Union's (EU) enterprises was falling behind their competitors from the US and Japan (Breschi and Cusmano, 2004). This early step towards a policy that weaves a research network among European organizations was concretized in 2000 by the formulation of the Lisbon Strategy. Dissatisfied with the progress after a 20 years ongoing catch up process the heads of state revised the former European innovation strategy and agreed to a plan that aimed to develop a European Research Area (ERA), for which the FP was chosen as the key instrument to accomplish that goal (Hoekman et al., 2013). Meanwhile, there is a long tradition of eight consecutive FPs that spent approximately 180 billion euros to create a comprehensive R&D network across Europe. Fostering the integration of organizations at the European level, the revision of the innovation policy implies the understanding of the ERA as a transnational innovation system among the members of the EU (Delanghe et al., 2009).). In this context, this strategy shares significant elements with Lundvall's (1988) and Freeman's (1991) idea of a national innovation system, which emphasizes the role of a complex network of organizations for the innovativeness of an economy, but with a transnational focus. In high-tech sectors in particular, such as the biotechnology

industry (Powell et al., 1996), the knowledge is dispersed among various independent organizations. Thus, within a complex economy, innovating organizations are forced to collaborate (Brusoni et al., 2001) since innovations strongly depend on the recombination of diverse and complementary skills (Boschma, 2005; Nooteboom, 2000).

One of the first observations for the European research network was the discovery of a large oligarchic core, representing a dense cluster of various central organizations. Breschi and Cusmano (2004) identified this network formation for the 3rd FP (1992-1994) and 4th FP (1992-96). Since the revision of the EU policy was sought to foster the degree of network integration on the transnational level, it is highly probable that their observed network formation process continues today. Later findings of Roediger-Schluga and Barber (2006) support this argumentation, since they found for all FPs that large fractions of the organizations transit between separate but consecutive FPs. As a consequence, there is a significant overlap between the programs and a permanent replication of once established network formations. A certain degree of stability is definitely needed for organizational research partnerships. Repetitive collaborations are embedded in trustworthy relationships (Granovetter, 1985; Uzzi, 1996), which are known to be a prerequisite for innovations since they reduce the risk of the counterpart's unpredictable behavior (Larson, 1992), extending the organization's willingness to share its knowledge and resources (Hippel, 1988; Kogut and Zander, 1992). However, excessive interactions lower the chance for creative inputs (Cowan and Jonard, 2004) and hinder new incumbents from acquiring central positions within the overall network.

The funds of the FP are distributed as financial and project-based contributions to groups of organizations that have submitted a project proposal to the European commission (EC). After an application, the EC decides whether to award or to reject the financial contribution. During the 7th FP, the European administration awarded only 15% of all proposed projects with a grant, which illustrates that the allocation process for an EU funding award is extremely selective. Therefore, the decision-making process regarding the allocation of a project grant potentially has an significant impact on the performance of EU innovation policy. To a high degree, it is the administration that decides consciously or unconsciously about the formation of the pan-European research network. With each additional decision, the commission shapes the development of the network, and thus the stage of the network at the end of a funding phase represents just one specific network formation of endless alternative stages.

Contrary to the broad consensus about the emergence of oligopolistic network structures and significant overlaps between consecutive funding phases, the process that determines the formation of the network remains unclear. Breschi and Cusmano (2004) suspected this network pattern as being shaped by the coordinators of the projects, since they observed that those "prime contractors" are more frequent participants in promoted research projects than others; but this explanation omits all previous contributions to the dynamics of networks that would be the presumptive "prime contractor" of the outcome of a process rather than the initial trigger. Another contribution to this topic comes from Hazir and Autant-Bernard (2012). Both analyzed the funding process before the consortium's initial application for a project grant. They emphasized that organizations consider their benefit from additional access to other external knowledge sources when

they participate within a consortium, but the impact on the overall decision was rather limited and they found no significance for their assumption that organizations try to preserve their cooperation partners across various applications.

It is expected in this research that the commission's process of allocation is both affecting and affected by the formation of the network. For the application process previous experiences play an important role (Brockhoff et al., 1991; Barajas and Huergo, 2010; Paier and Scherngell, 2011; Aschhoff, 2009). They correspond to the learning curve of the organizations and their ability in writing high-quality proposals. But it is also expected that experiences that become manifested in networks (Ahuja et al., 2012), such as trust, loyalty and mutuality, also have a significant impact on the quality of a proposal. After the decision and the award of a cooperative project grant, the network transits into a new stage, representing the new experiences that are accumulated by the organizations of the network. This ultimately induces a feedback link between experiences, network-related as well as non-network-related, and the award of additional project grants.

Following the work of Barajas and Huergo (2010). the participation of an organization in the FP depends on a two-stage decision-making process. During the first stage, an organization that must be a member of a consortium decides whether to apply for an FP project; secondly, depending on its quality, the European Commission (EC) approves or rejects the proposal of the total consortium.

In the following sections, this paper analyzes whether or not the EU's allocation process of project grants is affected by the formation of the network. If so, this would only become possible due to two explanations. As the EU is the responsible agency with the authority over allocation, it is only possible that the administration appreciates or neglects the influence of the network. In both cases knowingly or unknowingly the administration would facilitate a selective process that promotes submitted proposals of well-connected consortia.

To bring clarify, this paper analyzes the evaluation procedure for two Knowledge Based Bio-Economy (KBBE) calls that were part of the 7th FP (2007–2013). As the funding decision of the EC strongly depends on the outcome of an expert evaluation procedure that attaches a certain score value to each submitted project proposal, it is possible to estimate the impact of network-related determinants on the allocation process by estimating two ordinary least-square models. The first model analyzes a KBBE call in 2013, asking whether the emerged network structure of the current FP determines the proposal's priority ranking. The second model investigates for a KBBE call in 2007, lying directly between the transition phase among the 6th and 7th FP, if the network formation of a previous funding phase influences the selection process of the current one. To the best knowledge of the author, there have been no previous studies that have deployed this approach.

The next section gives a short introduction about the EU's project allocation process. The third section concludes with three theory-based hypotheses, concerning the impact of network-related determinants. The fourth section presents the employed data for the empirical part of the paper as well as the construction of the networks. The fifth section will introduce the variables that have been used to specify the models required for testing the hypotheses. Section six discusses the results of the estimation. The paper concludes

with a summary of the key findings and limitations of the paper, presenting ideas for further research as well.

2 The allocation mechanism of a project grant

As the EC is the responsible authority for the FP, the allocation process of the project grants is one of its key assets to achieve their vision of a pan-European research network. Since the first time the Framework Programme for Research and Technological Development (FP) was established, only those consortia were eligible to apply for project grants that consist of several independent organizations coming from different EU member states or associated countries (Roediger-Schluga and Barber, 2006). Thus, each additional allocated project contributes to the formation of the transnational research network. Proposals that have passed the eligibility check, and therefore comply with the minimum requirements, are subject to an evaluation process, which prioritizes the submitted projects on the basis of a criteria catalog. In contrast to the rather inflexible eligibility check, this stage of the allocation process provides space for pursuing political aims, for example, allocating at least 15% of the funding to small and medium-sized enterprises (SMEs) (EU, 2006) or promoting the formation of a research network. Considering the results of the evaluation process the commission decides whether to support the proposal with a project grant or to reject the submitted proposal.

The prioritization is carried out by an appointed group of experts (EU, 2013) that has to evaluate the submitted proposals under the following criteria: (1) the scientific and technological excellence, (2) the relevance to the program objectives, (3) the potential impact of the project results and (4) the quality and efficiency of the implementation and management. While the second criterion is directly related to the promotion of research networks, as the formation of networks is a ubiquitous aspect within the "Work Programmes" for the FP (EU, 2013; EU, 2007), there are some additional indirect effects that occur when fostering the evolution of the research network through the first and third criterion. From an excellent proposal, the EC demands scientific and technological state of the art and an efficient plan for the project implementation, which needs to include significant coordination activities in front of proposal submission, as the project consortium has to submit its proposal jointly. At the final stage of this process each proposal is assessed with a score value, which ranges usually between 0 and 100, signaling the quality of the proposal. Ultimately, considering the expert's prioritization, the EU administration distributes the funds of the FP to the proposals with the highest evaluation scores.

3 Hypotheses

The literature points to the important role of previous experiences for the application process (Brockhoff et al., 1991; Barajas and Huergo, 2010; Paier and Scherngell, 2011; Aschhoff, 2009). This is, however, misleading, since most of the researchers do not

distinguish or recognize the difference between having experience with the application procedure and having experience with collaborative partnerships. For experiences with the application process, an organization only requires a frequent number of previous applications, which do not even need to be successful (Barajas and Huergo, 2010). On the contrary, experiences with R&D co-operations require the award of a project grant to establish a long-term research partnership. Since co-operative experiences become manifested in networks (Ahuja et al., 2012), it is reasonable to question whether the positioning of the consortium's members, and, indirectly, the formation of the overall network, has an impact on the expert committee's project prioritization.

Several theoretical arguments support this point of view. To ensure the quality of a proposal, organizations could seek to collaborate mostly with those partners that have already proven their credibility as reliable stakeholders. This reputation helps to mitigate the problem of incomplete contracts (Larson, 1992; Mora-Valentin et al., 2004) before and during the implementation phase of a project, which entails the possibility for hazards, such as free riding or opportunistic behavior. Under these circumstances, the trustworthiness of an organization becomes visible through their degree of social embeddedness in networks (Granovetter, 1985; Uzzi, 1996), or, as Powell et al. (1996) posit, by their "central connectedness." Furthermore, organizations with experience in collaborating and with a central position within the network are capable formulating a coherent project proposal due to their access to a more diverse knowledge pool (Powell et al., 1996). Similarly, Hagedoorn et al. (2006) and Umlauf (2014) have shown, in the case of general inter-firm and funded research partnerships, that firms with strategic network positions have a higher probability of obtaining additional partnerships or project funds.

Furthermore, it harms the reputation of the experts if one of their chosen projects is abandoned during the phase of the project implementation; thus, experts might tend to select organizations that have already proven to be successful in completing a project, which in their view reduces the probability of project failure (Blanes and Busom, 2004; Cantner and Kösters, 2009; Aschhoff and Schmidt, 2008). If so, that would even promote the selection of organizations with previous cooperative experiences, since these are the organizations which are very likely to accomplish the project objectives. To evaluate whether the positioning of the consortium members within the research network influences the experts' scoring process, and ultimately the overall network formation, motivates the first hypothesis ***H1***.

> ***H1:*** *The better the strategic positioning of the consortium within the network, the higher lies the evaluation score.*

The leading organization of the consortium is the project coordinator (*prime contractor*). The composition of the consortium members usually depends on the coordinator's choice and his ability to attract other organizations to participate, for which the coordinator requires both a large bundle of contacts and a good reputation. Moreover, it is the task of the prime contractor to coordinate the activities of the participants during the initiation and implementation phase of the project (Breschi and Cusmano, 2004). Thus, to a large extent, the success of the project application depends on the capabilities and cooperative experiances of the coordinator (Barajas and Huergo, 2010). The

importance of prime contractors for the formation of the network is confirmed by the frequency of their participation in other projects (Breschi and Cusmano, 2004), which lies significantly above the average. The implication of these thoughts is concentrated in hypothesis ***H2***, expecting, in accordance to the ***H1***, that the quality of the submitted proposal is associated with the coordinator's position within the research network.

> ***H2:*** *The better the strategic positioning of the coordinator within the network, the higher lies the evaluation score.*

Additionally, it is expected that the degree of preexisting interlinkages among the members of a consortium improves the quality of the project proposal. While the previous two hypotheses focus on the external network of the consortium, the question arises whether the connection within the group has an effect or not. Particularly, first hand experiences, which come from previous bilateral relationships, reduce the probability of a hidden agenda of the counterpart (Granovetter, 1985; Uzzi, 1996). Moreover, the exchange of project-relevant knowledge among the potential partners requires long-term co-operations (Hippel, 1988; Kogut and Zander, 1992). Previous give-and-take relationships that have satisfied the expectations of the organizations are prerequisite for a non-defensive attitude, which enables the transfer of even tacit knowledge through preexisting communication channels (Cavusgil et al., 2003) and organizations can collaborate more efficiently. The logic behind these preferential relationships leads to a replication of the same relationships, entailing a strong social cohesion between organizational subgroups (Duysters and Charmianne, 2003; Rosenkopf and Padula, 2008; Walker et al., 1997). All these factors lead to the third hypothesis ***H3***.

> ***H3:*** *The more preexisting relationships within the group of a consortium, the higher lies the evaluation score.*

4 Data

To investigate whether the scoring process of the expert committee is affected by the factors named in the hypotheses, the empirical analysis of this paper makes use of different sets of databases related to the European FP. The evaluation results of the KBBE calls are taken from the proposal database of the 7th FP[1], which contains various information about the group of the applicants, such as organization names, contact persons, required budgets or whether the organizations are SME. The extraction of the database includes 414 proposals for the *KBBE call 2007-1* and 467 for the *KBBE call 2013-7*, respectively (see Table 1). In total, 136 of 841 eligible proposals were accepted for the commission's main list, which names all selected proposals that will receive a project grant. Those proposals that have been named on the commission's "reserve list" obtain a second chance to receive a project grant if the call's budget is not depleted by the projects from the main list. Proposals that have not been mentioned on the

[1]The proposals were extracted from the ECORDA database, June 2014 version.

main or reserve list are rejected (332) and have no further opportunity for access to funding. Moreover, the database includes 11,101 entries about organizations that have taken part in both calls. Due to the rather limited quality of the database, it was necessary to apply an intensive deduplication procedure, which identified a number of 4,832 unique organizations in both calls. Since most proposals name the highest legal entity of the applying organization, subdivisions where aggregated to their highest legal level, to secure the comparability between the organizations. Since ineligible proposals do not receive an evaluation value from the group of experts, 41 proposals were excluded from the estimation process.

Table 1: Overview KBBE calls

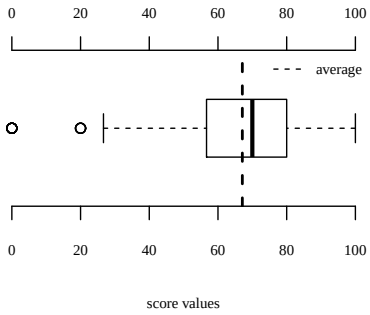
call	proposals	ineligible	eligible	mainlist	reserve	rejected	participants	organizations
2007-1	414	17	397	64	157	176	4,248	2,035
2013-7	467	24	443	72	175	196	6,853	3,468
total	881	41	840	136	332	372	11,101	4,832

Despite the approximately equal number of project proposals for both KBBE calls, there are some differences regarding the distribution of score values (see Figures 1(a) and 1(b)), which could lead to difficulties comparing the estimation results for both calls. While both evaluation processes lead to score values ranging from the highest possible value of 100 to the lowest possible value of 0, the standard deviation of the KBBE in 2013 (31.2) lies 60% above the deviation (19.1) in 2007. The mean score value reaches 67.1 in 2007, compared to 54.3 in 2013. Both findings suggest that, except for the significance levels, direct comparisons between the later estimated parameter values should be avoided.

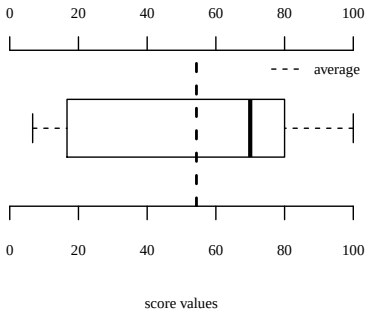
The ultimate grant decision of the EC is highly influenced by the expert's prioritization (see Figures 1(c) and 1(d)). Those proposals that obtained the highest evaluation scores from the group of experts are usually named on the commission's main list. However, in some situations, proposals are not part of the main list even if they have higher scores compared to others. That is because each call has some specific thematic sub-divisions. For each sub-field there is a specific amount of money that can be spent and if the budget's limit is reached, proposals with relatively high scores are also added to the reserve list.

The networks were extracted from two different databases. For the *KBBE call 2007*, the network was constructed from the project database of the 6th FP, because in 2007 the network of the 7th FP was in its embryonic stage. As a by product it is possible to evaluate whether the network configuration of the previous FP affects the scoring procedure of the following one. As this approach requires a unification of the 6th and 7th FP, the network was restricted due to the manageability of the matching procedure to those projects that fall within the scope of biotechnology-related topics.[2] The network for the

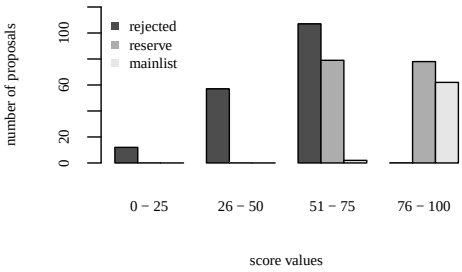
[2]Therefore, only those projects were selected from the 6th FP, which belong to the following sub-themes: (1) life sciences, genomics and biotechnology for health, (2) food quality and safety, and (3)



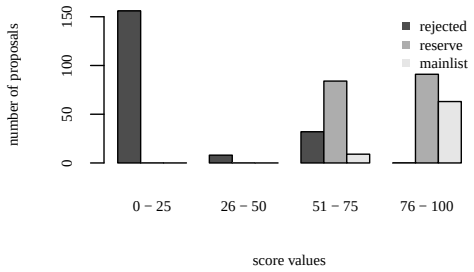
(a) KBBE call 2007 expert evaluation



(b) KBBE call 2013 expert evaluation



(c) KBBE call 2007 grant decision



(d) KBBE call 2013 grant decision

Figure 1: Results of the allocation process

2013 call was built on the project database of the 7th FP, considering all projects which belong to the specific "Cooperation" program and whose initial starting dates lie before the call's deadline for the proposal submission. To focus on organizational interlinkages, the initial affiliation network, which consists of vertices representing projects and organizations, is projected to a unipartite graph (Breschi and Cusmano, 2004) which has the advantage of using network-related measures that are only available for one-mode networks.

Table 2: FP network structure

characteristics	network KBBE *2007-1*	network KBBE *2013-7*
organizations	8,826	18,793
edges	196,542	396,602
density	0.005	0.002
components	53	77
greatest component		
organizations	8,490	18,611
share	96%	99%
average distance	2.75	2.74
isolates	16	48
degree centralization	0.18	0.25
betweenness centralization	0.04	0.11
average degree	44.5	42.2
transitivity	0.22	0.12
average transitivity	0.82	0.82
diameter	6	6

The observed networks differ in terms of the number of organizations and the number of edges (interlinkages). While the network for the *KBBE call 2007* only includes 8,826 organizations, the network for the *KBBE call 2013* consists of 18,793 organizations, which is more than double. The same is true for the number of interlinkages, where there are 196,542 edges against 396,602. The primary reason for this is the restriction of the KBBE 2007 network to biotechnology-related projects and the different time horizon, as the time frame for the KBBE 2007 network includes only four (2003-2007) instead of six (2007-2013) years. Another factor that plays a role is that each subsequent FP over-exceeds its precursor in terms of the financial budget and the number of subsidized projects (Roediger-Schluga and Barber, 2006). In contrast to the different size, the structural patterns of the networks equals quite well. For both networks the share of the greatest component is close to one and the average transitivity (0.82) is identical to the second decimal place. The same is reflected by the average degree that reaches a value of 44.5 in the case of the KBBE 2007 network and lies only slightly above the value of 42.2. The structural similarity between both networks ensures the comparability of the model results within the next sections.

sustainable development, global change, and ecosystems.

5 Variables

Using an ordinal least square (OLS) model for the estimation of the score values that have been awarded by the expert committees, it is necessary to include several exogenous variables in order to check the relevance of the underlying hypothesis. Due to the different closing dates for the analyzed KBBE calls, it is necessary to calculate the variables for two different time points (see Table 3).

Several measures are able to describe the centrality of an organization within the research network, with each concept pointing to a specific role of the actor's position in relation to the rest of the network. To verify the hypothesis ***H1***, that the centrality of a consortium has an influence on the expert's evaluation processes, the model includes two distinctive centrality measures. As the perspective focuses on the level of the whole consortium, the individual centrality measures need to be aggregated to the level of the group. The first indicator ($group\ degree_{avg}$) summarizes the average number of connections (degree), which each member of the group has established to other organizations within the research network. By doing that, a large number of neighbors reflect both past gained knowledge and experiences through previous collaborations as well as preexisting external knowledge sources. The expected improvement of the submitted proposal should encourage the expert group to give a higher priority score to the submitted proposal. The second centrality measure refers to the group's overall centrality within the network. While the degree only reflects the direct neighborhood of the consortium, the eigenvector centrality reviews the groups's position in respect to the entire network. Measuring the importance in respect to the entire network leads to a self-referential problem since the importance of an organization depends on the importance of its neighbors which can be solved due to the calculation of the research network's eigenvector (Jackson, 2008; Bonacich, 1987). For the construction of the variable $group\ evcent_{sum}$, the individual eigenvector centrality measures of the organizations were added up to the level of the consortium. As the variable quantifies the quality of the group's neighborhood, it is supposed that a higher variable value improves the score value of the proposal.

The second hypothesis ***H2*** is similar to the first one, but with a different focus. It aims at the centrality of the project coordinator instead of the centrality of the consortium. The underlying assumption is that the "primary contractor" is of higher relevance in comparison to the ordinary project participant. To describe the coordinator's network positions, the same indicators, as in the case of the first hypothesis, are used, with the only difference being, that the centrality measures are not aggregated to the level of the group.

While the first two hypotheses have an outward-looking perspective regarding the consortium's network position within the overall network, the third hypothesis ***H3*** gives attention to the inner connectivity of the group. Previous bilateral project participations are manifested in organizational interlinkages signaling both previous experiences and mutual trust, formed through face-to-face contacts and contract compliance. The connectivity between the project applicants is measured by their subgroup's network density. The value of the indicator varies between 0 and 1, 1 indicating the presence

of all possible interlinkages. In that case, each member of the consortium is perfectly familiar with the rest of the group. A value of 0 would signal that the members of the group are totally unknown to each other. For the confirmation of the hypothesis ***H3***, it is expected that indicator variable *group connectivity* has a positive impact on the experts' evaluation process.

As stated in the funding rules of the EU commission, the project consortium should contain at least three independent organizations. That's why the smallest consortium counts three participants, whereas the greatest submitted proposal has 55 organizations on its list. A key rationale behind R&D cooperation is to diversify costs and risks of an innovation process across different organizations. However, is has been shown, in accordance to the transaction-cost theory (Coase, 1937; Williamson, 1981), that the costs start to grow with the administrative efforts which are required to coordinate greater groups (Barajas and Huergo, 2010). Moreover, the exchange of knowledge becomes more complex and difficult; thus, the benefit comes to an end if the marginal profit of an additional project participant does not exceed its own cost. To investigate the effect, the variable $members_{count}$ was added, counting the number of applications of a submitted proposal.

The EC has to meet a balance of national interests regarding the allocation of the FP budget. Since the budget for the European FP comes directly from the member states, it is usual that national authorities claim a proportion of the project funding, which is equivalent to their specific contribution to the program. This leads to the expectation that the final list of contributed consortia represents approximately the origin of the public funds. To ensure this, the experts' evaluation procedure has to consider that no country is overrepresented regarding their financial contribution to the program. Therefore, several variables were added to the model, counting the consortium's number of applicants coming from a specific country. A comparison between the variable *country* es_{count} and *country* de_{count} for the KBBE call 2013 explains that (see Table 3), on average, Spanish organizations (2.0) are overrepresented compared to German (1.6) ones, as it can be assumed that Germany's financial contribution to the budget of the FP exceeds the Spanish one. Consequently, it can be expected that the evaluation process prioritizes those consortia that ensure a balance of national interests.

Many authors have highlighted the importance of the geographic proximity (Ponds et al., 2007; Broekel and Hartog, 2013; Ter Wal, 2013; De Stefano and Zaccarin, 2013; Hoekman et al., 2013) for organizational cooperation. Closeness eases the communication between the members of the consortium; personal meetings become more likely and therefore more affordable, which stimulates the creation of mutual trust, stimulating the exchange of information and tacit knowledge (Kogut and Zander, 1992; Cavusgil et al., 2003). Nevertheless, it is possible to substitute geographic proximity by other confidence-inspiring factors, such as previous experiences or social proximity (Autant-Bernard et al., 2007; Paier and Scherngell, 2011). To evaluate whether the geographic proximity has an influence on the quality of a submitted proposal, the model includes the variable *coordinator* $distance_{sum}$, measuring the sum of the geographic distances between the project coordinator and the rest of the consortium.

For the objective of the paper it is necessary to distinguish network-related experiences

from those reflecting the organizational learning curve concerning the formal application process (Barajas and Huergo, 2010; Yelle, 1979). While network-related experiences become explained though the variables for the hypotheses, the organizational know-how has not been implemented up to now. It describes the extent of the organization's professionalization in seeking and elaborating further projects, which becomes shaped most widely by former proposal submissions (Levinthal and Fichman, 1988; Mora-Valentin et al., 2004; Aschhoff and Schmidt, 2008; Barajas and Huergo, 2010). Organizations with previous submissions can build upon preexisting communication channels with to the EU administration, which entails an information advantage over other organizations when formulating a high quality application. Taking into account this effect, the model includes three different variables. Counting the number of successfully acquired projects, the variable *log experience positive*$_{count}$ explains the sum of positive experiences that a consortium has collected before a submission deadline, the *KBBE call 2013* variable is based on the 7th FP, and the *KBBE call 2007* uses the 6th FP, respectively.[3] For the *KBBE call 2013* it is also possible to consider negative experiences (*log experience negative*$_{count}$) in the form the consortium's list of rejected project proposals. In contrast to the positive experiences, the number of negative project applications is considered to have a negative impact on the experts' evaluations. Possibly, a large share of rejected proposals is a signal for a kind of spamming strategy, where a large set of low quality submissions are used to obtain project funds from time to time.

Table 3: Variable statistics

	KBBE 2013				KBBE 2007			
variable	mean	min	max	sd	mean	min	max	sd
$members_{count}$	15.12	3.00	55.00	6.93	10.21	1.00	25.00	4.40
$country\ uk_{count}$	1.31	0.00	8.00	1.45	0.93	0.00	6.00	1.09
$country\ de_{count}$	1.57	0.00	10.00	1.64	0.85	0.00	5.00	1.08
$country\ es_{count}$	1.97	0.00	20.00	1.97	0.79	0.00	7.00	1.12
$country\ it_{count}$	1.49	0.00	8.00	1.68	1.13	0.00	8.00	1.33
$country\ fr_{count}$	1.10	0.00	8.00	1.49	0.65	0.00	6.00	0.96
$country\ nl_{count}$	1.00	0.00	9.00	1.41	0.46	0.00	3.00	0.76
$country\ be_{count}$	0.59	0.00	6.00	0.97	0.40	0.00	5.00	0.76
$country\ pt_{count}$	0.49	0.00	6.00	0.96	0.21	0.00	5.00	0.61
$thirdparty\ countries_{bool}$	0.25	0.00	1.00	0.43	0.29	0.00	1.00	0.46
$thirdparty\ lower\ middle_{count}$	0.28	0.00	6.00	0.81	0.44	0.00	8.00	1.20
$coordinator\ distance_{sum}$	1,377.46	0.00	7,356.75	1,093.31	1,542.98	0.00	7,058.80	1,171.02
$log\ experience\ negative_{count}$	6.62	0.00	8.27	1.13				
$log\ experience\ positive_{count}$ *	8.02	1.10	9.70	1.11	4.14	0.00	5.91	1.24
$log\ publications_{count}$	10.54	0.00	12.84	1.70	10.31	0.00	12.83	1.95
$group\ degree_{avg}$	375.18	5.50	1,177.33	212.44	25.80	0.00	73.89	14.54
$group\ evcent_{sum}$	2.60	0.01	9.09	1.62	1.01	0.00	4.51	0.84
$coordinator\ degree_{avg}$	723.86	0.00	4,647.00	872.05	31.91	0.00	114.00	39.20
$coordinator\ evcent_{sum}$	0.32	0.00	1.00	0.31	0.14	0.00	0.99	0.24
$group\ connectivity_{share}$	0.47	0.00	0.94	0.24	0.14	0.00	0.75	0.17
$theme\ I_{bool}$	0.26	0.00	1.00	0.44	0.49	0.00	1.00	0.50
$theme\ II_{bool}$	0.31	0.00	1.00	0.46	0.35	0.00	1.00	0.48
$theme\ III_{bool}$	0.43	0.00	1.00	0.50	0.16	0.00	1.00	0.36
$theme\ IV_{bool}$					0.003	0.00	1.00	0.05
$employee\ less\ 250_{count}$	6.35	0.00	22.00	3.87	4.20	0.00	14.00	2.91
$turnover\ ls\ 50_{count}$	6.81	0.00	26.00	4.08	5.44	0.00	18.00	3.25
$coordinator\ university\ education_{bool}$	0.37	0.00	1.00	0.48	0.46	0.00	1.00	0.50
$coordinator\ research_{bool}$	0.35	0.00	1.00	0.48	0.34	0.00	1.00	0.47
$experts_{share}$	0.02	0.00	0.27	0.04	0.02	0.00	0.50	0.06
number of observations								

* For the KBBE call 2013 mesured in project aquisitions during 7th FP and in case of the KBBE call 2007 mesured in project aquisitions during 6th FP.

[3] Another model setting which included the number of the coordinator's positive and negative project experiences was also tested, but it was rejected,

Most importantly, the experts' evaluations should reflect the scientific expertise of the written proposal. It is obvious that the best approximation for the accumulated knowledge of the consortium is their academic publication activity in recent years (Umlauf, 2014). For that purpose, the variable *log publications*$_{count}$ includes all publications of the consortium members that refer to the topics of the KBBE calls. The publication data was extracted for each organization from the Web of Science, the time horizon starting in the year 2000 and ending at the closure date of the respective call. The number of publications is logarithmized since it is assumed that each additional publication is less important.

It is a special aim of the EC to internationalize the participants of the 7th FP (EU, 2013). The inclusion of third-party countries is an important objective under the "Cooperation" program, if those participants contribute to the innovative potential of the elaborated proposal. A third-party country is neither a member of the EU nor a currently associated country of the FP. The variable *thirdparty countries*$_{bool}$ signals whether a third country is under the list of organizations.

Roediger-Schluga and Barber (2006) have shown that the institutional affiliation of an organization also plays a role to a large extent. They reported that universities and research organizations show a greater persistency among consecutive FPs in comparison to firms and other organizations. Thus, they were able to gain more experiences regarding the application processes in recent years. Another factor that might play a role for the allocation process is that universities and research centers are experts in managing basic research, since this activity is a major part of their daily business. To investigate whether the sectoral affiliation of the coordinator plays a role, the variables *coordinator research*$_{bool}$ and *coordinator university*$_{bool}$ have been added to the model, the variable being 1 if the organization belongs to the specific sector and 0 otherwise.

Tanayama (2009) found some evidence that SMEs and large firms are treated differently, but it is unclear whether the consortium benefits more from the participation of SMEs or large firms. While a regulation from the EC requires that at least 15% of the overall funding goes to SMEs (EU, 2006), large organizations have the advantages of economies of scale and lower vulnerability in terms of sunk cost and other risks. Moreover, the "picking-the-winner" strategy contributes to the selection of larger firms (Wallsten, 2000; Cantner and Kösters, 2009). To measure this effect, two variables were added to the model, containing the number of organizations in the consortium with less than 250 employees (*employee less 250*$_{count}$) or an annual turnover below 50 million euro (*turnover less 50*$_{count}$). The limits of the variables are exactly equivalent to the limits of the EU to define whether an organization is an SME or not.

Each KBBE call is divided into different activities; thus, each call addresses several specific research questions related to the respective technological field. During the application process, organizations are able to decide for which kind of sub-activities they want to submit their proposal. Notwithstanding the possibility to consider a thematic sub-field below the activity level, the model includes as much thematic dummy variables as possible, to represent the actives of the respective call. This procedure assumes that the expert group's evaluation procedure differs between the various activities, which is possible since the composition of the expert group changes case-by-case.

The role of the expert group cannot be overstated. For the composition of the expert group, the EC maintains a list of appropriate persons. To become an expert, persons require a high level of expertise and competence regarding the requested scientific sub-field (EU, 2011). Beside this, the group should reflect a sensible balance between academics, industrial experts and users, a reasonable gender balance and a reasonable distribution of geographical origins and the principle of rotation. The requirement of a person's excellent expertise entails the possibility of a conflict of interest. It's very likely that highly educated persons having a similar scientific background are familiar with each other. Thus, personal acquaintances between experts and applicants cannot be avoided. As a consequence of that, experts have to indicate whether they are in a conflict of interest or not, and if so, experts are usually excluded from the relevant decision. However, it remains widely unclear whether further effects influence the decision, such as unconscious preferences or even agreements between the experts, in advance of the evaluation process. To approximate this effect, the variable $experts_{share}$ was added to the model. Based upon the persons named in the respective proposal, the variable explains the share of the consortium's members that have also been announced as experts evaluating a KBBE call between the years 2007 and 2013.

6 Results

The model results of several OLS estimations are shown in Table 4 and 5. Unfortunately, both models (1a, 1b) that have been estimated first lead to the problem of multicollinearity. Thus, it was necessary to reduce the list of parameters by those variables, which have been indicated through the variance inflation factor. This is particularly the case for the variables *log experience positive*$_{count}$ and *log experience negative*$_{count}$, showing a high degree of positive correlation. Thus, it was decided to omit the latter one from the model. The same applies to the parameters *employee less 250*$_{count}$ and *turnover less 50*$_{count}$ in the case of the *KBBE 2013 call*, since both employment and turnover are quite interdependent. Due to the lower significance of the turnover, the variable *turnover less 50*$_{count}$ was eliminated from the model. Additionally, the variables explaining the hypotheses ***H1*** and ***H2*** were separated into two different models, since the variables for both hypotheses caused further multicollinearity problems.

The findings for hypothesis ***H1*** differ, depending on the circumstances of the respective call. While the hypothesis is rejected for the *KBBE 2007 call*, the hypothesis is broadly supported from the results of the KBBE 2013 call in model (2b). Interestingly, the results confirm the broadly observed and often theorized pattern that the quality of interconnections counts more than the pure quantity of neighbors (Hagedoorn et al., 2006; Rosenkopf and Padula, 2008; Umlauf, 2014). This is expressed by the significant parameter values of the variables *group degree*$_{avg}$ and *group evcent*$_{sum}$. The value of the degree variable indicates a negative influence on the experts' evaluation score caused by each additional link maintained by the consortium. This highlights the circumstance that the maintenance of interconnections is a costly matter, which can exceed the bene-

fit.[4] Contrastingly, the estimated parameter of the variable *group evcent*$_{sum}$ explains that what really matters is the relative importance of the group's neighborhood. Indeed, if the members of a consortium are partnered with organizations obtaining central positions within the network, why not should this be more important than to be linked to many, albeit unnecessary, organizations? The quality dimension possibly induces the observed core-periphery structure of the network since this entails the organization's strategy to partner with the most central organizations within the overall network, irrespective their current centrality, even if they have already reached a central network position. Due to the problem of collinearity, the variable *group evcent*$_{sum}$ was removed from the model for the *KBBE call 2007* (model 2b). However, this does not change the results regarding the insignificance of the variable *group degree*$_{avg}$ for the *KBBE call 2007*, which aimed to explore the transition between two consecutive FPs. The observation that both network measures are insignificant is surprising. It remains unclear whether the network formation breaks between consecutive funding programs or if this observation is caused by a selection bias since some compromises were made due to manageability of the network construction. Another possible explanation for this pattern would be if the "Work Programmes" for the respective calls differs in terms of their addressed thematic priority, but there were no indicators in the outline of the programs that support this point of view. In addition to that it was check whether differences occur between the thematic priorities of the 6th and 7th FP; however, the little differences seem to be negligible. Moreover the group of experts that have evaluated the proposals of the 6th FP was not accessible. Maybe information above the organization's centrality gets lost, when it comes to a radical break regarding the member of the expert group between consecutive FP.

Similar observations were made concerning the role of the coordinator's centrality (***H2***). Two models (3a, 4a) were estimated for the *KBBE call 2013*, measuring the effect of the coordinator's network position. The finding that both centrality indicators of the coordinator's network position were found to be positive and significant might be caused by the fact that it was impossible to combine the variables into one single model, as the single model would run into the problem of multicollinearity. Otherwise, the explanatory power of the variable *coordinator degree* might have turned out to be insignificant or have a negative impact, as indicated by the model (1a), which is now possibly overestimated in model (3a), caused by the missing variable *coordinator evcent*. Nevertheless, the centrality of the consortium's coordinator is an important factor in terms of the experts' evaluation. Well connected coordinators can use their networking capabilities for the composition of a promising and well-shaped consortium, enabling the group to deliver a high quality proposal for the application process, compared to others.

The support for the hypothesis ***H3*** is overwhelming. No estimated model questions the positive effect that originates from the group's internal connection resulting from previous collaborations. To a great extent, the group's performance depends on the pre-existing relationships among the members, explained by the subgroup's network density.

[4] A quadratic influence of the variable *group degree*$_{avg}$ was also tested, but it was rejected, refusing a relation that follows an inverted U-shape.

Bilateral relations, ideally formed through personal contacts, entail a sphere of trust and familiarity among the project partners, which eases the exchange of tacit information and knowledge due to already established information channels and elaborated routines. In contrast to the centrality, the group's internal connectivity survives the regime switch between two consecutive FPs since the variable *group connectivity*$_{share}$ based on the network of the 6th FP was able to explain the experts' prioritization within the 7th FP.

The influence of the consortium's size was found to be negative for the models of the *KBBE call 2013* and insignificant in case of the *KBBE call 2007*. It seems that the coordination costs of large consortiums exceed the benefit of additional group members, due to the complexity of administrative efforts in greater groups.[5]

As theorized, the composition of nationalities represented within the applicant group affects the prioritization of the expert committee. The case of the Spanish organizations is an illustrative example. Compared to others, Spanish organizations were overrepresented within proposals for the *KBBE call 2013*, but they were underrepresented within the *KBBE call 2007* (see Table 3). This observation is reflected by the estimators for the variable *country es*$_{count}$, counting the number of Spanish organizations within the respective call. Due to their overrepresentation in the first case, the impact of the variable was estimated to be negative for the *KBBE call 2013* and positive for the *KBBE call 2007*. This tendency reflects the aim of the EU administration to consider a certain degree of balance between the member states. The parameter of the variable *thirdparty countries*$_{bool}$, explaining whether the consortium includes an international organization, was insignificant; thus, the internationalization of the program plays a secondary role or is carried out through the eligibility check.

Interestingly, the geographic distance, expressing the distance between the coordinator and the rest of the participants, has a positive, but weak impact on the evaluation score, in the case of the *KBBE call 2007*. This is contradictory since proximity is usually a key driver for organizational collaboration (Broekel and Hartog, 2013; Ter Wal, 2013). This might reflect the circumstance that there is a political aim behind the prioritization process. Constructing the ERA, the administration might favor collaborations between distant organizations to enlarge the pan-European research network. Another possible explanation is that the geographic proximity was substituted through other factors, reducing the importance of being located close to each other, such as social proximity or previous experiences (Autant-Bernard et al., 2007; Paier and Scherngell, 2011).

Less surprisingly, consortia with a large amount of previous experiences obtain higher evaluation scores. The overall significance of the variable *log experience positive*$_{count}$ proves that producing high quality proposals is an iterative learning process, triggered by a professionalization in writing submissions and preexisting communication channels to the administration. The more project or proposal submissions are accumulated by the members of the consortium over time, the better the result as explained by the learning curve.

Most surprisingly, the number of publications has a negative impact on the experts'

[5] A digressive impact of the variable was tested within an alternative model, but it was found to be insignificant.

prioritization for the *KBBE call 2013*. It seems counterintuitive that the degree of academic expertise that is related to the biotech sector should not contribute to the quality of the proposal. A possible explanation might be that the large amount of publications leads to a concentration of academic actors within the consortium, which is unintended by the administration's policy since EU tries to stimulate innovations by bringing different sets of actors together.

The awarded score value depends on the respective activity of the call for which an application has been submitted since the estimated parameters for variable *theme* II_{bool} were significant for both KBBE calls. The exact cause of this remains unclear since several effects come into question, such as a different composition of the expert group or higher requirements for the consortium.

The results for the variables measuring the size of the firm are diverging. For the *KBBE call 2013*, the variable *employee less* 250_{count} explains that a consortium benefits from each additional organization having less than 250 employees. This outcome likely reflects the fact that a large number of projects that were offered by the call in 2013 explicitly require that at last 15% of the total EU contribution go to SMEs.[6] The fact that the *KBBE call 2007* does not contain an equivalent requirement for the applying consortia potentially leads to a change in the variable's influence. The absence of the SME requirement might induce a greater influence of the economies of scale; thus, consortia with larger human resources were able to succeed against those consortia with a higher proportion of SMEs. The variable *turnover less* 50_{count} was found to have a positive influence in case of the *call KBBE 2007*, meaning that organizations with a rather low annual turnover raise the experts' evaluation score, which reduces the negative impact of the preceding variable, if the same organization falls under the definition of SMEs. If so, both effects nearly compensate for each other; thus, the SMEs are seen as somewhat neutral within the *KBBE call 2007*.

The institutional background of the coordinator does not play a role for the observed calls. The explanatory power of the parameters *coordinator university*$_{bool}$ and *coordinator research*$_{bool}$, explaining the affiliation of the coordinator to the academic or research sector, was insignificant.

The share of the experts named in the list of appropriate persons has a great influence concerning the experts' evaluation scores for the *KBBE call 2013*. Theoretically, a proposal would receive a score value of nearly 100% if the composition of the consortium consists completely of the expert group. However, the highest observed value of the variable *experts*$_{share}$ was 0.27; thus, this is only an intellectual game. As stated earlier, it remains mostly unclear what shapes this effect. Undoubtedly, the members of the expert group have rich expertise in the field of biotechnology. Thus, it is very likely that these persons are able to write high quality proposals. However, this might indicate the possibility of an existing conflict of interests, if personal relations within the group of experts have an influence on the decision-making process.

[6] An alternative model specification, using a variable explaining the number of organizations falling under the EU definition of an SME, was also tested, but the result was insignificant.

7 Conclusion

The aim of this paper was to analyze the factors that shape the formation of the pan-European research network. Therefore, the paper argues that the allocation mechanism of project grants is both affecting and affected by the formation of the research network. The allocation mechanism is a political process regulated by the EU administration, which is highly selective, and thus the resulting research network represents only one possible stage of endless alternatives. With each additional award of a project, the EC fosters the intended or unintended formation of the pan-European research network. In evaluating this outcome, several hypotheses were formulated, postulating that the project allocation is influenced by both the centrality of the consortium and coordinator within the overall research network as well as by the group's internal network configuration. Therefore, the empirical part of this paper used micro data from two FP calls that were related to the biotechnology sector, representing 4,832 organizations in 881 proposals. Several OLS models were estimated to analyze the impact of the hypotheses on the experts' prioritization, which represents the commission's basis of decision-making for the project allocation. The hypothesis ***H1***, suggesting that the network centrality of the group and the coordinator affects the experts' assessments, was supported in the case of the *KBBE call 2013* and rejected in case of the *KBBE call 2007*. An explanation for this might be that the centrality is not transmitted or forwarded between two consecutive FPs, since two different FP databases were used to construct the network for the respective calls. The idea behind this was to show that the network configuration is maintained between two different regimes, but the result does not support this point of view. The same applies to the hypothesis ***H2***, investigating whether the centrality of the coordinator plays a role for the experts' evaluation procedure, which was found to be significant for the call in 2013, but insignificant for the call in 2007. The outward-looking perspective was complemented by the result of the third hypothesis ***H3***, which focused on the internal connectivity of the group's members. Interestingly, this last hypothesis was very important for the formation of the network, as the bilateral relations are stable even between two consecutive FPs. Nevertheless, both findings, the impact of the group's centrality and internal affiliation with the prioritization of the experts, induce a feedback link between the allocation mechanism and the formation of the network during the funding phase of a single FP. The awarded projects of the analyzed KBBE calls lead to a reconfiguration of the current network state and contribute, as a result of these additional impacts, further project allocations.

The result that the impact of the centrality does not transit between consecutive FPs was surprising. A possible explanation for this pattern might be a radical break between two different FPs, for example, in terms of the research objective or the staff composition of the expert committee. Another possibility is that those projects started in the final year of the preceding FP will continue operating even if the next program has already started, so that the same relations are shared across the FPs. To evaluate whether the same observation is true for technological fields other than the biotech sector, further investigations are needed for different calls. Another interesting question would be whether the identified pattern has something in common with the "Matthew Effect" in

social networks. The effect explains the formation of an oligopolistic network structure by small starting differences that accumulate over time into a "winner-takes-it-all" network formation, due to the preference of other actors in being tied to extraordinarily embedded organizations. This contributes to the following interpretation: Small starting differences are secured between subsequent FPs by the preexisting bilateral relations, which compromise the initial network formation and the first central organizations. Due to the preference of central actors, these initial advantages accumulate over time, ending up in the formation of the oligopolistic network structure as observed by Breschi and Cusmano (2004). To buttress this presumption, further investigation is highly recommended for the empirical analysis to evaluate whether the impact of the network rises over time.

By facilitating a network that equals oligopolistic patterns, the allocation process induces several risks in European innovation policy. Too many repetitions of the same network patterns entail the risk of technological lock-ins and path dependencies, due to the homogenization of the knowledge, routines, and interests among a large fraction of the network. New incumbents are forced to the periphery of the network, from where it is difficult to get access to the promoters of new technologies. The displacement of diverse knowledge patterns decreases the chance for innovations, as heterogeneity is a key driver for both incremental and especially radical innovations. By this, the allocation process might counteract the political aim of the EC, which is stimulating the performance of the EU by helping develop new innovations. Additionally, the core-periphery network structure is likely to affect other networks, due to cross-effects between various coexisting networks, which might induce the transition of the same structure to non-target networks. This would be problematic and cause a state failure, since there is no imperfection in the market mechanisms, which would possibly legitimize a governmental intervention.

It sounds less problematic if the oligopolistic structure of the research network is unable to transit between two consecutive FPs. If so, this would ensure that in the case of a transition, the core-periphery structure becomes broken so that there is a new round in the race for the most central positions within the network.

If so, this would secure that at the latest when it comes to a phase of transition the core-periphery structure becomes broken so that there is a new round in the race for the most central positions within the network. However, the duration of the FPs has continuously risen in the past, which can indeed become a problem, since grater durations help to prevent the oligopolistic formation of the network.

To soften the automatism that seems to increase the advantage of central and well-connected organizations within a funding phase, the European commission could modify the allocation process of forthcoming project calls. That could be, for example, a wildcard for an organization that show great potential, or financial pre-submission contributions that mitigate the risk in an application. Another possibility would be that consortia have to meet a threshold, which requires that a certain amount of the funding goes to less connected organizations, similar to the basic requirement that allocates at least 15% of the funding to SMEs. Any of these suggestions can contribute political decryption of the allocation process that favors mostly central organizations.

Further research is needed, since the results of this paper only rely on two selected calls of the 7th FP, and it is questionable whether the same applies to sectors other than the biotech industry. The selection of the *KBBE call 2007* might have induced several insignificant parameters of the estimated model, since the observed variance of the score values was rather low, compared to the *KBBE call 2013*. Another interesting question might be how the allocation of the projects and the resulting network would look without the influence of the network effects. Knowing the impact of the network-related determinants it becomes possible to approximate an alternative setting of the network formation that is only shaped by non-network-related determinants. The results can help to identity alternative outcomes of the European innovation policy.

Table 4: Estimation results KBBE call 2007

	model 1b				model 2b			
variable	β	s.d.	t-value	sign.	β	s.d.	t-value	sign.
constant	43.44	4.92	8.82		44.18	4.77	9.26	
$members_{count}$	0.34	0.58	0.59		0.12	0.46	0.27	
$country\ uk_{count}$	2.13	0.84	2.55	*	2.11	0.84	2.52	*
$country\ de_{count}$	1.81	0.90	2.01	*	1.81	0.90	2.01	*
$country\ es_{count}$	1.53	0.80	1.91	.	1.59	0.80	1.99	*
$country\ it_{count}$	-0.91	0.70	-1.30		-0.89	0.70	-1.28	
$country\ fr_{count}$	2.13	0.95	2.25	*	2.09	0.94	2.21	*
$country\ nl_{count}$	3.05	1.30	2.34	*	2.93	1.29	2.28	*
$country\ be_{count}$	1.78	1.17	1.53		1.73	1.16	1.49	
$country\ pt_{count}$	-0.35	1.36	-0.26		-0.38	1.36	-0.28	
$thirdparty\ countries_{bool}$	-3.72	2.30	-1.62		-3.66	2.29	-1.60	
$coordinator\ distance_{sum}$	0.00	0.00	1.85	.	0.00	0.00	1.86	.
$log\ experience\ positive_{count}$	2.14	1.28	1.67	.	2.16	1.28	1.70	.
$log\ publications_{count}$	0.21	0.66	0.33		0.27	0.65	0.42	
$group\ degree_{avg}$	0.00	0.02	0.20		-0.01	0.02	-0.30	
$group\ evcent_{sum}$	-2.01	3.24	-0.62					
coordinator degree	-0.03	0.04	-0.98		-0.04	0.03	-1.01	
coordinator evcent	8.383	5.73	1.46		8.60	5.71	1.51	
$group\ connectivity_{share}$	17.24	9.43	1.83	.	15.05	8.73	1.72	.
$theme\ II_{bool}$	-8.27	1.86	-4.46	***	-8.28	1.85	-4.47	***
$theme\ III_{bool}$	-2.63	2.53	-1.04		-2.61	2.53	-1.03	
$theme\ V_{bool}$	4.89	17.18	0.29		7.79	16.52	0.47	
$employee\ less\ 250_{count}$	-1.37	0.66	-2.07	*	-1.33	0.66	-2.01	*
$turnover\ less\ 50_{count}$	1.132	0.65	1.73	.	1.18	0.65	1.81	.
$coordinator\ university_{bool}$	3.28	2.46	1.34		3.16	2.45	1.29	
$coordinator\ research_{bool}$	1.04	2.49	0.42		0.85	2.47	0.34	
$experts_{share}$	17.94	13.87	1.29		18.54	13.83	1.34	
Adjusted R^2	0.315				0.316			
AIC	3,345.1				3,343.5			
BIC	3,456.7				3,451.1			

Significances of the parameter: *** 0.1%, ** 1%, * 5%, . 10%.

Table 5: Estimation results KBBE call 2013

variable	model 1a				model 2a				model 3a				model 4a			
	β	s.d.	t-value	sign.	β	s.d.	t-value	sign.	β	s.d.	t-value	sign.	β	s.d.	t-value	sign.
constant	55.80	16.43	3.40	***	33.50	10.93	3.07	**	36.49	9.73	3.75	***	36.83	9.71	3.79	***
$members_{count}$	-1.42	0.59	-2.39	*	-1.35	0.59	-2.28	*	-0.40	0.40	-1.00		-0.41	0.40	-1.03	
country uk_{count}	1.00	1.05	0.95		1.15	1.05	1.09		1.74	1.02	1.71	.	1.71	1.01	1.69	.
country de_{count}	2.21	0.96	2.31	*	2.27	0.96	2.37	*	2.32	0.95	2.44	*	2.39	0.95	2.52	*
country es_{count}	-2.66	0.77	-3.44	***	-2.93	0.76	-3.84	***	-2.79	0.76	-3.66	***	-2.77	0.76	-3.64	***
country it_{count}	-0.81	0.97	-0.83		-1.17	0.96	-1.22		-1.11	0.95	-1.16		-1.07	0.95	-1.13	
country fr_{count}	1.75	0.99	1.77	.	1.99	0.99	2.02		2.23	0.98	2.28	*	2.10	0.98	2.16	*
country nl_{count}	1.45	1.09	1.33		2.24	1.08	2.08	*	2.08	1.07	1.95	.	1.96	1.07	1.83	.
country be_{count}	2.87	1.43	2.01	*	2.86	1.44	1.99	*	3.32	1.42	2.33	*	3.36	1.42	2.36	*
country pt_{count}	1.31	1.48	0.89		0.73	1.48	0.49		1.16	1.48	0.79		1.28	1.48	0.87	
thirdparty countries$_{bool}$	-4.06	3.71	-1.09		-3.45	3.74	-0.92		-4.18	3.73	-1.12		-4.32	3.72	-1.16	
coordinator distance$_{sum}$	0.00	0.00	1.43		0.002	0.001	1.44		0.002	0.001	1.63		0.002	0.001	1.64	
log experience positive$_{count}$	21.15	7.89	2.68	**	9.14	3.24	2.82	**	4.80	2.58	1.86	.	4.72	2.57	1.84	.
log experience negative$_{count}$	-13.17	7.78	-1.69	.												
log publications$_{count}$	-3.53	1.51	-2.33	*	-3.88	1.50	-2.58	*	-3.19	1.47	-2.17	*	-3.22	1.47	-2.20	*
group degree$_{avg}$	-0.04	0.01	-2.54	*	-0.03	0.01	-2.26	*								
group evcent$_{sum}$	4.48	2.45	1.83	.	4.10	2.42	1.70	.								
coordinator degree	-0.002	0.01	-0.31						0.004	0.002	2.44	*				
coordinator evcent	19.81	15.54	1.28										14.43	5.08	2.84	**
group connectivity$_{share}$	17.94	9.39	1.91	.	20.94	9.39	2.23	*	20.68	8.50	2.43	*	19.72	8.50	2.32	*
theme II$_{bool}$	-13.76	3.71	-3.71	***	-15.17	3.67	-4.14	***	-14.17	3.63	-3.91	***	-13.63	3.63	-3.76	***
theme III$_{bool}$	3.83	3.49	1.10		3.41	3.49	0.98		3.62	3.47	1.04		3.87	3.47	1.12	
employee less 250$_{count}$	1.53	1.28	1.19		1.40	0.62	2.26	*	1.18	0.56	2.12	*	1.21	0.55	2.18	*
turnover less 50$_{count}$	-0.065	1.16	-0.06													
coordinator university$_{bool}$	-4.35	3.73	-1.17		-0.97	3.41	-0.28		-2.32	3.48	-0.67		-3.77	3.58	-1.05	
coordinator research$_{bool}$	-2.62	3.75	-0.70		1.66	3.46	0.48		-1.62	3.73	-0.43		-2.20	3.73	-0.59	
experts$_{share}$	91.59	34.01	2.69	**	93.83	34.32	2.73	**	91.14	34.26	2.66	**	90.56	34.18	2.65	**
Adjusted R^2	0.29				0.28				0.28				0.28			
AIC	4,181.4				4,186.5				4,183.9				4,181.7			
BIC	4,296.0				4,284.7				4,278.0				4,275.8			

Significances of the parameter: *** 0.1%, ** 1%, * 5%, . 10%.

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