ARTICLE

FUNDING STRUCTURE OF CLUSTERS IN POST-COMMUNIST AND DEVELOPED COUNTRIES

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Abstract

The paper compares the funding structure of European clusters. It uses a hand-collected questionnaire survey (n = 185) to examine the budget structure of European clusters. The objective is to identify the differences between clusters in post-communist and developed countries, as well as between clusters located in countries with higher and lower levels of innovation performance. The results show that clusters in (i) post-communist countries and (ii) countries with lower levels of innovation performance have a much higher share of EU structural funds and community programmes in their budgets than clusters in (iii) developed countries and (iv) countries with higher levels of innovation performance. The latter two groups of countries exhibit a predominantly higher share of funding from national, regional and local subsidies and grants. These are sources to which other European clusters frequently do not have sufficient access. Moreover, the results indicate that there is no relationship between cluster budgets and their sectoral classification.

Implications for the Central European audience: The issue of clusters, cluster policies and their support and financing has been topical since the 1990s, especially in Western and Northern Europe and North America, as well as in developed Asian countries. In Central Europe, the penetration of clusters as an effective instrument of regional but also innovation policy has been slower, although there are also considerable differences in the implementation and support of cluster policies among Central European countries, with the most problematic situation among the V4 countries being in Slovakia. Through a self-administered questionnaire survey, in which responses from V4 clusters are among the most represented, we compare the structure of European cluster budgets, highlighting the differences in cluster funding between the different country groups.

Keywords: Clusters; cluster policies; financing clusters; public/private sources; financial structure

JEL Classification: O31, O38, R58

Introduction

Clusters – or different concepts of agglomeration exploiting external economies of scale – have long been acknowledged as a crucial element in the organisation of economic activity for businesses, regions and national economies (Haus-Reve & Asheim, 2023). Forces of agglomeration enhance attraction to clusters and clusters enhance knowledge spillovers to increase the competitiveness of regions and institutions that operate within them (Minárik et al., 2022). The topic of the advantages of spatial agglomerations has been analysed since the late 19th century (the 1890s), starting with the pioneering work of Marshall (Cumbers & MacKinnon, 2004; Andini et al., 2013; Ehrl, 2013; Turečková, 2018). Nevertheless, clusters, cluster initiatives and cluster policies have become a subject of great interest to the professional public, mainly due to the publication of Michael Porter's book *The Competitive Advantage of Nations* (Porter, 1990). In his subsequent papers, Porter developed the concept of clusters in more detail (1998, 2003). Since then, research studies dealing with clusters, their funding and various other aspects have been growing in number. Currently, it is possible to find in the regional and industrial economics literature a wealth of scientific contributions which take the cluster concept – directly or indirectly – as a critical departure for regional planning and policy strategies. In both the developed and the developing world, clusters have been suggested as an operational policy tool for regional and urban planning (Gordon & Kourtit, 2020).

Clusters have gradually received even more attention from practitioners and policymakers. As noted by Martin et al. (2011), industrial clusters are prevalent among policymakers and during the last three decades, national and local governments have attempted to foster their development. Haus-Reve and Asheim (2023) agreed with the view that clusters have gained significant attention in policy-making and academic circles. Moreover, they stated that clusters can play an essential role in helping regions address transformative innovation policies in Europe, focusing mainly on (i) sustainability, (ii) smart specialisation, promoting diversified specialisation, and (ii) reshoring/regionalisation of value chains to secure economic sustainability and resilience. Clusters can be considered vital change agents in aligning cluster policies with transformative policies and repositioning their role in the innovation policy landscape. Moreover, clusters are a unique tool linking the activities of firms and research institutions, which positively affects the innovation performance of all participating institutions and regions in which clusters operate. As Odei and Stejskal (2018) said, this collaboration can be achieved through joint research and other academic consulting or training activities. This relates to the knowledge and technology transfer networks and the spillover effect of research outcomes that firms can use to further commercialise. Universities can disseminate knowledge and information and transform codified academic knowledge into commercial values. Firms can use the knowledge acquired from universities in their production process, leading to improved consumer outputs and services. These facts also draw attention of policymakers at national, regional and local levels to the issue and growing support to clusters in European countries and beyond.

Also, the European Cluster Panorama Report 2024 points to the fact that the specific role of clusters and cluster organisations as crucial actors in the European industrial innovation ecosystem and the relevance of cluster policies in the European Union is to drive

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https://doi.org/10.18267/j.cebr.397

transformation processes and to further strengthen competitiveness and resilience (Kramer et al., 2024). This is one of the reasons why, currently, in the European Union, there are over 3,000 cluster organisations whose members employ more than 50 million workers, with every fourth job being linked to a cluster organisation. Clusters are associations of competitive yet cooperating legal entities, including academic and research institutions, local governments and civil society. Today, they are considered an effective form of supporting innovation in small and medium-sized enterprises and development of the regions in which they operate. According to available data, the productivity of business entities involved in clusters is 25% higher than the average (European Commission, 2021; Adamovský et al., 2024). At the same time, a positive correlation has been identified between the prevalence of clusters and several critical indicators of industrial competitiveness. This encompasses a range of factors, including human resources in science and technology-related roles, the proportion of the workforce employed in technology and knowledge-intensive sectors, the level of business R&D investment, the number of patents filed and a variety of economic outcomes, such as GDP and productivity (Kramer et al., 2024). Furthermore, as Gordon and Kourtit (2020) stated, perhaps the most critical question is not whether cluster creation and development needs government support but rather what type of support it needs in a given institutional and regional development context.

1 Public and Private Sources of Cluster Financing and Empirical Research into Cluster Financing

Quantifying the amount of public support for cluster policies in the EU27 countries combined is highly challenging. In addition to international resources from the EU level, public resources from the national, regional and local levels in all EU member states need to be added to these resources. According to Kramer et al. (2022), this amounts to approximately 6 billion euros and refers to ongoing policies in the observation period (i.e., only the year 2022). These national/regional cluster policies do not necessarily align with the EU Multiannual Financial Frameworks. The estimated amount of 6 billion euros for national/regional cluster policies also includes policies in third countries. Thus, it is not only public financial resources spent in the EU27 countries, although these resources form a significant part of the total, but also public resources for cluster policies in so-called third countries such as the USA, China, Canada or Japan. Across the EU member states, clusters are supported by either specific cluster policies or broader and sectoral economic policies. However, dedicated cluster policies focus more on a comprehensive support system for clusters than broad and sectoral policies. While the latter often have as an objective the support of new cluster initiatives, demonstrating their role in the initial development of cluster landscapes, dedicated cluster policies are essential to support the development and maturing of clusters. The funding for cluster programmes is derived from a combination of EU, national and regional funding. They may be included in European Regional Development Fund Operational Programmes at national and regional levels or in the Single Market Programme at the EU level. In such instances, grant members have access to earmarked funding streams. Alternatively, they may combine different sources across regional and national levels of governance (Kramer et al., 2024).

Many studies have focused on supporting the development of clusters through their funding, particularly since 2003. Among other factors, they have looked at the structure of public and private cluster financing. These studies include worldwide research into different ways of financing clusters (Sölvell et al., 2003; OECD, 2007; Lindqvist et al., 2013) or concentrated on surveying finance, predominantly in European countries (Oxford Research AS, 2008; Barsoumian et al., 2011; Müller et al., 2012; Meier zu Köcker & Müller, 2015; Burger, 2022). Other studies have analysed clusters and their support in groups of countries which are somewhat specific and demonstrate some common features that frequently distinguish them from others (Ketels & Sölvell, 2006, dealing with clusters in the EU-10 new member countries; Ketels et al., 2006, exploring clusters in developing and transition economies; Kergel et al., 2018, studying clusters in the Danube Region in particular). Similarly, some of the research studies have mainly been concerned with financing clusters in some selected European countries (Hantsch et al., 2013), regarding clusters in Germany, France and Norway. Okamuro and Nishimura (2015) compared Germany, France and Japan; Sölvell and Williams (2013) clusters in Sweden; and Buhl et al. (2019) clusters in Germany. The Slovak authors Adamovský et al. (2024) also contributed a valuable study comparing cluster financing in Slovakia, the Visegrad Four countries, EU countries and the so-called Excellence Clusters portfolio.

Studies by Lindqvist et al. (2013), Kergel et al. (2018) and Adamovský et al. (2024), in particular, with sufficiently large and representative samples and with a suitable time interval of about five years, map the structure of public and private funding of clusters in an interesting way. The results of these three studies highlight several interesting facts. While in the global survey by Lindqvist et al. (2013), public funding of clusters dominates at 54% to 46%, in the European study by Kergel et al. (2018), private sources dominate cluster funding at 56% to 44%. This ratio is even more skewed towards using private sources in financing clusters from the Danube Region (71% to 29%). The Danube Region in this study covers ten countries: Austria, Czechia, Slovakia, Hungary, Slovenia, Croatia, Romania, Bulgaria, Serbia, Montenegro and the two German regions of Baden-Württemberg and Bavaria. It also suggests that several clusters in the Danube Region countries may not have had optimal access to public funding at the time. Adamovský et al. (2024), based on data from the European Secretariat for Cluster Analysis (ESCA), prepared a study comparing cluster financing in Slovakia, the Visegrad Four countries, the EU countries and the portfolio of the so-called Excellent Clusters. The study partly confirmed that in Slovakia especially (39%) but also in the other V4 countries (47%), the share of public resources in cluster budgets is lower than in the European Union countries as a whole, where it was at 54% and public resources were used in cluster budgets to a greater extent than private resources (46%). The Excellence Portfolio consists of the best-rated cluster organisations, with the "score" based on the ESCA algorithm, determined for each cluster organisation based on data from reference comparisons. In this portfolio of excellence clusters across Europe, the share of public and private resources in the cluster budget was balanced (52% public resources to 48% private resources). A fascinating fact about these surveys was the information on the share of membership fees as an essential private resource in cluster budgets. In all the clusters studied in these three surveys (which were between 2013 and 2024), the value of the share of membership fee ranged from 23% to 29%. In contrast, the percentage value of chargeable services and other private resources within the private resources used by clusters varied over a much more comprehensive range. Chargeable services, which present

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https://doi.org/10.18267/j.cebr.397

important revenue from private resources, are a significant part of cluster income nowadays. Madleňák (2020) mentioned the growing popularisation of paid services as being a potential source of income for clusters. These include facilitation or consultancy services, conducting market research, educational, research and development activities and activities related to the internationalisation of business entities. For regular customers, there are also opportunities to cooperate in implementing innovation processes and technology transfer, among others. The data collection in said research was conducted by the European Secretariat for Cluster Analysis (ESCA). It took place between January 2020 and August 2023, which overlaps with the data collection of our paper.

Table 1 | Share of public and private financing in total budget of clusters

	Lindqvist et al. (2013)			**Kergel et al. (2018)**		**Adamovský et al. (2024)**			
	Respondents from 50 countries			Danube Region	EU 28 and Norway	Slovakia	Visegrad Group (V4) countries excluding Slovakia	European Union, excluding Slovakia and V4 countries	Excellence Portfolio
Number of clusters	356			82	234	24	32	233	96
Public resources	54%			29%	44%	39%	47%	54%	52%
	National	Regional/ local	Inter-national						
	18%	23%	13%						
Membership fees	26%			25%	26%	29%	24%	23%	24%
Chargeable services	8%			15%	14%	22%	25%	18%	18%
Other private resources	12%			31%	16%	10%	4%	5%	6%
Private resources	46%			71%	56%	61%	53%	46%	48%

Source: Authors' elaboration based on Lindqvist et al. (2013), Kergel et al. (2018) and Adamovský et al. (2024)

Notes: The Excellence Portfolio consists of the best-rated cluster organisations, with the "score" based on the ESCA algorithm. The composition of the Excellence Portfolio changes over time, but these changes do not affect the characteristics and values of cluster excellence.

2 Data Description and Methodology

A custom questionnaire was distributed between 2022 and 2023, reaching out to 1,520 clusters from 32 European countries.

The database of European clusters was mainly created from the website of the European Cluster Collaboration Platform, which brings together clusters (mostly but not exclusively) from Europe. A list of registered clusters in each European country was then created, some of which also offered a contact e-mail address for the cluster facilitator. However, in most cases, it was necessary to find the contact e-mail address of the cluster facilitator on the individual cluster website itself. The questionnaires were then sent out to all the cluster

facilitators asking them for completion. The questionnaires were anonymous and took no more than 5-7 minutes to complete (see the Appendix).

After cleaning the data, 185 responses were completed correctly, which resulted in a return rate of 12.17%. The highest number of correctly completed questionnaires came from Germany (20), Slovakia (19) and Spain (15), followed by Czechia (13), Belgium (10), Italy (9), Norway and Poland (8 each), Hungary, Lithuania, Romania and Sweden (7 each), Bulgaria, France (6 each), Denmark, Austria and the Netherlands (5 each), Latvia, Greece, Ireland and Slovenia (4 each) and Serbia and Portugal (3 each). A maximum of two correctly completed questionnaires were received from the other countries addressed.

Based on the literature by Sölvell et al. (2003), Ketels and Sölvell (2006), Barsoumian et al. (2011), Lindqvist et al. (2013), Meier zu Köcker and Müller (2015), Burger et al. (2017), Kergel et al. (2018), Strelcová and Janasová (2018), Buhl et al. (2019), Sedlmayr et al. (2021) and Adamovský et al. (2024), eight possible funding sources were included in the questionnaire. Different funding options were classified as public or private resources (Table 2). Compared to some of these surveys, more emphasis was placed on identifying the origin of public resources (whether they were provided to the cluster budget from the national, regional or local level or from the EU structural funds and community programmes).

In the questionnaire survey, clusters indicated which sources make up the revenues in their annual budgets. They also revealed what percentage each funding source comprised of the cluster's total yearly budget, while the total amount of all funding sources for the cluster was set at 100%. Clusters were also offered the possibility of selecting "other sources" without closely specifying the financing source. Despite having that possibility, none of the clusters chose that option.

Table 2 | Funding sources included in questionnaire

Source	Variable name	Description
Public resources	EU_funds	EU structural funds and community programmes (EU funds to finance cluster activities)
	National	National subsidies and grants (national/governmental funds)
	Regional	Regional subsidies and grants (regional funds, including state level in the case of federal states)
	Local	Local subsidies and grants (municipal funds)
	Membership	Membership fees of cluster members
Private resources	Revenues	Cluster revenues from their own activities
	Loans	Credit funds – bank loans
	Venture	Venture capital, business angels and donor contributions

Source: Authors' elaboration

The clusters in the questionnaire survey were divided according to two breakdowns. Firstly, the clusters were divided into two groups: clusters from successor states of post-communist countries and clusters from non-post-communist countries (for the sake of brevity, we will refer to those as the “developed” ones). The second breakdown divided the clusters according to the European Innovation Scoreboard 2023, whose innovation indicators are mainly from 2021 and 2022. The European Innovation Scoreboard 2023 divides European countries according to their level of innovation performance into four groups: innovation

leaders, strong innovators, moderate innovators and emerging innovators (European Commission, 2023). For this research, clusters of innovation leaders and strong innovators were combined into one group of countries with higher innovation performance. Conversely, moderate innovator and emerging innovator clusters were classified as another group of countries with lower levels of innovation performance.

Table 3 | Full sample of all clusters participating in questionnaire survey by individual breakdowns

	Full sample (n = 185)		**Post-communist countries (n = 81)**		**Developed countries (n = 104)**		**Lower innovation performance (n = 112)**		**Higher innovation performance (n = 73)**	
Variable	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.	Mean	Std. dev.
Age	11.897	6.760	11.457	5.208	12.240	7.765	11.554	5.924	12.425	7.888
Public sources	0.573	0.274	0.549	0.293	0.589	0.259	0.551	0.275	0.605	0.272
Private sources	0.427	0.276	0.451	0.295	0.411	0.261	0.449	0.279	0.395	0.272
Funding sources										
EU_funds	0.268	0.282	0.406	0.324	0.160	0.184	0.338	0.308	0.160	0.195
National	0.152	0.219	0.104	0.176	0.189	0.242	0.116	0.182	0.208	0.258
Regional	0.128	0.195	0.028	0.089	0.206	0.219	0.084	0.162	0.195	0.222
Local	0.022	0.062	0.010	0.042	0.032	0.073	0.010	0.038	0.042	0.084
Membership	0.265	0.243	0.260	0.266	0.269	0.224	0.271	0.256	0.256	0.223
Revenues	0.152	0.184	0.177	0.222	0.133	0.146	0.166	0.204	0.132	0.146
Loans	0.006	0.037	0.006	0.030	0.006	0.042	0.008	0.047	0.000	0.000
Venture	0.007	0.036	0.009	0.047	0.005	0.026	0.007	0.040	0.007	0.030

Source: Authors' elaboration

The basic descriptive statistics show significant differences in funding clusters from different sources. While there are no significant differences between the cluster groups when comparing the overall share of public vs private resources, significant differences emerge between the different cluster groups when comparing the different types of public and private resources. In particular, the representation of various types of public resources in the cluster budgets varies greatly between the cluster groups. These differences will be examined more closely and verified by the following hypotheses:

Hypothesis 1: There is no significant relationship between the innovation level of a cluster and the post-communist history of a given country.

Hypothesis 2: There is no significant relationship between the sectoral classification of a cluster and its budgets.

Hypothesis 3: There is no significant relationship between types of funding resources and the cluster country group. The examined country groups are (i) post-communist vs developed countries (Hypothesis 3.1) and (ii) lower vs higher innovation countries (Hypothesis 3.2).

The first two hypotheses are evaluated using the Pearson's χ^2-test and we also estimate the size of the association by Cramér's V and Kendall's tau-b coefficients. The third hypothesis will be evaluated by estimating the following seemingly unrelated regression (SUR) model:

Estimation setup for Hypothesis 3.1:

$$source_{ij} = \alpha_{j0} + \beta_{j1}\, budget_{ij} + \beta_{j2}\, age_{ij} + \beta_{j3}\, NACE_{ij} + \beta_{j4}\, country\_group_{ij} + \varepsilon_{ij} \quad (1)$$

Estimation setup for Hypothesis 3.2:

$$source_{ij} = \alpha_{j0} + \beta_{j1}\, budget_{ij} + \beta_{j2}\, age_{ij} + \beta_{j3}\, NACE_{ij} + \beta_{j4}\, innovation\_level_{ij} + \varepsilon_{ij} \quad (2)$$

where i is the number of examined clusters, j = 1, 2,...,7 is a given equation in our system corresponding to a specific type of public/private source of funding, α_{j0} is a constant term, and ε_{ij} is an error term.

As the ratio of a given funding source to the total sources is our explanatory variable, it is reasonable to assume that error terms are correlated across equations for a given cluster but uncorrelated across individual clusters. This is also formally tested using a Breusch-Pagan test of independence among residuals. The correlation between residuals among individual equations reaches the value of 0.5 in a few cases. The Breusch-Pagan test also suggests rejecting the null of residual independence at a 0.001 significance level. Hence, the application of the SUR model appears to be the best choice for our setup.

In our estimations, four explanatory variables are used:

(1) *budget* – the budget group ranking of a given cluster. Clusters did not provide the exact amount of their yearly budget, but rather were asked to classify themselves into one of the following ranges (values in EUR): less than 5,000; 5,000-25,000; 25,000-50,000; 50,000-100,000; 100,000-500,000; 500,000-1,000,000; 1,000,000-5,000,000; and more than 5,000,000;

(2) *age* – a variable showing the number of years the cluster had reached in 2023 since its creation;

(3) binary *NACE* variable – which takes the value of 1 if the cluster belongs to the primary and secondary sectors (industrial clusters) and 0 otherwise, i.e., clusters whose activities fall into the tertiary and quaternary sectors (service clusters);

(4) and then a specific dummy variable *country_group* is introduced to depict (i) whether the country has a communist history (takes the value of 1 for developed countries, 0 for post-communist ones) or (ii) whether it belongs to higher or lower-level innovation country (takes the value of 1 for high-level innovative countries, 0 otherwise).

3 Results

Table 4 shows a significant overlap between the analysed cluster groups (Pearson's χ^2-test with a p-value = 0.000, Cramér's V and Kendall's tau-b around 0.71). It can be seen that the successor states of post-communist countries are among the countries with a lower level of innovation performance (and vice versa). While the innovation performance of some post-communist countries (Slovenia, Czechia, Estonia) is close to the average innovation performance of EU countries, no successor state of a post-communist country exceeds the

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https://doi.org/10.18267/j.cebr.397

average innovation performance of EU countries according to the European Innovation Scoreboard 2023 (European Commission, 2023). As such, Hypothesis 1 can be rejected. Given the high correlation between these two country groups, it was decided in the estimation setup to include them separately (Hypothesis 3.1 and 3.2). Due to the high similarity between these two groups, however, qualitatively different results are not expected.

Table 4 | Contingency table for level of innovation and post-communist regime

	Lower innovations	Higher innovations	Total
Post-communist countries	81 (43.78%)	0 (0.00%)	81 (43.78%)
Developed countries	31 (16.76%)	73 (39.46%)	104 (56.22%)
Total	112 (60.54%)	73 (39.46%)	185 (100.00%)

Source: Authors' elaboration based on the European Commission (2023)

Notes: Although the former German Democratic Republic was a communist country, it is classified as a developed country in line with Roaf et al. (2014), Cieślik (2014) and many other authors. The relative frequencies are shown in parentheses.

Hypothesis 2 examines the sectoral structure of the industries in which the clusters operate (the so-called *NACE* variable). This fact adds value to whether it is appropriate to support clusters differently in terms of different forms of financial resources, depending on the sector in which they operate. This paper uses the most common breakdown, which divides them according to primary, secondary, tertiary and quaternary sectors. The primary sector is made up of agriculture, forestry, fishing and mining and quarrying, the secondary sector is comprised of complete manufacturing, manufacturing, energy, waste management and construction, the tertiary sector is all services with the exception of services related to the creation and sharing of knowledge and information and the quaternary sector is services related to the creation and sharing of knowledge and information (e.g., Bell, 1976; European Commission, 2008; Turečková, 2014; Burger & Šlampiaková, 2021). In order to make the results more relevant and obtain more observations for clusters in each group, the clusters and their responses were finally classified into two groups: the so-called industrial clusters (primary and secondary sectors) and service clusters (tertiary and quaternary sectors).

Table 5 shows a slight predominance of industrial clusters in the current sample and the fact that most clusters operate with an annual budget of more than 100,000 euros. It appears that there is not a significant relationship between these two variables and as such, Hypothesis 2 cannot be rejected (Pearson's χ^2-test with a p-value = 0.129, Cramér's V and Kendall's tau-b around 0.11). A practical implication of this result might be that there is no need for different policies for specific sectors.

Table 5 | Contingency table for budget level and sectoral structure

	Industrial clusters	Service clusters	Total
Annual budget < 100,000 EUR	44 (23.78%)	23 (12.43%)	**67 (36.22%)**
Annual budget ≥ 100,000 EUR	64 (34.59%)	54 (29.19%)	**118 (63.78%)**
Total	**108 (58.38%)**	**77 (41.62)**	**185 (100%)**

Source: Authors' elaboration

Notes: Relative frequencies are shown in parentheses.

In the final step of the analysis, estimation results from the SUR models are depicted in Tables 6 and 7. With regard to the effects of the first country group, it can be seen that the highest coefficient (-0.2397) relates to the first source – EU structural funds and community programmes. Clearly, EU funds are not a dominant source of financing clusters' activities in developed EU countries with regional subsidies and grants being more important (0.1803). While other resources are also statistically significant (national, local, revenues), their effect is rather marginal. As a result, Hypothesis 3.1 can be rejected as there is a significant relationship between various types of funding resources and clusters' country groups. This is most notably in EU funds and regional subsidies and grants, even controlling for budget range, cluster age and industry sector. In order to obtain a better perspective on the findings, Figure 1 shows the mean values of different funding sources, broken down into post-communist and developed countries.

Table 6 | Estimation results of SUR model (post-communist vs developed countries)

	Variable	Coefficient	SE	*z*-stat	*p*-value	
EU_funds	const.	0.4111	0.04	8.5200	0.0000	**
	budget	-0.0133	0.05	-	0.7970	
	age	-0.0010	0.00	-	0.6890	
	NACE	0.0277	0.03	0.7200	0.4740	
	country_group	-0.2397	0.04	-	0.0000	**
National	const.	0.1840	0.04	4.4400	0.0000	**
	budget	0.0075	0.04	0.1700	0.8650	
	age	-0.0062	0.00	-	0.0120	**
	NACE	-0.0292	0.03	-	0.3320	
	country_group	0.0877	0.04	2.1400	0.0320	**
Regional	const.	0.0744	0.02	2.5300	0.0110	**
	budget	0.0017	0.03	0.0500	0.9570	
	age	-0.0024	0.00	-	0.1600	
	NACE	-0.0473	0.02	-	0.0470	**
	country_group	0.1803	0.02	6.3400	0.0000	**
Local	const.	0.0264	0.00	2.7400	0.0060	**
	budget	0.0044	0.00	0.5100	0.6110	
	age	-0.0013	0.00	-	0.0380	**
	NACE	-0.0079	0.00	-	0.3860	
	country_group	0.0205	0.00	2.8300	0.0050	**
Membership	const.	0.1831	0.04	4.1200	0.0000	**
	budget	-0.0303	0.04	-	0.4580	
	age	0.0062	0.00	2.1900	0.0280	**

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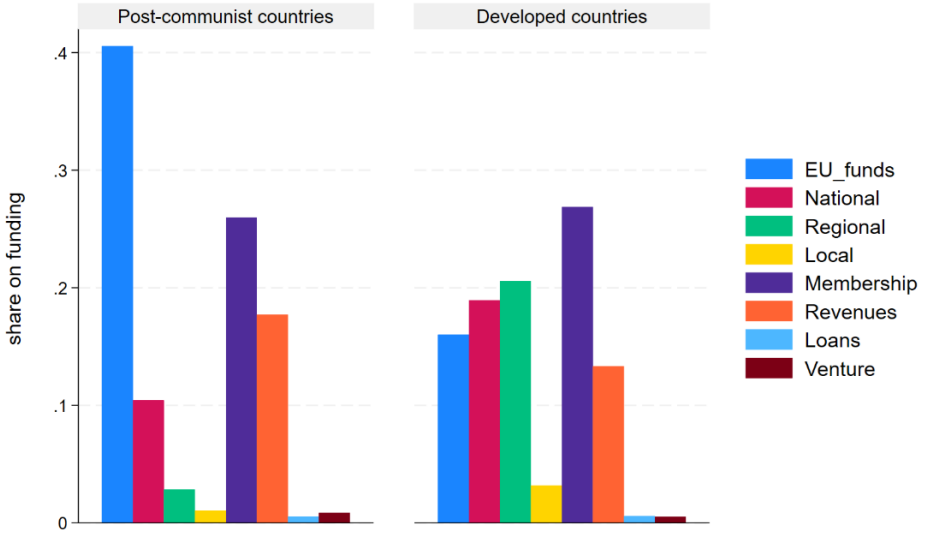
	NACE	0.0430	0.03	1.2000	0.2310	
	country_group	0.0161	0.03	0.4300	0.6640	
Revenues	const.	0.1031	0.03	2.9000	0.0040	**
	budget	0.0254	0.03	0.8100	0.4200	
	age	0.0053	0.00	2.5100	0.0120	**
	NACE	0.0105	0.02	0.4000	0.6900	
	country_group	-0.0600	0.02	-	0.0370	**
Loans	const.	0.0124	0.00	1.3300	0.1850	
	budget	-0.0013	0.00	-	0.7760	
	age	-0.0002	0.00	-	0.6250	
	NACE	-0.0035	0.00	-	0.4470	
	country_group	-0.0025	0.00	-	0.5270	

Source: Authors' elaboration

Notes: "SE" is the standard error. The symbols *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

Figure 1 | Mean values of funding sources (post-communist vs developed countries)



Source: Authors' elaboration

Table 7 presents the results obtained from the SUR model when the clusters were divided according to the degree of innovation. As expected, these results are qualitatively the same as the previous ones. The EU structural funds and community programmes were not of much importance for the high-level innovator countries (-0.1492), with the regional subsidies and grants being more important (0.0892). Cluster age was also significant in almost half the cases although the other control variables were not significant at all. It appears that budget range and the sector in which the clusters operate do not influence the structure of their funding. However, Hypothesis 3.2 can be rejected as there are clearly several significant

relationships between various types of funding resources and the clusters' country group. Figure 2 highlights the differences in average values of funding sources between this second group of countries.

Table 7 | Estimation results of SUR model (lower vs higher innovation countries)

	Variable	Coefficient	SE	*z*-stat	*p*-value	
EU_funds	const	0.3721	0.04	7.7500	0.0000	**
	budget	-0.0719	0.05	-1.3700	0.1700	
	age	-0.0003	0.00	-0.1200	0.9040	
	NACE	0.0101	0.04	0.2400	0.8070	
	innovation_level	-0.1492	0.04	-3.6100	0.0000	**
National	const	0.1907	0.04	4.6200	0.0000	**
	budget	0.0146	0.03	0.3700	0.7100	
	age	-0.0064	0.00	-2.5700	0.0110	**
	NACE	-0.0177	0.02	-0.6000	0.5510	
	innovation_level	0.0898	0.03	2.3000	0.0220	**
Regional	const	0.1087	0.03	3.1200	0.0020	**
	budget	0.0551	0.03	1.6500	0.1000	
	age	-0.0030	0.00	-1.4900	0.1360	
	NACE	-0.0372	0.02	-1.4500	0.1470	
	innovation_level	0.0892	0.03	2.5700	0.0160	**
Local	const	0.0256	0.00	2.7600	0.0060	**
	budget	0.0016	0.00	0.1900	0.8510	
	age	-0.0013	0.00	-2.0900	0.0370	**
	NACE	-0.0037	0.00	-0.4300	0.6680	
	innovation_level	0.0321	0.00	3.5100	0.0000	**
Membership	const	0.1897	0.04	4.3700	0.0000	**
	budget	-0.0188	0.04	-0.4600	0.6460	
	age	0.0062	0.00	2.1700	0.0300	**
	NACE	0.0416	0.03	1.1800	0.2400	
	innovation_level	-0.0086	0.03	-0.2400	0.8080	
Revenues	const	0.0944	0.03	2.7400	0.0060	**
	budget	0.0128	0.03	0.4000	0.6870	
	age	0.0054	0.00	2.4500	0.0140	**
	NACE	0.0053	0.02	0.2000	0.8450	
	innovation_level	-0.0424	0.02	-1.6300	0.1120	
Loans	const	0.0114	0.00	1.2800	0.2010	
	budget	-0.0030	0.00	-0.6000	0.5520	
	age	-0.0002	0.00	-0.4600	0.6450	
	NACE	-0.0033	0.00	-0.6600	0.5080	
	innovation_level	0.0011	0.00	0.2400	0.8070	

Source: Authors' elaboration

Notes: "SE" is the standard error. The symbols *, ** and *** denote statistical significance at the 10%, 5% and 1% levels, respectively.

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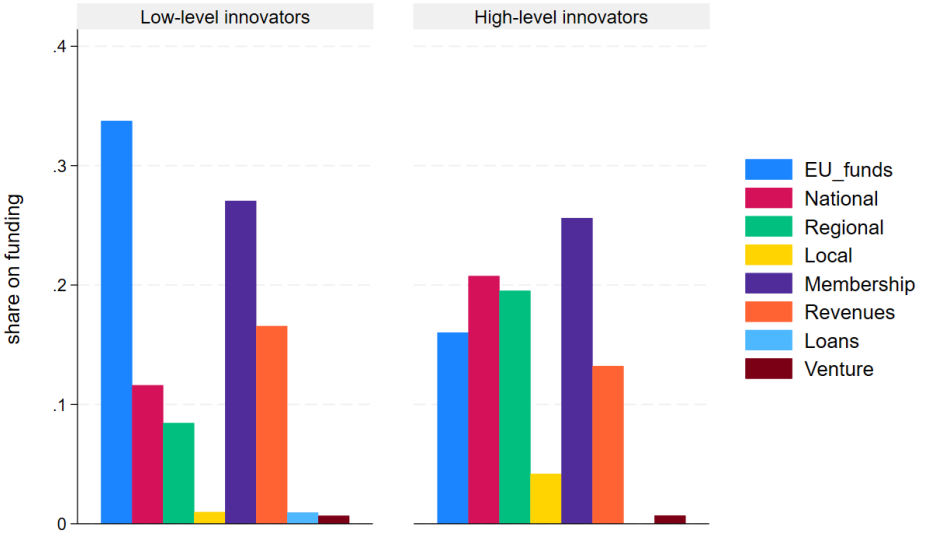
Figure 2 | Mean values of funding sources (low-level vs high-level innovating countries)



Source: Authors' elaboration

4 Discussion and Concluding Remarks

The results indicate that there are significant differences in funding resources between the cluster groups from different countries. The most marked differences are in the structure of public resources in the cluster budgets. In particular, the clusters from post-communist countries are dominated by the EU structural funds and community programmes while clusters from the developed countries use regional subsidies and grants to a greater degree. This can be explained by the fact that public funds from the other three sources (national, regional and local) are not available in post-communist countries to the same extent as in developed countries. Local subsidies and grants are a source of funding which is not used to a considerable extent by clusters in either post-communist or developed countries. In both groups of countries, this type of resource might be perceived as complementary rather than the main source of funding. It should also be mentioned that the differences between clusters from post-communist and developed countries in utilizing private resources are lower in comparison to their public counterparts. In saying this, membership fees are one of the pillars of funding for both groups of clusters. Their share in the annual budgets is almost the same across different groups of countries. In contrast, cluster revenues from their own activities are the only private source for which a statistically significant difference was found between the clusters in the post-communist and developed countries. Other private sources such as credit funds, bank loans, venture capital, business angels and donor contributions are used rarely and to a minimal extent by the clusters across the examined country groups. As such, no significant differences were observed for these types of private sources.

The results were found to be almost identical when we applied a different country group segmentation (based on the level of innovativeness). We found that the post-communist countries are rated as having lower levels of innovation while most of the developed countries are high-level innovators. The only exceptions are the Spanish, Italian, Portuguese and Greek clusters (categorized as developed countries with a lower level of innovativeness).

Based on the results, the following conclusions can be drawn:

1. The share of public and private resources in clusters' budgets varies in the different country groups in the study. It has been shown in earlier research that public resources have again started to dominate over private resources in European cluster budgets over the last five years (see, e.g., Adamovský et al., 2024; Sedlmayr et al., 2021).
2. In line with Kergel et al. (2018) and Adamovský et al. (2024), clusters in the Danube Region (or V4 countries, respectively) are mainly clusters in countries with lower levels of innovation performance. The current study can confirm that clusters from post-communist countries (or those with lower level of innovation) have a higher share of EU funds in their budgets than in the developed countries (or those with higher innovation performance).
3. The share of membership fees is approximately the same across all the cluster groups. Although membership fees are the most heavily used private source in cluster budgets, they are roughly equal in each cluster group according to both distributions.
4. Clusters rarely use credit funds, venture capital, business angels or donor contributions.

It is evident from previous research that clusters in the post-communist countries and also in the countries with lower levels of innovation performance have to compensate for the frequent lack of financial resources in their budgets from national, regional and local subsidies and grants. In this case, they have to secure a larger share of public financial resources from EU structural funds and community programmes as well as through a larger share of cluster revenues from their own activities. At the same time, the support for clusters in these countries at the national, regional and local levels is insufficient. It is also necessary to mention that this research has limitations. Indeed, it would undoubtedly be more beneficial to work with a larger sample of European clusters. Future research could also compare the funding structure of European clusters with clusters in other parts of the world where cluster policy is at a higher level. In particular, it could look at clusters in North American countries as well as in developed and innovative Asian countries. This would raise the level of cluster policy in EU countries. Although cluster organisations are active in all EU member states, only half of them have developed dedicated cluster policies to support clusters' activities. The development of such dedicated cluster policies throughout the EU is crucial to further enhancing the contribution of cluster organisations to industrial competitiveness and transition processes. It is imperative that cluster policy be integrated into the respective industrial EU, national and regional policy context. This integration can simultaneously create synergies with adjacent policies such as smart specialisation, training initiatives, internationalisation strategies or start-up programmes. Cluster organisations are ideally placed to assume a pivotal role within this framework. Cluster organisations and the

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implementation of dedicated cluster policies are of significant importance in the further development and improvement of numerous areas on the European single market. This includes the facilitation of economic resilience and market integration and the support of SMEs in their internationalisation efforts and cross-border projects (Kramer et al., 2024). These are also the reasons for cluster support in the post-communist countries, as well as in the countries with a lower level of innovation performance in general, to be predictable, systematic, well-targeted, of optimal size and to come from national, regional and local budgets more than has been the case so far.

Acknowledgement

Funding: No special funding.

Conflict of interest: The authors hereby declare that this article was not submitted or published elsewhere. The authors do not have any conflict of interest.

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Appendix

Appendix 1 | Questionnaire

Dear Sir or Madam,

Let me kindly ask you for cooperation in completing a questionnaire regarding methods of cluster funding in Europe. The questionnaire is designed for cluster representatives in all European countries. It consists of seven questions and will not take longer than 5–7 minutes.

By completing the questionnaire, your cluster can enjoy the opportunity to compare itself with other clusters in Europe. You will be supplied with some valuable and interesting findings about the survey as soon as the information has been collected, processed and evaluated. I did a similar comparison back in 2012 and 2017; the results are attached. One of the key outputs of this research will be exploring the trend in cluster funding and how it may have changed over the last ten years.

Should you have any further questions, do not hesitate to contact Assoc. Prof. Peter Burger, PhD., e-mail: peter.burger@tuke.sk.

All information provided will be treated as strictly confidential and will not be disclosed to any third parties. Of course, you are not obliged to answer all the questions, even if you have agreed to participate in the survey.

Thank you for your willingness to complete the questionnaire.

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1. Please indicate the country where your cluster is registered.

2. Please specify the cluster industry.

3. Provide your position within the cluster. You are:

- chief executive officer (CEO), manager or cluster facilitator
- cluster employee not working in a managerial position
- member of the administrative or supervisory board of the cluster
- employee of the cluster leader or cluster member organisation

4. Please enter the year of establishment of the cluster whose member you are.

5. Mark the amount of the annual budget of your cluster.

- < €5,000
- €5,000–25,000
- €25,000–50,000
- €50,000–100,000
- €100,000–500,000
- €500,000–1,000,000
- €1,000,000–5,000,000
- > €5,000,000

6. Indicate the approximate structure of funds in your cluster. Specify the shares of individual funds within the annual budget of the cluster (expressed in percentage, while the total is 100%).

International funding sources (e.g., EU funding for clusters – EU structural funds and framework programmes or funding from other international organisations)
0%

National budgets (national/governmental funds)
0%

Regional budgets (regional funds, including the state level in the case of federal states)
0%

Local budgets (municipal funds)
0%

Membership fees of cluster members
0%

Revenues generated from the cluster's own activities
0%

Credit instruments – bank loans
0%

Venture capital, business angels, crowdfunding circles and donations
0%

Other resources... please, describe the other resources:
0%

7. How long do you think cluster support from public funds should last?
0 – Mark it if you regard cluster support from public funds as inappropriate.
10 – Mark it if you think that cluster support from public funds should last ten years or longer.

- 0 years
- 1 year
- 2 years
- 3 years
- 4 years
- 5 years
- 6 years
- 7 years
- 8 years
- 9 years
- 10 years

Thank you for your time, willingness and cooperation in completing the questionnaire.

The research article passed the double-blind review process. | Received: 30 September 2024**; Revised:** 3 December 2024**; Accepted:** 17 December 2024**; Available online:** 13 April 2025**; Published in the regular issue:** 8 October 2025.