Logics of integration and actors' strategies in European joint programs

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Abstract. This paper analyses how the interaction between social institutions on the one hand and actors' strategies and interests on the other hand is shaping European integration in research policy. We specifically focus on the implications of the existence of different conceptions of European integration (logics) on the emerging landscape of research funding programs jointly managed by the European Union (EU) and National States (*joint programs*). Our results display the central role of the introduction of a logic of coordination by the EU; it created a breeding ground for a new generation of programs and, at the same time, allowed to make the integration model more flexible and acceptable to National States (as funding became only virtually integrated). Most newly created programs were characterized by largely symbolic commitments and very small budgets, while stronger commitments had to be constructed through successive steps of integration. This process was highly selective and dependent on the presence of strong interests from the research community; additional funding from the EU was critical to ensure stability of national commitments. Further, National States by large delegated to independent funding agencies the management of national participations: delegation allowed to achieve greater homogeneity among national participants, but also to decouple decisions to participate (driven by compliance to institutional pressures) from the level of resources to be committed (driven by national interests). While in the year 2000, the European Research Area (ERA) strategy of coordinating national research policies was largely an empty concept, our case study shows how in the following decade, it was filled in with specific experiences and practices, led to the redefinition of actors' understanding of European integration and roles in European research policies and, ultimately, to the emergence of original models of integration.

Keywords. European integration, institutional logics, actors' interests, European research policy, joint research programs

1 Introduction

Since the launch of the European Research Area (ERA) strategy in 2000, increasing the integration level of European research has become a central focus of European policy (Luukkonen and Nedeva, 2010), mirroring similar processes in other policy domains (Marks et al., 1996). This shift can be interpreted as an attempt to overcome the limitations of the policies developed in the 1980s and 1990s which focused on the establishment of European Framework Programs (FP; Banchoff, 2002, Trondal, 2002). It can also be interpreted as the recognition that a model of integration, where all competences (and the relative budgets) are transferred to the European level, was not endorsed by national actors and thus coordination of national research policies was required (Edler et al., 2003).

In the following years, instruments towards integration were introduced in different layers of the research policy system. In the policy layer, the adoption of the Open Method of Coordination (Borrás and Jacobson,

2004) aimed at coordinating European and national research policies, while in the performers layer, European networks of Excellence have been launched to structure research fields (Luukkonen et al., 2006) and initiatives have been undertaken to coordinate large-scale research infrastructures through the European Strategy Forum for Research Infrastructure.

This paper aims to investigate integration processes in the funding layer –concerning the establishment of what we call *joint programs,* i.e. research funding programs which are jointly managed by more than one country (possibly with the participation of the European Union). Historically, the first examples of these programs were created in the 1950s and 60s in order to achieve critical mass in domains where the resources of individual European countries were not sufficient to compete with the United States, like in nuclear energy (Euratom in 1957) and space (European Space Agency – ESA - in 1975); they were based on international treaties and managed by an international agency receiving resources from participating countries and funding directly national performers. From the 1970s, a second set of programs was created, with a broader scientific scope and a focus on networking (Gronbaek, 2003); the design and selection functions were delegated to a supranational agency, while funding was managed at the national level without trans-border flows of funding. The European Cooperation in Science and Technology program (COST; created in 1971), the European Science Foundation (ESF; 1974) and Eureka (1987) belong to this group (Guzzetti, 1995).

Beginning in 2000, the European Union (EU) introduced a number of schemes promoting cooperation between national funding policies. As part of the European Framework Program, the EU supported so-called ERA-NET initiatives, which were conceived as variable geometry instruments for coordinating national funding policies. Further, article 185 of the European Union Treaty allows the EU to participate and co-fund research funding initiatives, which are jointly undertaken by several member States (so-called Article 185 initiatives). More recently, Joint Technology Initiatives (JTI) have been launched as long-term public-private partnerships in order to support large-scale multinational research projects in areas of major interest to European industry and society (Brummer et al., 2008).

We specifically deal with two characteristics of integration in joint programs, their distributed and multi-actor setting on the one side, the presence of different *institutional logics* (Thornton et al., 2012) on how integration should take place on the other.

Studies of European policies have recognized the multi-level and multi-actor nature of European governance (Edler and Kuhlmann, 2011,Kuhlmann, 2001) and that actors have different interests and identities which interact during the policy process; hence both the existence of a 'change champion' and the ability to overcome resistance from key actors is required for the establishment of European instruments (Nedeva, 2012). In this respect, joint programs represent a highly decentralized setting where, under the variable geometry approach introduced by the European Commission, actors' networks can be flexibly constructed around specific programs and interests.

In turn, studies in the neo-institutionalist tradition consider social institutions to be central to policy processes; they frame and shape actors' behavior (March and Olsen, 1984,Bulmer, 1994), while also driving resistance to change and path-dependency (Pierson, 2004). These studies underline the lasting heritage of institutional structures, revealing that EU research policy was locked into a specific model and actors' constellation around the FP programs (Banchoff, 2002).

Bridging these traditions towards a more systematic understanding of the interaction between institutions and actors in shaping European policies is clearly relevant (Aspinwall and Schneider, 2000; Caporaso and Sweet, 2001).

We focus on the implications of *institutional pluralism*, i.e. the presence of fundamentally different conceptions (*logics*) concerning what European integration should be at both a general level (Schmitter, 1996) and in research and innovation policy (Kuhlmann, 2001). These suggest different models concerning the competences to be transferred at the European level, details on how joint activities should organized, and the role of national actors (Edler, 2009,Barré et al., 2012).

Accordingly, joint programs represent an ideal setting where competition between institutional logics and their interaction with actors' strategies can be observed. Unlike the creation of a funding agency, entry costs are relatively low and programs can be light settings which do not necessarily require high level of investment and long-term commitments. However, selection and retention are expected to depend on the level of endorsement by relevant actors – specifically those who control a significant share of the research funding budget –generating a situation where growth in terms of budget is highly selective.

We address the following questions: first, do we observe the emergence of patterns in joint programs, which can be related to underlying models of European integration? More interestingly, to which extent do actors' interests lead to hybrid programs combining different models? Second, can we understand the program's selection and retention process as an outcome of the interaction between the characteristics of the institutional model and actors' interests? Can we identify some characteristics that lead individual programs to grow to a sizeable budget? Finally, can we anticipate implications for the development of joint programs and for the integration of national research policies?

Our investigation is based on a dataset covering roughly 90 programs in 11 European countries, including information on their organization, budget, national participation for the year 2009, as well as data on budgets since 2000.

The paper is organized as follows. Section 2 develops our theoretical framework around the institutional logics approach and introduces our hypotheses and research questions. Section 3 describes the dataset and the methodology, while section 4 presents the results concerning characteristics of joint programs, patterns of actors' participation, and the evolution of budgets. Section 5 discusses of the results in the context of European research policy.

2 Integrating institutions and actors in the European context

While early sociological institutionalism argued that actors' behavior is driven by compliance to codes of appropriate conduct provided by social institutions rather than by their interests – more recent work has attempted to provide a more balanced account of agency (Greenwood et al., 2008). The central role of institutions in framing and enabling behavior is recognized – actors have at their disposal a limited set of culturally conceivable and legitimate choices, while their interests are themselves socially constructed. However, especially when there is ambiguity and pluralism in the institutional context, compliance is likely but not automatic, and actors' responses are driven by their characteristics and interests as well (Thornton et al., 2012).

We conceive the relationships between institutions and actors as a recursive one, where institutions frame and embed current actors' behavior, while actors engage actively in the institutional design shaping and reproducing those institutions which will frame their future behavior (Scott, 2008,Mahoney and Thelen, 2010). We are interested in explaining how – from social norms and rules concerning European integration – specific models for joint programs have been constructed, as a part of the broader process of institutionalization of the European space (Sweet et al., 2001).

2.1   Institutional logics in European integration

Sociological institutionalism comes up with a thick conception of institutions, which not only include rules constraining behavior, but also cultural and cognitive models shaping the way actors represent the reality and defining legitimate practices (Meyer and Rowan, 1977). Early institutional theory emphasized the internal coherency of institutional systems and their stability across time, driving to isomorphism (DiMaggio and Powell, 1983).

More recently, it has been recognized that most organizational fields are characterized by the coexistence of different *institutional logics*, stipulating alternative ways of organizing social life (Friedland and Alford, 1991). Institutional pluralism has key implications for agency, practices, and institutional change (Scott, 2008). On the one hand, the co-existence of different logics creates ambiguity concerning behavior, leading to hybridization and to the continued emergence of new practices (Lounsbury, 2007; Kraatz and Block, 2008). On the other hand, the prevalence of competing logics in a field will be historically contingent and is likely to be driven by a specific actors' constellations, creating room for institutional agency (Thornton and Ocasio, 1999).

A useful way to analyze implications of institutional pluralism is to devise a number of ideal types, which identify the main conceptual alternatives available to actors (Thornton and Ocasio, 2008). Types are not just cultural frames of reference, they also include normative and regulatory dimensions, like stipulations on how joint programs should be organized, which functions should be integrated, how their budget should be managed, and thus specify general models of integration for the domain at hand. Importantly, types are analytical models and not descriptions of observed programs, even if empirical data might provide useful information to design them.

We construct three ideal types for joint programs building on alternative conceptualizations of European integration (Edler and Flanagan, 2011; Schmitter, 1996).

The *integration logic* refers to the transfer of competencies to a higher institutional level (table 1). This type is related to accounts of European integration as transferring competences from the national to the European level, by creating a common governance structure (the *State/federation model*). In research and innovation policy, it corresponds to a centralized scenario, where decision-making arenas are established at the European level and the role of national policy is strongly reduced (Kuhlmann, 2001).

Three main rationales underpin this logic: first, achieving critical mass in domains where national programs cannot; second, promoting competition among research performers by enlarging the market; and third, favoring research collaboration through transnational projects. In terms of program organization, this type foresees the transfer of all program functions, including funding, to a supranational entity. The origins of this logic can be traced back to the early steps of European integration; it's ancestors are EURATOM (1957) and the European Space Agency (1975).

At the other extreme, *collaboration* implies that national partners work together on a specific funding scheme, without delegating decisions concerning policies to a supranational body. This logic is related to a decentralized scenario of European integration ("*condominio* model"; Schmitter, 1996; Kuhlmann, 2001). Its rationale is to strengthen the national research basis through collaboration. This logic foresees collaboration between national funding bodies on specific activities, with each retaining control over evaluation, selection, and funding decisions, but matching takes place by funding projects selected by both parties. Collaboration is *ad hoc* (for a specific activity) and *one-off* (for a limited time). The first ancestor is the French-German cooperation in transport research DEUFRAKO (1978).

Coordination means bringing together different elements to form a lasting relationship (Edler and Flanagan, 2011). This goes farther than collaboration towards a mutual alignment of funding policies; to this aim, some forms of integration might take place – like the creation of joint bodies or consortia - but without implying that these take over national competences. This logic is related to scenarios of European integration emphasizing the diversity of national and regional spaces and conceptualizing S&T policies as multi-actors and multi-level spaces, where National States, the EU, and funding agencies interact, compete, and agree on joint actions (Kuhlmann, 2001). The rationale is to value and exploit the complementarities between national systems and to seek coordination where it provides added value. In funding policies, this logic is related – *but not limited to* - joint programming initiatives by the European Union, like ERA-NETs, adopting a variable geometry approach where national states can decide levels of commitments (European Commission, 2008).

[table 1 about here]

2.2   Shaping the domain of joint programs

The pressure to develop joint programs originates from broader internationalization tendencies in the research system itself, in the economy and society (Nedeva, 2012). This includes research communities, given the internationalization of research and the need to achieve critical mass in specific domains; industry, given the internationalization of the economy and the need to achieve better European collaboration for technological development in order to respond to competition from the United States, Japan, and recently, emerging countries; finally, public administration and society, since European integration also requires the development of common solutions and standards. Actors in these fields are expected to exert pressure on research policies in order to introduce funding schemes which respond to internationalization needs *in their respective domains* (figure 1*)*.

Further, once some level of institutionalization of European policies is achieved (in research policy and in general), European institutions will themselves exert pressure to further promote Europeanization both through normative pressures and through specific actors who are interested in strengthening the European level – such as the European Commission and other European funding agencies (Sweet et al., 2001) – thus leading to self-reinforcing mechanisms and path dependency.

 [figure 1 about here]

To respond, actors are expected to resort to the legitimate models available in the domain. This process will not simply imply adopting ideal types: on the one hand, ideal types do not fully specify how programs should be organized and managed – the integration type requires transfer of competences to the supranational level, but does not specify which kind of supranational structure should be created. On the other hand, the presence of different legitimate types allows actors to blend characteristics of more than one type if this bears advantages – in terms of program functionality, matching their interests and identity, and getting the endorsement of other actors. Accordingly:

H1. We expect that joint programs can be referred to the three ideal types identified, but we also expect that hybrid programs blending characteristics of more than one type will emerge.

2.3   Participation profiles and actors' roles

We expect variations in the responses of individual actors following different mechanisms (Greenwood et al., 2008).

First, actors occupy different positions in organizational fields implying different roles, normative pressures, constraints, and positions in the actor networks (Davis and Greve, 1997). Second, they will try securing the

critical resources required for their operations (Pfeffer and Salancik, 1978) and protecting their technical core from institutional requests which run counter their interests - decoupling, i.e. adopting purely symbolic actions might not be always possible (Meyer and Rowan, 1977). Third, compliance is more likely when institutional pressures are aligned with the actors' history, mission, and norms (Greenwood et al., 2008, Kostova and Roth, 2002): thus actors will be selective towards those programs aligned with their identity and mission.

We specifically focus on political actors – the European Union and National States – and on funding agencies. Traditionally, their relationship has been represented in terms of delegation, with the State defining policy goals and agencies executing implementation tasks (Braun, 2003). Hence, it is important to differentiate the analysis by task in order to understand their respective roles in joint programs.

Launching a program is a largely political and symbolic act, but does not necessarily require a significant investment of resources. Accordingly it should be driven by two main rationales: promoting actors' representation of European integration on the one hand, signaling compliance to the institutional pressures the actor is subject to on the other hand. We expect that political authorities are the main actor, with the European Union launching programs near to the integration type, and National States near to the cooperation type (as they are rooted in a tradition of national sovereignty and promoting national interests). Since the tendency of agencies to behave as policy actors on their own has been demonstrated especially for research councils (Slipersaeter et al., 2007), we foresee some role of the latter in launching programs as well.

Joining an existing program is a less engaging decision on the symbolic and financial side. For European-level initiatives, the joining of additional countries increases their legitimacy even without financial commitments. Accordingly, a share of purely symbolic participation (without a budget) is also expected since this would also be in the interest of the other participants. The number of countries is expected to grow when programs are more established (for example having a supranational agency) and when commitment from the EU is strong (top-up funding) – both due to isomorphic pressures and national interests.

For bilateral programs, joining is likely to be considered as free riding if no additional resources are provided; since it does entail advantages in terms of legitimacy – bilateral programs do not need to be covered in most European countries. Accordingly, we expect this behavior to be discouraged, and thus less frequent.

Since the delegation of program management to independent agencies is a general phenomenon characterizing research policies in European countries (Lepori et al., 2007, Nedeva, 2012), we expect that the *management of national participation* is largely delegated to agencies. Delegation might also allow national states to decouple symbolic behavior (participation) from effective commitments (resources), by leaving the decision concerning the level of participation and budget to the agency.

Moreover, funding agencies tend to be specialized by research policy goals - distinguishing between science-oriented agencies (research councils), innovation-oriented agencies, and sector agencies focusing on policy domains (Lepori et al., 2007): thus, the choice of the agency is likely to be driven by the specific program domain. On the contrary, bilateral programs are promoted by specific national actors (research ministries, funding agencies) and thus it is expected that they play a stronger role in managing participation as well.

Accordingly:

H2. Actors display different roles and participation profiles to programs which are revealing of the correspondence between their interests and position in the field and the characteristics of the programs.

2.4   Resources and the growth dynamics of joint programs

While we anticipate that establishing and participating in joint programs might be largely symbolic – to demonstrate compliance and witness on-going developments, the decision to commit financial resources is expected to be more selective and related to the presence of strong interests, since budgets are scarce and critical for achieving policy goals (Braun, 2003). Accordingly,

H3. We expect a very skewed distribution level of resources among joint programs with some types of programs displaying a higher level of budget, as well as stronger growth with time.

First, a significant investment of resources in joint programs depends critically on mutual commitments by National States – if only a single country commits resources, the program goals cannot be achieved. One option would be legal commitments (for example through international treaties), but this will be exceptional, as National States would then lose control of their budgets. Softer commitments can be sustained by social norms promoting cooperation associated with the integration (and partially coordination) logic, by the creation of lasting integration structures (for example agencies), and finally, by financial incentives generated by EU top-up funding. We then expect large programs in terms of budget, to be associated with these characteristics.

Second, joint programs cannot be established unilaterally by a single actor – like the European Union for the European Research Council (Nedeva, 2012) - , but requires mutual commitments between the European Union, National States, and funding agencies. Given the high degree of uncertainty, this negotiation process is likely to start with low levels of integration and commitment of resources, and then, if it works and trust can be constructed, ultimately the process will move towards stronger forms of integration and a larger amount of resources. We then expect that successive steps of integration characterize successful programs.

Third, moving along this path should depend on two conditions: first, the successful completion of the previous phases of integration, in terms of national commitments and the functionality of the program; second, the presence of strong interests ("change champions"; Nedeva, 2012) who push for further integration. The relevant actors in this respect are expected to be the research community for science-oriented programs (like in the case of the establishment of the European Research Council), and the industry for technological-oriented programs (industry was one of the main actors pushing for the development of the EU FP; Banchoff, 2002).

Given lasting differences in national research systems and policies, this process is likely to be selective, with only a few countries displaying strong interests in a given domain – interestingly, this is likely to make reaching an agreement easier, as no overall European consensus is required. We then expect large joint programs to be characterized by a restricted core of countries promoting them and providing most of the resources, with other countries joining with lower levels of engagement and at a later stage.

3   Methods and data sources

The dataset was collected in a project commissioned by the European Union, which provides for the year 2009 a census of joint programs in 11 European countries (Czech Republic, Denmark, France, Germany, Italy, Netherlands, Norway, Poland, Switzerland, Spain and the United Kingdom). Since these countries

cover about 85% of the total ERA public research funding, the results can be considered as fairly representative of the European landscape.

The perimeter includes programs funding research through open calls for proposals – excluding national collaboration schemes only allocating means for travel and coordination purposes, as well as direct cooperation between large research organizations. Programs managed solely by the EU, like framework programs, are excluded as well, while both European Union initiatives (like ERA-NETs) and bi- and multi-lateral cooperation between National States (including countries outside the ERA) are covered.

For each program a set of organizational descriptors has been collected, based on a closed list of categories to allow for systematic comparisons. Data has been collected by national experts, validated, and crosschecked by the project team and integrated into a relational database. A few programs have been excluded from the analysis because of incomplete information.

We hold information on the start date of each program. We consider programs with status changes (like ERA-NETs becoming ERA-NET plus) to be single programs; the change event has been coded specifically to analyze program dynamics (see section 4.4).

Program characteristics. We make use of three descriptors that detail how programs are organized and which functions are integrated. The *organizational structure* (1) characterizes how common program activities are organized. Four categories are defined: *agency*, when a supranational agency has been created with an enduring status; *coordination*, when joint activities are managed by non-permanent structures, like joint committees, whose existence is specifically related to the program itself; *delegation*, when the management of the joint activities is delegated to a national agency in one of the participating countries; *independent selection* when evaluation and selection are done independently and the project is approved if all parties decide to finance it. The *funding model* (2) describes how program resources are managed. In the *common pot*, resources are managed by a supranational agency, whereas in the *national pot,* resources are managed by national agencies. Furthermore, we identify those programs for which there is *European Union top-up funding* in addition to national contributions. The *submission procedure* (3) identifies whether proposals have to be submitted to a single agency (*single entry-point*), or at the same time to agencies in the different participating countries (*parallel submission*).

Program domain. We classify programs by their policy goals – using the standard Nomenclature for the Analysis and Comparison of the Scientific Programs and Budgets (NABS) of the Frascati manual (OECD, 2002). We distinguish between three categories (Lepori et al., 2007); general-purpose and science-oriented programs (program covering all categories and general advancement of knowledge), policy-oriented programs (environment, transport, education, etc.) and industry-oriented programs (industrial production and technology; space).

Actors' involvement. We first identify the *actors which officially created a joint program* through some kind of legal decision – distinguishing between the European Union (all initiatives decided under the FP), National States, when programs are established by a treaty – and funding agencies, when the program was established through an agreement between agencies. *National participation* identifies whether the country participated in the program in the year 2009. Data has been derived from program descriptions, Websites, and inventories like NETWATCH; from data on the national budget by program, we further identify participations without funding commitments. The same sources provide information on *funding agencies participating* in each country. For comparative analysis, agencies have been classified by distinguishing between ministries (research ministry and sectorial ministries), independent agencies (research councils, innovation agencies, and sector agencies) and public research organizations.

Program budget. Data on funding flows were collected for the period 2000-2009, including information on the country's origin of funding and the funding agency receiving it. Data is based on 2009 perimeter: thus the dataset does not include past programs which have been terminated – we do not expect this to significantly affect our figures. The share of non-available data is higher than for descriptors (18%, 12% for 2009). This data allows for the calculation of the *total program budget* for each year, its evolution over time, and the repartition between European and national sources.

Methods. Given the size of the sample, we employ descriptive statistics by constructing groups of programs with specific characteristics, as well as cross-tables between different dimensions. We generally prefer medians for budget distribution, as well as for age, since the distribution of these variables is quite skewed. For hypotheses testing we employ non-parametric methods for comparing medians which are more robust against non-normality (Mann-Whitney and Kruskal-Wallis). We use chi-square test for contingency tables when its assumptions are satisfied (all expected counts>1 and less than 20%<5); otherwise we use the Fisher exact test. The corresponding null hypotheses are that distributions (or medians) are the same for the compared groups, respectively that distribution of cell counts in contingency tables are the product of rows and columns marginal (and hence there is no significant association between the considered variables).

4   Results

4.1   An overview of joint programs

The dataset includes 91 programs, whose total funding volume in 2009 was 3.461 billion Euros, i.e. 3.42% of public research expenditures in the considered countries (table 2); 23% of funding was provided by the European Union, while the European Space Agency alone accounts for three-quarters of the total budget.

42 programs can be characterized as European initiatives, in principle open to all European countries – including programs in the framework of EU policies, like ERA-NETs and JTIs and intergovernmental programs like ESA, COST, and Eureka – and 49 as bilateral initiatives among two or smaller groups of countries.

[table 2 about here]

In terms of *organization*, 14 programs are managed by a supranational agency, 64 by coordination through a joint committee, 6 by delegation, and 7 by independent selection. In terms of funding model, 6 programs are characterized by common pot (2 of them with EU additional funding), 13 by national pot plus EU common funding, and 72 by purely national pot. Most programs are characterized by single submission (62).

Only 7 programs were created before 2000 – the oldest being COST (1971) - 27 programs between 2000 and 2005, and 57 in the years 2007-2009, thus documenting the growth seen after the launch of the ERA. In the period between 2000 and 2009, the total budget of joint programs more than doubled (+119%); excluding ESA, it increased from 34 million Euros in 2000 to more than 800 million in 2009, and more than doubled between 2007 and 2009 (this increase might have been somewhat exaggerated by missing data in earlier years).

36 programs were classified as generic (all topics) or oriented towards the advancement of knowledge (investigator-driven programs), while the rest could be attributed to a specific policy domain, mostly industrial production (20 programs), health (14), and environment (8). In terms of funding volume, the industrial domain accounts for two-thirds of the budget; industry-oriented programs largely support

research in the private sector, whereas the two other groups are mostly oriented to public-sector research (table 3).

[table 3 about here]

4.2   Identifying groups of programs and their relationships to ideal types

Descriptive analysis displays associations between organizational characteristics, which allow for the identification of seven groups of programs (table 4). Namely, all programs with agency and delegation are characterized by a single entry-point, whereas all independent programs are characterized by parallel submission. Common pot programs and programs with EU top-up funding are found only among programs with agency or committee. These associations are statistically significant against a random distribution of organizational characteristics (Fisher exact test $p < 0.05$ between organization and funding, $p < 0.001$ between organization and submission, $p < 0.01$ between organization and EU top-up funding).

We classify three ambiguous cases - two programs with committee and common pot and one parallel program with single-entry point – based on their organizational structure, which we consider as a more lasting feature of programs.

[table 4 about here]

Only four programs correspond to the ideal type of integration, where all competences are transferred to the supranational level. Three are between groups of countries in the same geographical or cultural region, namely the Nordic cooperation, the Visegrad Funding between Central European Countries and the Iberoamerican program on Science and Technology for Development. ESA remains an exceptional case in the European context, which should be explained by the characteristics of the field, namely the high level of investment required and the level of internationalization of the research community- at the European level no other fully integrated programs have been established except those financed solely from the European budget (European Framework Programs; European Research Council).

The second group can be characterized as a hybrid where integration takes place for all functions except funding, which is coordinated among participating countries (figure 2). 7 out of 10 programs receive additional EU funding, and half of them are industry-oriented. This group includes four article 185 programs (Ambient Assisted Living, Clinical Trials, Metrology, Eurostars), and two Joint Technology Initiatives (ARTEMIS and ENIAC), as well as two programs created in an intergovernmental framework, which developed strong linkages to European policies: COST has an official partnership and is co-funded by the European Union, whereas Eureka manages the EUROSTARS program. Only the two European Science Foundation programs are unrelated to EU policy and do not receive EU funding; interestingly they were closed in 2012.

The 41 programs with a committee and single entry point are near to the coordination type: competences are transferred to the supranational level concerning the design of calls, submission, and evaluation, while funding is coordinated between national agencies; the transfer of competences is limited in time and managed on *ad hoc* basis. Most are ERA-NETs, but this model has been adopted for bilateral cooperation as well; these programs display a stronger focus towards policy-relevant issues and (to a lesser extent) science. Among them, we separate a subgroup of ERA-NET plus programs, to which the EU grants top-up funding in exchange for stronger national commitments – with at least five countries agreeing to commit resources for a joint call.

[figure 2 about here]

Independent programs are near the ideal type of collaboration, where there is no transfer of competences or coordination; a larger group is composed by programs with some level of coordination –submission and evaluation are done in parallel, while a joint committee coordinates national funding decisions to ensure that both partners receive resources.

Finally, delegation programs represent a specific setting where operational coordination is achieved by delegating submission, evaluation, and funding decision tasks to one participating agency, under the (restrictive) condition that funding policies are already aligned by the similarity of national funding schemes (and thus where coordination is not required concerning funding policies, evaluation criteria, etc.).

This descriptive analysis shows that while ideal types are a useful analytical tool to represent the space of alternatives, no dominant group can be observed (at least regarding the number of programs) and a large deal of blending between types takes place. To better understand the underlying processes and the functions in the ERA, we now turn to an analysis of the actors' constellations behind groups of programs.

4.3   Analyzing actors' roles

Table 5 presents data supporting our hypotheses on the role of actors in *launching joint programs*.

[table 5 about here]

First, we do not observe historical layering by type and thus there is no indication that a single logic is becoming dominant (in terms of *number* of programs): in all groups more than half of the programs were founded after 2006 - committee programs with EU top-up funding (the ERA-NET plus scheme introduced in 2007) and delegation programs between funding agencies being the most recent. The exception are fully integrated programs (including funding): only one program in this group was launched after 2000, namely Nordforsk. Full integration with national contributions was an important model before the launch of the ERA (2 out of 7 programs established before 2000), but it was no longer significant afterwards.

Second, after the launch of the ERA, the European Union emerged as a central actor with 37 out of 84 programs established after 2000. National States were the only relevant actor before (6 out of 7 programs before 2000), but kept an important role afterwards (22 programs after 2000). Their roles are distinct: the European Union focused on initiatives with a higher level of institutionalization in the coordination-integration logics, whereas National States transitioned to lighter initiatives oriented towards collaboration. Importantly, the advent of the ERA marked a deep change in the role of the latter, since 4 out of 7 programs established by National States until 2000 were agency programs.

Research councils are a third emerging actor – 18 out of 26 programs established by funding agencies are agreements between councils. Other types of agencies (innovation, sector agencies) remain bound to the role of managing programs as delegated by National States. Expectedly, they mostly focus on establishing science-oriented programs (18 out of 26 programs) and are somewhat more oriented towards coordination – probably less bound to a strict definition of national interests, and more subject to pressures from research communities to develop international coordination. On the contrary, no significant associations are found between program domain and programs established by EU and National States, thus demonstrating that models of European integration, rather than characteristics of fields, are driving their founding behavior.

As expected, European initiatives display a larger *number of country participations* than bilateral programs and their number increases from committee to agency programs (to which all JOREP countries participate), consistently with the increase of institutional pressures and incentives from EU top-up funding (see also table 7). Most bilateral programs have a single JOREP country participating (together with other countries

non covered by JOREP), showing that participation is selective. 35 out 49 programs (and 20 out of 26 in the collaborative area) are with non-ERA countries (mostly China, USA, Canada, Japan and India).

Data confirms the high level of delegation of *program management* and, accordingly, emphasize the central role of independent agencies in joint programs: 70% of national participations are managed by independent agencies or research performers, the only countries where ministries account for more than half of the participations are, the Czech Republic, Italy, and Spain (table 6). In more than half of the participations (accounting for about 60% of the funding volume), the decision on the budget allocated to the program is delegated to the agency as well. National States do not simply delegate to agencies managerial tasks, but also the decision on the level of resources to be committed.

[table 6 about here]

Expectedly, program domain and agency participations are associated with a stronger presence of research councils in science-oriented programs, sector agencies, and ministries in policy programs and innovation agencies – confirming that the selection of the agency is largely driven by the alignment between agency mission and program domain.

There are also differences related to establishing authority: among programs established by National States, the share of participations managed by ministries is higher than average (31% against 13%; the difference is statistically significant, chi square test, $p<0.001$). These programs are likely to be considered as part of the foreign research policy and thus tend to be more located at the ministerial level. Second, programs established by funding agencies are essentially managed by research councils.

Some patterns are also related to differences in the organization of national research policies, where similar functions are allocated to different bodies – for example, participations from research ministries and PROs to science-oriented programs are mostly from countries without a research council, where either the research ministry (Spain; Cruz-Castro and Sanz-Menéndez, 2007) or PROs (Italy; Potì and Reale, 2007) assume this function. Analyzing the impact of specific national structures on participation to joint programs is another relevant issue which could be investigated using this data (Reale et al., 2013).

We summarize our findings by distinguishing between three groups of programs.

First, the programs in the integration-coordination area are situated in the ERA space, they are promoted by the European Union, while national participations are mostly delegated to agencies with a specific mission in the program scientific domain – stronger levels of institutionalization translate into a larger number of countries participating. Delegation of tasks to agencies implies that, despite national differences in the organization of research policy, there is some level of homogeneity in the characteristics of agencies participating in individual programs, associated with their policy domain. Importantly, agencies and not National States mostly decide on the commitment of resources.

Second, programs established by National States are oriented towards the collaboration logics; consistently, they are limited to a few countries - collaboration would be difficult to apply with a larger number of participations - and focus on countries outside the ERA, where there is no specific pressure for integration coming from European institutions and the differences between national systems are larger. As instruments of foreign policy, they are to a large extent directly managed by the ministries.

Finally, research councils are becoming an actor on their own in joint programs, specifically in science-oriented programs. The attempt to create their own European funding agency with the establishment of

the European Science Foundation in 1974 did not lead to the expected results, since many national research councils perceived the procedures to be too complex. Furthermore, the research councils were not willing to commit resources to joint programs managed by the ESF, meaning its two main funding schemes were closed down in 2012. More recently, national research councils have established joint programs through bilateral agreements with the participation of a smaller and more homogeneous group of countries. Novel forms of coordination are then introduced, such as lead-agency agreements, which do not require the transfer of competences to the supranational level, but instead leverage mutual trust and similarities between the agencies' organization and funding policies.

4.4 Budget and evolution across time

Since ESA represents an exceptional case accounting for three-quarters of the total budget, we exclude it from the following analysis.

As expected, budgets are highly skewed: the median in 2009 was only 2.3 million Euro, whereas the 10 largest programs accounted for 72% of the total - the Gini coefficient being 0.79. Among the 90 programs in the dataset, only 25 were larger than 5 million Euro, while 27 were below 1 million and thus can essentially be considered as symbolic.

[table 7 about here]

Table 7 confirms that levels of integration and EU commitment are strongly associated with budgets. Medians of program budgets for 2009 are significantly different between groups of programs ($p < 0.001$ Kruskal-Wallis two-tailed test) and between programs with and without EU funding ($p < 0.001$, Mann-Withney two-tailed test). On the contrary, there is no evidence of an impact on program age: the two largest programs in the dataset are old (ESA, 1975 and Eureka, 1985), but the median budget in 2009 of programs created in the period 2000-2005 is *lower* than those in 2006-2009, the difference being insignificant (Mann-Withney two-tailed, $p > 0.1$). Furthermore, there is no evidence of an influence of the type of agency participating in the budget – programs with participation of research councils (which have larger total budgets) are not significantly larger than the average. There is however, some (weak) association with program domain, with 6 out of the 10 largest programs being industry-oriented, which might reflect that European-level networks have been preferentially constructed in this domain through FP.

Most of the resources are concentrated on agency programs without the integration of funding, characterized both by strong integration and high levels of EU additional funding (reaching 50% of the total budget for programs like AAL or Joint Technology Initiatives). Smaller budgets and a lower share of EU funding characterize the group of committee programs with EU top-up funding, while programs belonging to the other groups are much smaller on average. Ranking programs by budget in 2009 provides similar results, with agency programs without integration of funding coming at the top of the list, followed by the committee programs. The last four groups are composed mostly of programs with very small budgets, alongside a few programs accounting for most of the funding volume. Consequently, European initiatives (including COST and Eureka) account for more than 80% of the total budget: in terms of volume, joint programs are essentially a phenomenon related to the ERA.

The analysis of growth is more difficult as most programs are recent and data for the past are less complete; a comparison between budgets for the years 2006 and 2009 displays a general increase in the median size of individual programs, as well as in the total amount of funding for all groups. The increase is larger for the agency and committee programs, which account for most of the growth in the total resources devoted to joint programs. Once they are institutionalized, programs grow more rapidly in terms of budgets, leading to the observed high level of skewedness of program budgets.

The analysis of the ten largest programs in the dataset is informative of the mechanisms driving this process. All of them are European-level initiatives, 7 are integrated programs without integration of funding, 2 committee programs with EU top-up funding, and 1 a committee program without integration of funding, namely the EUROTRANSBIO ERA-NET.

Eureka and COST, as well as the EUROSTARS program managed by Eureka, are broad umbrella initiatives predating the ERA, but displaying a steep growth - the budget was multiplied by 11 times for Eureka and 5 times for COST from 2000 to 2009. The reason of their success can be traced in their broad scope, being containers providing a framework for individual initiatives (Eureka clusters and COST actions) related to generic forms of collaboration (public-private collaboration, respectively networking). The existence of a stable setting based on intergovernmental agreements allowed them to function as catchments for integration needs generated by the ERA. However, EU funding was critical in two respects: avoiding that countries have to provide resources to operate the agency and providing mechanisms for participation from countries that do not provide resources (in the case of COST, where coordination costs are supported by the EU). Interestingly, the EUROCORES program presented similar characteristics, but the European Science Foundation did not have its own budget and this might have been a reason why the scheme closed in 2012.

Six programs are focused on specific topics and share two characteristics: first, they went through successive steps of increasing integration, and second, it is possible to identify a core group of countries providing most of the national resources.

The two Joint Technology Initiatives ARTEMIS (embedded systems) and ENIAC (microelectronics) were preceded by the European Technology Platform with coordinating objectives, but no joint funding; participation and support is concentrated in the countries for which this industrial domain is relevant (FI, NL, FR, DE for ARTEMIS; IT, NL and DE for ENIAC). Three programs started as ERA-NETs, two being upgraded to ERA-NET plus: NORFACE plus (migration studies) and ERASysbio+ (system biology), are mostly promoted by DE and UK, EUTRANSBIO (biotechnology) by DE, FR, and ES. Similarly, the European Metrology Research Program started as ERA-NET/ERA-NET plus (IMERA) and moved to an art. 185 initiative, mostly supported by DE and UK. Finally, the Ambient Assisted Living program started from the onset with a highly integrated model as an art. 185 initiative; it is based on an European action plan and the interests of individual countries – as revealed by the level of funding – are more similar; this might be a reason the institutionalization process was more direct.

This analysis leads to the following conclusions. First, there is a strong association between forms of institutionalization on the one hand and the level of resources on the other hand: joint programs reach a sizeable level of budget only if they can build on lasting structures and commitments. Stronger institutionalization translates both into higher starting budgets and more rapid growth over time, leading to a very skewed distribution where a handful of programs accounts for most of the resources. The European Union provides, at the same time, a normative environment promoting integration, regulatory models, and financial incentives through EU top-up funding, which help consolidating national commitments even under the national pot model – explaining why, in terms of resources, joint programs are essentially a European phenomenon.

Second, large programs emerge in domains where a few countries have a strong interest, including some, but not necessarily all large European countries. The individual cases displays that pressure for internationalization comes from industry (ARTEMIS, ENIAC), public service needs (metrology) or specific interests of research communities (NORFACE, promoted by a UK large research center on the topic). Accordingly, the distribution of budgets by countries is quite skewed, with only a few of the countries

providing most of the resources, while the national pot mechanism allows other countries to join with lower levels of commitments. Joint programs are thus a choice instrument in domains where the level of interests of countries is highly variable.

Third, as expected, most of the currently integrated programs were started as lighter programs in the coordination model and then progressively moved towards stronger forms of institutionalization. The establishment by the EU of a set of instruments with different levels of integration – from ERA-NETs to ERA-NETs plus to art. 185 – was thus a sensible strategy, as it allowed integration to be constructed progressively - unlike the intergovernmental approach based on treaties, which required stronger commitments from the onset.

5 Discussion

Three limitations of this study can be highlighted. First, the coverage of the dataset is somewhat limited in terms of the number of observations, countries, and timeline. While we are confident in the robustness of the general patterns identified, as we included all European initiatives and the largest countries in the ERA, we acknowledge that extending the data to the whole of the ERA would add to the robustness of our findings. More importantly, a limited account of program changes is provided. This cannot be avoided, as joint programs are a very recent phenomenon, but by repeating data collection in a few years and introducing a systematic account of program change and demographics, it would allow to extend our findings and adopt more robust statistical models (such as event models). Finally, the focus on general patterns, while consistent with the goals and research questions of the paper, disregards the specific constellations leading to the emergence of individual programs; as we shortly outline in section 4.4, the two processes are largely complementary and thus our results open interesting paths for more in-depth understanding of individual programs development.

With these limitations in mind, the analysis provides substantial support to the hypotheses concerning the relationship between ideal types and observed programs, actors' roles and distribution of resources. Moreover, it identifies a few substantive results of broader relevance for the establishment of the ERA.

a) *Ideal types and observed programs (H1).* Overall, empirical data supports the hypothesis that the variety of observed programs can be associated to different underlying models of European integration. Two findings are relevant to our understanding of how logics drove practice: first, the introduction of coordination logics by the EU was central to foster the development of joint programs; second, the availability of different logics and their blending was key to allow for the construction of programs which met different actors' interests and which also worked in practice.

The coordination logic represented a true institutional innovation, since – at least concerning joint programs – no real antecedents could be identified and it was associated with the creation of specific regulatory models, like ERA-NETs.

On the one hand, its introduction allowed for the launch of a larger number of programs (requiring limited financial engagement by national actors), which provided a breeding ground for joint programs and demonstrated that they can be an instrument for the integration of European research. We consider that this partially explains why National States and funding agencies became proactive in this domain – institutional pressures are more effective when they materialize in practice.

On the other hand, this logic bridged the gap between the integration and cooperation logic. While National States no longer endorsed integration logics, as it required transferring the budget at a supranational level, they were willing to adopt a weaker form of integration, where national budgets are

coordinated and other program functions are integrated. Also, the pure collaboration logics between National States (parallel programs) could hardly be considered as a response to internationalization needs, but when blended with some coordination elements (a joint committee selecting projects), it emerged as an option to develop joint initiatives with non-ERA countries.

As foreseen by the theory, the availability of different legitimate logics allowed actors to avoid being stuck into a single model, but to start combining them in order to devise new solutions and to find compromises. While a first wave of programs (ERA-NETs) was strongly associated with the coordination logics, with time some of them moved towards stronger forms of integration. Also, entirely new groups of programs emerged, like lead agency agreements that combined elements of collaboration and coordination.

Importantly, blending started at the level of practices, but then led to a redefinition of the content of the logics themselves: the integration logic was reinterpreted as a model where all functions are integrated, but the budget is only *virtually integrated* (as stated in official documents). The reinterpretation of key concepts, like the one of common pot, becomes a key process in bridging institutional requirements and actors' interests (Thornton et al., 2012). Accordingly, the notion of integrated, coordinated, and collaborative programs has been redefined in order to better suit the specific requirements and actors' constellation of joint programs.

b) *The role of actors (H2).* Second, our analysis shows the central role of agency and actors' interests in adopting institutional models and translating them into practice. By their nature, joint programs require the construction of agreements between actors who have different notions of European integration and interests, which in this respect meant that the possibility to combine elements of different logics into hybrid models was critical.

While all actors involved in program funding – the European Union, National States, and funding agencies - were responsive to internationalization pressures, their roles were redefined and differentiated during this process. The European Union moved from a change agent approach (Nedeva, 2012), where it responded directly with its own budget to internationalization pressures, to an incentive model which provided instruments and top-up funding to initiatives emerging from national actors. National States differentiated their responses: within the ERA, they adopted a compliance behavior, joining programs where there was some pressure to do so. The delegation of program management and decisions on resource levels to agencies allowed National States to decouple the symbolic act of joining from the material side of participation, which has to be selective because of limited resources. Outside the ERA, National States were proactive in establishing joint programs with emerging countries: these highly political acts signal the willingness to establish collaborative research, and accordingly they are mostly managed by the research ministries themselves.

The role of independent funding agencies extended beyond the traditional model of delegates of governments for the implementation of policy, but did not imply the hollowing out of national research policies, with agencies bypassing the governmental level in order to participate directly in European actions (Langfeldt et al., 2012). Rather we should speak about broadening the space of autonomous negotiation: agencies receive a mission from the State related to a specific domain of research funding and are mostly endowed with a global budget to this aim. In their domain of competence, they are in charge of arbitrating levels of resource commitments between national and international programs, depending on the interests and needs of the research community (respectively of industry in technological programs).

For research councils, this went as far as establishing new types of programs for themselves, (the delegated programs based on lead agency agreements) in a domain where European instruments are perceived to be

unsuited to the needs of academic research. After the failed experiment with the European Science Foundation, research councils stopped any new initiatives concerning European integrated programs, confirming that without EU involvement this could not be stabilized. They concentrated their international activities on a specific niche not covered by European programs, i.e. bilateral cooperation within the ERA. This move towards bilateralism allowed them to be more selective concerning the partners with which to establish agreements, achieving a greater homogeneity between participating agencies.

c) *Distribution of programs and budgets (H3)*. Third, empirical results confirm expectations concerning the concentration of the budget in a few programs, and the existence of selection mechanisms underlying this progressive concentration.

Abandoning the strong integration model was central in the emergence of new programs. This model requires, before launching a new program, binding commitments and secured resources – as shown by ESA and EU Framework programs. This requires creating strong coalitions between funders and the involved research communities before the establishment of new programs –this is possible only in domains where a strong champion is present.

The variable geometry model does not require this level of commitment, thus allowing for the launch of a larger number of programs, which explores international cooperation opportunities in less strongly structured and homogeneous domains. However, for programs to grow to a sizeable budget and become durable entities, commitments nevertheless have to be constructed and this process has been highly selective. Joint programs then become learning spaces for integration rather than the outcome of a previous integration in science and/or technology.

The analysis displays a few critical elements that have fostered this process. The normative pressures and incentives from the European Union explain why joint programs with a significant level of resources have emerged only within the ERA. Trust between the actors involved – which has been consolidated through repeated interactions and successive steps of integration – could effectively replace binding regulations in managing joint programs, as highlighted by delegated programs. However this process critically depends on creating some level of homogeneity among the participating actors – hence the importance of delegating program management activities to agencies with similar functions and mission.

Finally, our results are consistent with the idea that, behind the establishment of joint programs, there are the needs of societal actors towards internationalization, pushing them also to promote the establishment of programs in their specific domains. This is not only the case for research communities, but also industry for technology-oriented programs and public administration in fields like metrology. Of course, in-depth case studies would be required to better understand their role in establishing specific programs and how they interact with funding agencies (like in the case of the European Research Council; Nedeva, 2012).

In terms of our understanding of the institutionalization of the European space, the ERA represented in 2000 an empty frame of reference, promoted by the recognition that a federal model of EU policies was not endorsed by National States, while the intergovernmental model was not any more practical given the number of countries to be involved in negotiating agreements. Our case study displays how in the following decade, it was filled in with specific experiences and practices, led to the redefinition of actors' understanding of European integration and roles in European research policies and, ultimately, to the emergence of original models of integration.

6   Acknowledgments

7 References

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