

Does smallness of a country encourage integration and flexibility in science within EU?

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Background of the problem

Smallness is viewed as a constraint for building up domestic human and financial resources for science and expertise in different fields, even critical mass for domestic R&D (Berghäll *et al.* 2002). It is argued that small countries can overcome such disadvantages in resources through international cooperation (Thorsteinsdóttir, 2000b). Empirically, higher collaboration frequencies have been generally found (see for example the review in Thorsteinsdóttir, 2000a). Some contrary results for Europe are presented in Frenken (2002), involving only Luxembourg from the sample countries of this research. High collaboration with larger countries can stem from scale advantages (specialization, funding) (Frenken, Leydesdorff (2004)), which can be especially important for research fields demanding larger or more expensive research infrastructure. Additional reason for higher international collaboration can also be the experience of foreign education and respective connections researchers in small countries often have (Franklin, 1988).

With regard to the intra-country collaboration, it is found for example on the case of Luxembourg that in small countries, research activities are thematically, spatially and institutionally dispersed and domestic collaboration is often hindered because of large diversity which conflicts with the coupling of competence (Meyer, 2009). On the other hand it is also found that some aspects of smallness are favourable for intra-national collaboration, because of the more transparent and flexible institutional system of research, greater density and frequency of relationships (know-who), more informal relationships etc. (Cogan, McDevitt, 2003; Meyer, 2009). In science policy, small countries are facing a dilemma: if they focus on high-level research (involving higher international co-operation) they may risk with limited local relevance and if they focus too narrowly on the local issues, they will risk with isolation (Thorsteinsdóttir, 2000b). Therefore, the cooperation patterns can be influenced by the choices in science policy the small countries are following (some researchers find lack of thematically targeted or goal-oriented science policy in small countries, often also top-down process without specific mechanisms for new emerging areas (Thorsteinsdóttir, 2000b; Masso, Ukrainski, 2009), but in others, rather bottom-up approach is seen with stronger foresight (Meyer, 2009)).

Small countries are generally very sensitive to outside developments and therefore the cooperation patterns may vary in time. Estonian data show, that the country portfolio in cooperation patterns of Estonia has altered in the period of 2000-2009. Thorsteinsdóttir (2000a) brings out that the collaboration can be initiated by the scientists of larger countries recognizing the availability of specific research material rather than domestic ones seeking additional resources, which can also contribute to somewhat occasional pattern of international cooperation of small countries.

Research hypothesis

The paper aims at elaborating the role of small countries in European integration of research activities by examining whether a country's smallness encourages integration and flexibility in research. The hypotheses tested are the following:

H1: Small states are relatively more integrated to the European research system

H2: Intra-national research cooperation is lower in importance for small countries

H3: The flexibility of international cooperation patterns is high in small countries

H4: The patterns of international and intra-national cooperation vary by scientific fields

Methodology

We adapt for our research purposes the methodology proposed by Frenken (2002) and thereafter Frenken and Leydesdorff (2004) for measuring integration of science between countries through scientific collaboration. The methodology is using the matrix distribution of relative frequencies of interactions among countries and takes into account both intra-national and international collaboration (Frenken, Leydesdorff 2004). The sensitivity of the proposed indicators is also tested by using modifications of the initial methodology.

The data involves counts of different institutional addresses for publications contained in the Science Citation Index (this does not correspond to co-authorship, but rather inter-institutional analysis (see also Katz, Martin, 1997)). The analysis of collaboration is undertaken for the period of 1995-2009 on the country-level, but also on the level of scientific fields. The flexibility in research is assessed via variation in shares of cooperation partners during the period of observation.

Sample of countries

“Smallness” is a definition often used context-specifically (see also Geser, 2001). Therefore also in the science policy literature, micro-states along with relatively large countries are referred as small. The sample of the six small EU countries is selected for the analysis, because although they range in roughly 0.4-2.3 millions inhabitants, they have large differences in developmental levels, R&D expenditures, but also numbers of researchers and scientific cooperation activities (judged for example by participation in FP 7 projects (see Table 1)).

Table 1. Country characteristics in the sample

Country	Population (Mill inhabitants, 2010)	GDP (Euro per inhabitant, 2009)	GERD (Euro per inhabitant, 2009)	Researchers (FTE, 2007)	FP7 participation (% of participants of all signed contracts 2007/2008)
Estonia	1 340 127	10 300	147.2	3 690	0.5
Cyprus	803 147	21 200	97.8	799	0.4
Latvia	2 248 374	8 200	37.5	4 223	0.3
Luxembourg	502 066	76 500	1 295.0	2 201	0.2
Malta	412 970	14 100	76.8	494	0.2
Slovenia	2 046 976	17 300	323.2	6 250	0.8

Source: Eurostat, EC (2009)

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