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Fostering place-based innovation and internationalization – the new turn in German technology policy

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ABSTRACT

Since the mid-1990s German technology policy has experienced a paradigmatic shift from standard grant schemes towards a region-oriented and competition-based R&D policy. Currently, a new policy experiment, the InterClust contest, is under way, trying to simultaneously foster place-based innovation, R&D internationalization and the internationalization of innovative places. The current paper analyses the new policy, relating it to the recent literatures on heterogeneous firms and on cluster-life cycles, and presents results from a firm survey performed in 21 winner regions of InterClust. Findings show that the new funding scheme takes insights from recent theoretical developments into account and addresses important impediments to firm and cluster internationalization. Although it is too early for an overall assessment, it is argued that the long-term impact will critically depend on the inflow of heterogeneous knowledge and the strength of intra-regional mobilization effects.

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1. Introduction

In times of digitalization and growing complexity of research, international cooperation in research, development and innovation is becoming increasingly important. Innovators draw on knowledge and ideas from across the world, although they are often rooted in unique local and regional environments that allow them to combine local and global resources. Production and innovation are increasingly organized in global value chains and fragmented across countries (OECD, 2015). The emergence of new global centres of innovation in emerging countries provides new opportunities and challenges for innovative firms in Europe and the US.

Innovation policy has to take these new developments into account. The German Federal Government and, in particular, the Federal Ministry for Education and Research (BMBF) plays a particularly active role in this respect. In 2015 BMBF has launched a new, large-scale funding measure ‘**I**nternationalisation of **L**eading-edge **C**lusters, **F**uture Concepts and **N**etworks’ (short: *InterClust*) that has a volume of more than 100 million € and tries

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to combine the strengths of place-based innovation policy with the dynamic benefits of internationalization. The current paper investigates the innovative features of *InterClust* and tries to assess its chances of success by dealing with the following questions:

- (i) What are the expected effects of the policy programme on the performance of funded firms and research institutes?
- (ii) What is necessary to make sure that the benefits spill over from funded firms and research institutes to other cluster actors, and that the international cooperation induced by the public funding is sustainable?¹
- (iii) Which aspects of the new policy may be critical?

The overarching research question is:

- (iv) Can the programme effectively combine policy elements related to benefits from localized and international knowledge exchange, i.e. does it make sense to support the formation of international research collaborations out of local cluster initiatives?

Although the discussion on ‘cluster internationalization’ is not completely new, as some of the most successful clusters have always combined ‘local buzz’ with ‘global pipelines’ (Bathelt, Malmberg, & Maskell, 2004) and more and more cluster initiatives begin to look beyond their traditional geographic boundaries (Ketels, 2014), large scale policy programmes to simultaneously foster place-based innovation and internationalization are scarce and their effects and limitations are not well understood. Here the current paper will contribute. To answer the above-named questions we relate the design of the new policy to different strands of theoretical literature and make use of own organization surveys in the funded clusters of *InterClust*.

The remainder of the paper is organized as follows: The next section discusses the background and rationale of *InterClust* and presents the new policy instrument in detail. Section 3 discusses strengths and weaknesses of the policy instrument from a theoretical perspective. Section 4 presents empirical evidence from a comprehensive survey among organizations in 21 winner regions of the first two rounds of the *InterClust* competition. Section 5 discusses some critical features of the new policy and Section 6 concludes.

2. Description of the new *InterClust* programme

2.1. Background

The new policy instrument may be seen as the amalgamation of two major trends in German technology policy: The trend towards place-based innovation policies that started in the mid 1990s and the trend to foster international cooperation in research and development (R&D) that has gained momentum since 2009.

As is well documented in the academic literature, the BMBF has been a forerunner in the development of place-based innovation policies. The BioRegio contest, initiated by the BMBF in 1995, is a showcase of place-based technology policy that has received substantial attention in the scientific community (Cooke, 2002; Dohse, 2000, 2007; Eickelpasch & Fritsch, 2005; Engel, Mitze, Patuelli, & Reinkowski, 2013) and paved

the way for a large number of similar measures inside and outside Germany.² A key rationale behind place-based technology policy is utilizing the regional level to boost national innovation and competitiveness (Dohse, 2000). The BioRegio contest (as well as many of the subsequent funding measures) was designed as a competition among self-organized regional units for R&D funding. It followed a new, holistic approach trying to integrate economic, scientific and administrative activities within a region to foster biotechnological capabilities and the establishment of biotech industries in the regions. BioRegio had substantial positive effects in terms of firm births, reputation of winning regions and short-term R&D activity (Dohse, 2000; Engel et al., 2013; Staehler, Dohse, & Cooke, 2007), whereas results with respect to long-term R&D activity remain ambiguous (Engel et al., 2013).

With the launch of the Leading-Edge Cluster Competition in 2007, the Federal Ministry of Education and Research (BMBF) introduced Germany's first nationwide cluster funding programme, open to all technologies and to be made conditional on a long-term strategy. In a total of three competition rounds, an independent jury selected 15 leading-edge clusters from more than 80 competition entries and the winning clusters received funding for a maximum of five years.

At about the same time (2009) the German Federal Government launched a comprehensive strategy to push internationalization of science and research that was enhanced and updated in 2017 (Deutscher Bundestag, 2017). The Federal Governments Strategy for Internationalization of Education, Science and Research (in short: *Internationalization Strategy*) is focused on achieving five strategic objectives: (i) Strengthening excellence through global cooperation, (ii) Developing Germany's innovation capacity internationally, (iii) Expanding vocational training and qualification internationally, (iv) Working with emerging and developing countries in shaping the global knowledge society and (v) Overcoming global challenges together (BMBF, 2017). The first two objectives quite obviously reflect German national interest: The underlying idea is that exposing oneself to international competition while at the same time integrating into international research networks and global value chains is the best way to sustain research excellence and innovation capacity. The third objective seems to be driven less by national interest at first glance. However, one main idea behind internationally expanding the German system of vocational training and qualification is to facilitate international activities of German enterprises (BMBF, 2017). A similar argument holds for the fourth objective: Working with emerging and developing economies will help the development of these countries, but it will also help German enterprises to get a foot into the door in these increasingly important markets. The fifth objective, by contrast, appears as a truly international one, cooperatively tackling global challenges (e.g. climate change, health, food security) that do not stop at national borders.

The new policy experiment *InterClust* may thus be seen as a straightforward combination and enhancement of elements of the long established policy of fostering place-based innovation and the more recent internationalization turn in German innovation policy.

2.2. Policy design

InterClust supports German clusters and networks in advancing their cooperation with international partners in the field of R&D. The principle design of the new policy measure is displayed in Figure 1.

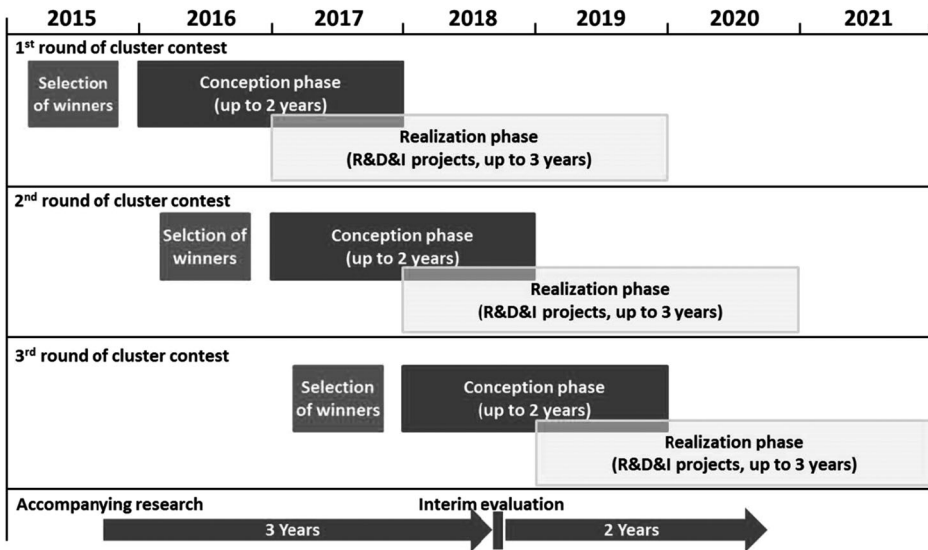


Figure 1. Principal design and time schedule of *InterClust*. Source: BMBF (own illustration).¹⁶

There are three competition rounds, starting with the selection of winners in 2015, 2016 and 2017.³ In each round about ten outstanding clusters and networks are selected for further funding. For each winning cluster an amount of up to four million Euro of funding is available. Table A1 in the appendix gives an overview of all winning clusters. The ‘selection of winners’ phase is followed by two further phases: In the concept development phase (duration: up to two years) cluster managements and cluster organizations shall develop internationalization strategies, get in contact with international partner innovation regions and mutually work out project ideas in a bottom-up process. In the final implementation phase (duration: up to three years) international cooperation will be established by conducting up to three collaborative R&D projects with international partners from the partner innovation regions.⁴ The funding of the cluster managements needs to be matched by 50% funding of their own, and a minimum of two cluster organizations as well as two foreign partners need to be involved in each project. The conducted projects are part of the internationalization strategy, but the strategy as such should be much more encompassing and sustainable, and the visions, aims and instruments should improve the conditions for all organizations in the cluster and not just for those participating in the selected projects.

InterClust has – according to BMBF – several overarching objectives.⁵ A key objective is to create sustainable positive effects for the development of German regions as a result of the international cooperation. The winning clusters are induced to sharpen and enhance their competence profile through cooperation with international partners that are excellent in their respective field and contribute complementary competencies to their common R&D project. This is expected to have a positive impact on the reputation of German clusters. Positive impacts are also expected on the cluster management level. As cluster managements prepare for international cooperation they will have to deal with new topics, in which they have to strengthen their own competencies. These include, but are not limited to, intellectual property protection, intercultural skills, open innovation and knowledge management.

Table 1. Overview of target countries in the first two rounds of the *InterClust*-project.

Target countries	Number of clusters Targeting the country
USA	6
Japan	5
Netherlands	4
Belgium	3
Czech Republic	3
Canada	3
France	3
South Korea	3
<i>Brazil</i>	2
Finland	2
Spain	2
UK	1
Austria	1
<i>China</i>	1
Denmark	1
Italy	1
Poland	1
Singapore	1
Slovenia	1
<i>South Africa</i>	1
Overall: 20	Overall: 45

Source: *InterClust* project homepage (www.interspin.de), own illustration.

Participating clusters are expected to be excellent in their respective business field, possess a leading position in their area of competence and have a successfully implemented innovation strategy in place (BMBF, 2017). According to BMBF, potential international partners need to be able to realize the cooperation on equal footing. For example, this encompasses the ability to find proper funding or have the necessary technological know-how to implement the R&D projects. Both partner clusters are expected to design joint rules of cooperation which stipulate matters of IP-protection and the exploitation of generated ideas and innovations.

In view of the high technological standards required to be on equal footing with German high tech clusters, it is not surprising that most international partner regions are located in advanced industrialized countries close to the ‘world technology frontier’, as can be seen from Table 1. It lists all targeted countries and presents the number of German clusters that target partners in the respective country for R&D cooperation.

Overall, the U.S., Japan and the Netherlands are the three most often selected target countries.⁶ Still there exists a long list of countries (20 in total) from which partners are selected, indicating that the clusters search for the best fitting partners no matter where those are located and aim at sourcing knowledge worldwide.

3. Why it might work: theoretical underpinnings of policies to support cluster-internationalization

3.1. Necessity to increase knowledge heterogeneity in clusters

While there has been earlier scientific work describing the interplay of ‘local buzz’ and ‘global pipelines’ (e.g. Bathelt et al., 2004), policy makers for a long time focused mainly

on fostering interaction and co-operation on a local or regional level, assuming that externalities operate on short geographical distances only. In the following two complementary approaches are described which both point to the necessity to increase heterogeneity at the regional or cluster level or to incorporate unrelated knowledge to prevent a lock-in situation and to sustain long-term innovativeness and growth.

The first approach is the cluster life cycle (CLC) model (Brenner & Schlump, 2011; Fornahl, Hassink, & Menzel, 2015; Menzel & Fornahl, 2010). Menzel and Fornahl (2010) have established a model of cluster dynamics which follows different developmental stages (*emergence, growth, sustainment and decline*; see Figure 2). They identify two key variables that change over the course of the life cycle and characterize each stage, namely the *number of employees* and the *heterogeneity of accessible knowledge* (Menzel & Fornahl, 2010, p. 218). The core drivers in their model are learning processes among actors in the cluster and subsequent changes in the heterogeneity of the knowledge base that lead to transitions from one cluster stage to another. For the transition from the emergence to the growth stage, the emergence of a thematic focus is necessary in order to gain from synergies between the organizations. Hence, growth in the number of employees and firms is achieved by a decrease in heterogeneity. During the *growth phase* the number of firms increases rapidly, as well as the number of employees, and firms become increasingly interconnected. Organizations learn from one another by intensive and recurring observation, interaction and cooperation. This results in a high rate of (incremental) innovation activities, but at the same time the heterogeneity of knowledge in the cluster decreases and firms' knowledge bases become increasingly similar.

Hence, in the *sustainment phase* it is most important to find adequate stimuli in order to sustain a level of heterogeneity that is high enough for the organizations to learn something new from one another, but at the same time low enough that the organizations in the cluster can benefit from synergies and agglomeration externalities (see Nooteboom, 2000 for a discussion on 'optimal cognitive distance'). If such impulses can be introduced

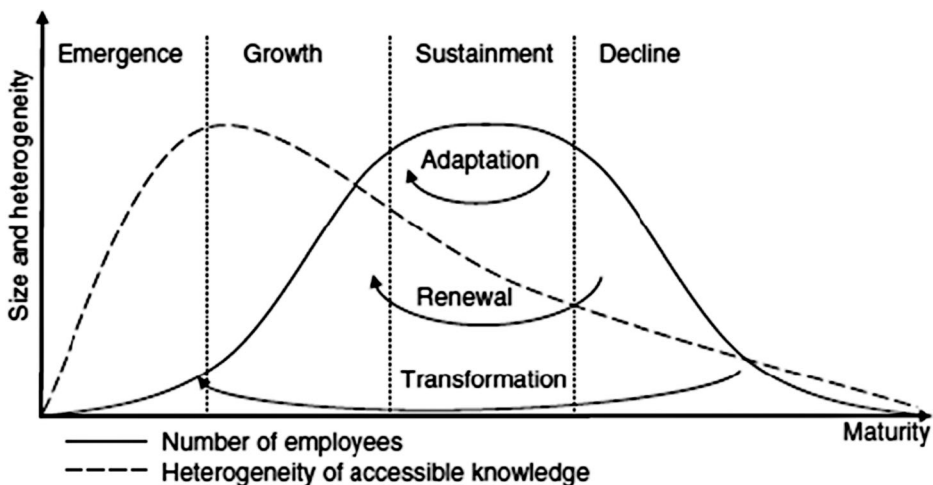


Figure 2. The cluster life cycle. Source: Menzel and Fornahl (2010), p. 218.

effectively, the cluster might be able to continuously generate innovations that increase productivity even further or start new product cycles. When the cluster fails to set such stimuli, the effect of increased rates of local learning combined with too much proximity and overembeddedness in the cluster leads to a cognitive or technological lock-in, drawing local actors towards inferior routines and solutions (Uzzi, 1996). This prevents them from recognizing opportunities in new markets and technologies (Lambooy & Boschma, 2001). As the overall number of its employees and the heterogeneity of its members decrease, the cluster loses innovative potential. Hence, a long-term success of the cluster is dependent on increases in knowledge heterogeneity by adaptation, renewal or transformation processes. While adaptation refers to incremental increases in heterogeneity, renewal and especially transformation processes have a more radical nature.

The second approach is complementary to the CLC approach by directly focussing on the relatedness of the regional or cluster knowledge base without differentiating into specific stages of development and leaving learning processes aside. *Technological relatedness* guarantees on the one hand a level of similarity which enables the exchange of knowledge and efficient learning processes and on the other hand a certain cognitive distance providing the potential for new knowledge combinations and innovations (Fornahl, Broekel, & Boschma, 2011). Diversification and branching are partly bound to the existing knowledge base and will follow paths consisting of closely related technologies. Based on these processes technological relatedness leads to path dependencies in technology development, but should prevent a lock-in for a longer period of time (Boschma, Heimeriks, & Balland, 2014). However, these regional path dependencies primarily lead to the emergence of incremental innovations with rather limited economic potential in the long term. In order to have a long lasting competitive advantage more radical innovations are necessary (Castaldi, Frenken, & Los, 2015). Hence, it is a crucial question, how organizations can escape the forces of path dependence and diversify into sectors or technologies that are – to some extent – unrelated to their current knowledge base.

3.2. Role of international linkages to broaden the local knowledge base

In order to stimulate cluster heterogeneity and to avoid the risk of becoming too narrowly focused, one possibility is to open the thematic boundary of the cluster and add related knowledge bases, technologies or industries from inside the cluster region. Another alternative is opening up the geographic boundary aiming at including knowledge from the thematic field of the cluster but from different locations (Boschma, 2005). This includes going international. Internationalization provides access to complementary assets, new market relationships and non-redundant information which is not available in the domestic market (Morisson, Rabellotti, & Zirulia, 2013), thereby enriching the cluster's knowledge base and making it more heterogeneous (Bathelt et al., 2004). The inflow of heterogeneous knowledge, in turn, can lead to a re-vitalization and renewal of the cluster, acting as a positive shock. Several studies have shown the effect of extra-local knowledge sources on innovativeness and knowledge accumulation (Owen-Smith & Powell, 2004; Rosenkopf & Almeida, 2003). Furthermore, they identified two important mechanisms having an effect on knowledge flows, namely *alliances* and *researcher mobility*. The effect of alliances and mobility increases with technological distance, indicating that by these mechanisms more unrelated knowledge can be transferred into the cluster.

However, the question arises whom to select as the most appropriate international partner. This relates first to the quality of the potential partner as well as to the matching. The latter again points to the importance of relatedness. If the acquired knowledge is either too similar or too different, compared to the already existing knowledge, it is possible that positive effects fail to materialize (Boschma, Eriksson, & Lindgren, 2008). Hence, the knowledge base and competences of foreign partners should be related to the own ones. Still more new ideas can enter the cluster compared to diversification based on regional assets because other distances (e.g. cultural distance) might lead to new perspectives and new ideas; although cognitive proximity might be high. Additionally, since bridging distances comes with a cost, it is unlikely that the geographic and the thematic boundaries are opened at the same time. Hence, an internationalization strategy should in a first step focus on knowledge cooperation inside the same or related thematic field(s).

3.3. Clusters as eco-systems for internationalization

Internationalization can be an important channel to increase heterogeneity and introduce new ideas into a region. But why are clusters in particular well suited to be the target for policy intervention? We want to address this question in the following.

A recent strand of literature in international economics investigates the reasons why firms differ in their propensity to enter foreign markets and their ability to do so. The theoretical basis for this literature was laid by the Melitz (2003) model of firm heterogeneity and trade. A key assumption underlying the Melitz model is that enterprises must pay sunk costs of exporting in order to enter foreign markets. Firms below a given productivity threshold are unable to cover these costs and will therefore only produce for the domestic market, whereas firms above this productivity threshold are also able to successfully commercialize their products overseas (Melitz, 2003). However, firm productivity and firm performance in general are not independent of location (Audretsch & Dohse, 2007; Combes, Duranton, Gobillon, Puga, & Roux, 2012). It is in particular young and small firms in knowledge-intensive sectors that tend to benefit from thick local input markets and from localized knowledge spillovers. The existence of regional network structures or other mechanisms, such as labour mobility, allows for knowledge exchange with other firms which target similar export markets. Therefore, firms embedded in local networks and other channels of knowledge transfer can be expected to have lower sunk costs of exporting since they benefit from knowledge spillovers. This can, in turn, be expected to increase their probability to enter foreign markets.

Exporting is, however, only one means of internationalization. Outsourcing might be seen as a further means in order to get access to superior inputs, including knowledge, that are not available in the domestic market, thus raising the quality of the produced good (Humphrey & Schmitz, 2002). Firms might also outsource certain inputs of their production process to low-cost regions abroad to improve their competitiveness (Belussi & Sammara, 2010). Developed clusters can thus profit from the internationalization of embedded firms which outsource activities to 'growth peripheries' (Storper & Walker, 1989). But the effect on the cluster level is difficult to predict. Outsourcing can reduce the number of firms and employees in the cluster, if parts of the production process are shifted. If other parts of the production processes or R&D activities stay in the cluster, these activities might gain from access to international input markets or division of labour.

Gaining access to larger output markets can be especially important for firms in high-tech industries, where some firms produce highly specialized products for niche markets. Their domestic market alone is often too small for firms in order to increase production and to reach minimum efficient size. These so called 'born globals' are targeting international markets directly from their inception on (Madsen & Servais, 1997). Connecting local cluster players with partners abroad provides local firms with information about the foreign market structure and helps them gather critical information in general.

Especially small and young firms often lack the resources to gather and process information on foreign markets. Knowledge spillovers from firms with prior international experiences to small and medium-sized enterprises (SMEs) can substantially decrease the information costs on foreign markets and the sunk costs of internationalization as a consequence. This strong exposure to cluster-internal knowledge spillover and knowledge networks can be further enforced by active cluster management organizations. While Fernhaber and Li (2013) already found that peers in a firm's network affect a young SME's general propensity to internationalize, Oehme and Bort (2015) extended this result by identifying that even the mode of internationalization is imitated in close networks and clusters.

Cluster-internationalization can also play a crucial role in attracting foreign firms, investors or partners for co-operation. Andersson, Evers, and Griot (2013) find positive effects of cluster reputation on SMEs. The attractiveness of a region and its reputation in general reduce the perceived risk of dealing with little-known SMEs in the eyes of foreign investors or cooperation partners. Furthermore, cluster reputation can serve as a substitute for firms' own international reputation. This is especially helpful for young and small firms, since building up their own international reputation can be a costly and lengthy endeavour (Zyglidopoulos, DeMartino, & McHardy Reid, 2006).

3.4. Enabling local learning processes to diffuse external knowledge

Organizations may function as gatekeepers in a cluster who search for and absorb non-local knowledge (e.g. Morrison, 2008), leading to the primary effect of an increase in the heterogeneity of knowledge in the cluster. But the flow of external knowledge to the cluster does not automatically spill over to each member of the cluster (Bathelt et al., 2004). Two important aspects should be noted that can influence the diffusion of knowledge: First, the possibility for intensive learning processes based on observation, communication or interaction must be present in the cluster. The latter is strongly affected by the degree of relational capital and, thus, by the direct and indirect links between the actors in the cluster (Bathelt et al., 2004). Second, actors especially learn well from those other actors that are comparable, e. g. in sectoral or technological background, production processes, size or age. In such cases a role model effect increases the likelihood that knowledge and information are incorporated in the own firm (Fornahl, 2003).

From the above it can be seen that there exists a non-negligible likelihood that external knowledge is just shared in closed 'clubs of partners' (Giuliani, 2007; Morrison, 2008). This problem especially occurs for younger firms and SMEs which are often not at the core of the local exchange. One way to organize knowledge exchange processes is the employment of a cluster management, whose main task is to establish jointly with the organizations from the cluster a strategy of how the whole cluster can benefit from the internationalization of some of its organizations.

4. Empirical evidence: results from a survey

4.1. Survey design

This section presents empirical evidence from a comprehensive survey among firms and research institutes in 21 winner regions of the first and second rounds of the *InterClust* competition. In the first part of the survey, respondents give general information about their organization, such as firm age, innovation activity and internationalization of their firms. In the latter parts the focus shifts towards obstacles to organization-level internationalization and the role that cluster-internationalization policies could play in overcoming these obstacles.

We addressed a total of 2050 firms and research institutes across 21 clusters of the first two rounds in the fall of 2016 and 2017.⁷ Our sample comprises 456 participants who sent back usable responses, from which 371 are firms (81%) and 85 are research institutes (19%), yielding an overall response rate of 22.2%.

4.2. Firm innovation and internationalization in the cluster context

Our sample comprises firms of different size classes.⁸ 126 firms are micro enterprises, another 131 are small and medium sized enterprises and 92 are large enterprises. 22 firms could not be classified as they didn't answer the questions related to turnover and employment.⁹ Of all responding firms, 77.7% invest in R&D activities. R&D expenditures as a share of total firm turnover are decreasing in firm size. In contrast to the share of R&D expenditures, the share of international turnover in total turnover is increasing in firm size. Engagement in international markets in general is high for cluster firms. 86.5% of the responding firms are already active abroad. Even though the winning clusters are excellent in their respective sectors and technologies, such a high share in international engagement still seems noteworthy. A self-selection of internationally active firms into this sample cannot be dismissed. Due to the international focus of the survey, some firms that are only engaged in domestic markets and are not actively involved or interested in their respective cluster's internationalization, might not have participated in the survey.

87.4% of all internationally active firms export goods or services, while 59.9% import. Additionally, 30.2% are active abroad via foreign direct investments (FDI) and 64.5% have some form of cooperation agreements with foreign partners. Furthermore, 16.8% are involved in the exchange of human capital with foreign firms.

Figure 3 relates firm internationalization to cluster-internationalization, by illustrating which part of the respective internationalization categories was embedded in the internationalization strategy of the cluster as a whole. It is evident from Figure 3 that very little international activity is directly linked to cluster-internationalization. This should not come as a surprise, since for some clusters their participation in *InterClust* represents their first attempt of setting up a cohesive internationalization strategy for the cluster as a whole. Cooperation agreements play the most prominent role here. They can be seen as a means to establish a first connection to foreign partners, serving as the basis for further R&D cooperation and other modes of international activity in a later stage. In order to establish proper links to international innovation regions and benefit from heterogeneous knowledge, a certain level of trust is necessary.

For all other internationalization categories, cluster-internationalization does not seem to play a particularly important role as yet.

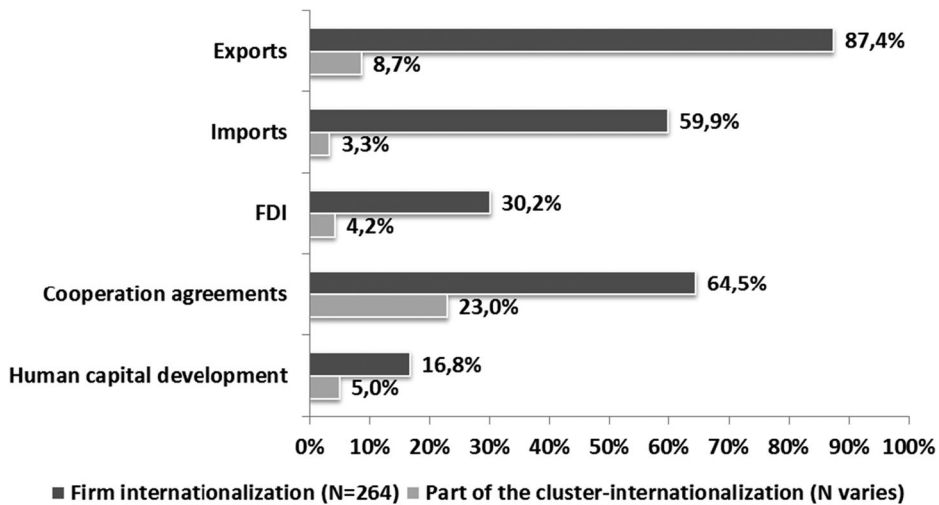


Figure 3. Firm internationalization categories and their embeddedness in cluster-internationalization. Source: Own survey.

To get a better understanding of which firms utilize their cluster ties more extensively when addressing foreign markets and, more specifically, in which category of internationalization this is the case, firms are divided into two age groups (young firms, i.e. firms in the first age quartile and all other firms).¹⁰ When distinguishing between younger and older firms it becomes evident that (i) firms in the lowest quartile of the age distribution (10 years or younger) have significantly lower international engagement than older firms (77.0% compared to 89.9%) and (ii) that cluster-internationalization is relatively more important for the internationalization of younger firms than for the internationalization of older firms.

Figure 4 displays international activities conducted as part of the cluster-internationalization for different age groups. As can be seen, for younger firms the cluster context is more important than for older firms.

For 33.3% of younger firms cooperation agreements have been arranged as part of the cluster's internationalization efforts, which is a significantly higher share than for older firms (19.3%). Furthermore, the cluster context seems to be much more important for younger firms' export activities (19.1%) than it is for older firms (6.0%).¹¹ This result supports the hypothesis that it might be particularly young firms that stand to benefit from cluster-internationalization. The relative importance of the cluster context in young firms' export activities fits the theoretical considerations of the previous chapter with respect to the Melitz (2003) model. Cluster-internationalization could lead to lower fixed costs of exporting (or reduce market entry costs) especially for younger firms, and might thus help them become exporters (see Section 3.3).

4.3. Expectations of cluster actors with respect to *InterClust*

4.3.1. Awareness of cluster policies/strategies

Our survey results show that, overall, 36.1% of organizations do not know their clusters' internationalization strategy, at all. This number increases to 42.9% when asked about the current *InterClust* measures. These numbers seem fairly high and uncover an important

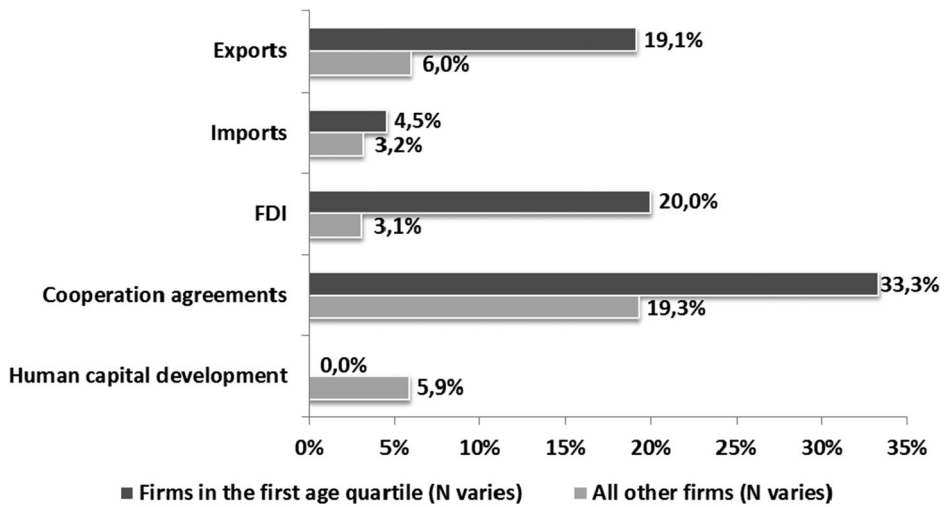


Figure 4. International activity related to the cluster-internationalization by firm age. Source: Own survey.

problem that cluster managements should work on if they want to reach a larger group of cluster actors, namely the aspect of direct and indirect links between actors in the cluster (compare ‘relational capital’ in Section 3.4). In light of creating a cluster environment in which knowledge and market information is to spill over from participating players to those that do not participate directly in R&D projects, information flows within clusters need to be substantially improved.

Significant differences arise between firms and research institutes. Research institutes are better informed than firms about the overall internationalization strategy of their cluster and about the current measures in the *InterClust* project, as well. Only 20.5% of research institutes do not know the cluster’s internationalization strategy, compared to 39.8% of firms. A similar pattern holds for the current *InterClust* measures (29.5% compared to 46.1%).¹² These results are directly related to the reported engagement of organizations in setting up the cluster’s strategy. Almost 40% of research institutes are somehow involved in developing the strategy, while only 27.3% of firms state that they are involved in some capacity. As was mentioned in Section 3.4, it should be avoided that only a ‘closed club of partners’ – those organizations involved in developing the strategy – is sharing new information. These results cannot dispel doubts about a limited diffusion of knowledge inside the clusters.

4.3.2. Main beneficiaries of cluster-internationalization

When the organizations are asked which cluster players will benefit in particular from the cluster-internationalization, *research institutes* and *SMEs* emerge as frontrunners (see Figure 5). This holds true across all organizations. Only 19.5% of large firms see themselves benefiting in particular from this policy. The answers of micro firms are slightly more diversified than those of large firms, SMEs and research institutes, but the main trend still applies. Research institutes and SMEs are viewed as the players that will benefit most from *InterClust*.

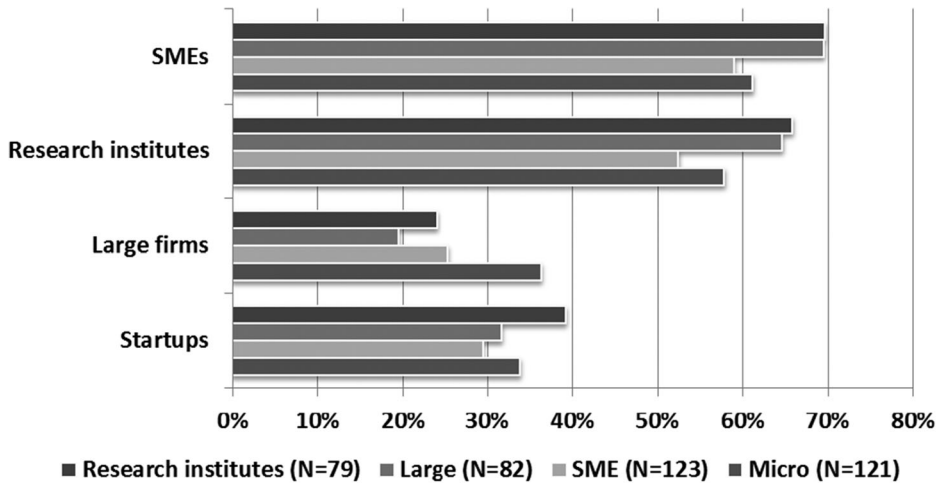


Figure 5. Organizations’ perception of main beneficiaries of cluster-internationalization. Source: Own survey.

The perceptions of the organizations are aligned with the overarching goals of *Inter-Clust*, as excellent research and strengthening internationalization of SMEs are at the core of this policy measure. While taking into account that official statements with respect to the objective of the policy might have affected the respondents’ perception, it appears that the policy is designed in such a way that cluster members identify the same potential beneficiaries as the public sponsor.

4.3.3. Barriers to the internationalization of firms and research institutes

Before looking at the expected advantages and disadvantages of cluster-internationalization, it is important to better understand the main barriers to internationalization, as perceived by firms and research institutes. As can be seen from [Figure 6](#), barriers to market

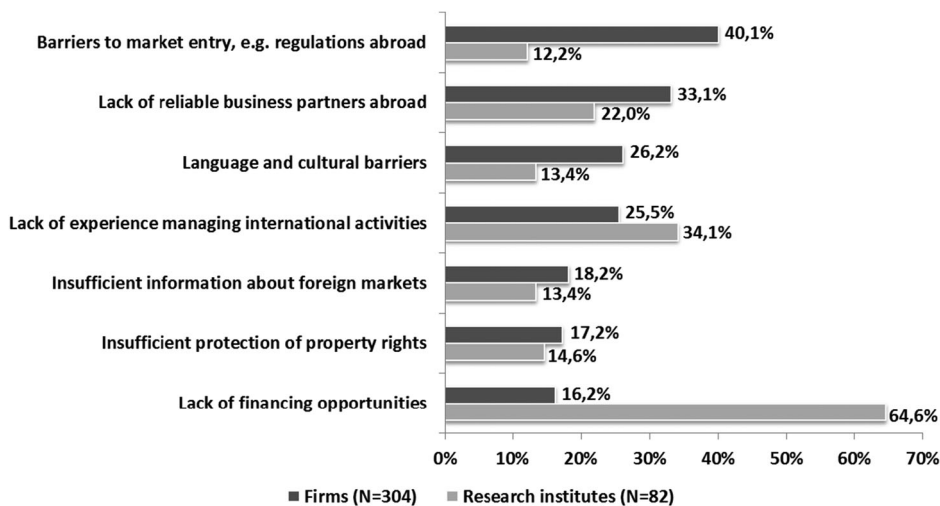


Figure 6. Most important obstacles to internationalization. Source: Own survey.

entry and a lack of reliable business partners abroad are the most prominent barriers to internationalization for firms (mentioned by 40.1% and 33.1% of all firms, respectively), followed by language and cultural barriers and a lack of experience managing international activities.

While the lack of experience managing international activities and lack of reliable business partners abroad also play a prominent role for research institutes, barriers to market entry do so to a significantly smaller extent. The most common barrier for research institutes is, however, a lack of financing opportunities, which is mentioned by 64.6%. This assessment is only shared by a relatively small share (16.2%) of firms.

Further important insights can be gained when taking a closer look at the barriers to internationalization for different groups of firms separately (see Table 2). It is striking that the second biggest barrier for large firms (after barriers to market entry) are language and cultural barriers. This barrier is also more prominent for older firms than for younger firms. A possible explanation could be that larger and older firms are more likely to have complex internationalization strategies that include FDI, where cultural and language barriers are harder to overcome than in more standardized import and export relations.

A lack of reliable business partners abroad appears to be a major internationalization barrier for young and small firms, and lack of financing opportunities plays a much bigger role for younger than for older firms.

In view of these results, the *InterClust* measure could be helpful in overcoming key obstacles to firm internationalization, such as lack of reliable and suitable partners abroad, problems of managing international activities, or cultural and language barriers. Moreover, the actions triggered by the policy measure could be helpful for firms of all size groups. An improvement in managing international activities and better relationships with suitable business partners could be achieved, for instance, by first garnering letters of intent from foreign business partners in order to set up common objectives while planning the R&D projects. This is one of the first steps that the *InterClust* winners take when they enter the concept development phase. As the project proceeds and the implementation phase starts, relationships are further institutionalized with the aim to increase trust and give the actors more security. This could help micro firms and SMEs in particular. The advantages of channelling the public support via a cluster are that the cluster managements can provide management capacities to develop a strategy, find appropriate business partners, organize IPR rules, etc. and that the firms can benefit from reputation effects.

Young firms that often lack financial capacity and foreign experience can also benefit when information about foreign markets collected by the cluster managements is made available to them. They might also benefit from better access to finance if improved

Table 2. Barriers to firm internationalization in different firm size and age groups.

Barriers to firm internationalization	Micro (N = 97)	SMEs (N = 110)	Large (N = 82)	Young firms (N = 67)	Older firms (N = 230)
Lack of reliable business partners abroad	41.2%	38.2%	20.7%	41.8%	31.3%
Barriers to market entry, e.g. regulations abroad	37.1%	40.0%	47.6%	35.8%	41.7%
Lack of financing opportunities	25.8%	20.0%	1.2%	32.8%	11.7%
Lack of experience managing international activities	24.7%	32.7%	19.5%	23.9%	26.5%
Language and cultural barriers	15.5%	25.5%	39.0%	19.4%	28.7%
Insufficient protection of property rights	15.5%	12.7%	24.4%	14.9%	18.3%
Insufficient information about foreign markets	14.4%	22.7%	18.3%	14.9%	19.6%

Source: Own survey.

cluster reputation attracts more investors. Large firms might benefit as well, for instance, if the *InterClust* competition leads to improvements in overcoming language and cultural barriers. Workshops, visits in the partner countries and teaching of intercultural competences offered by cluster managements can explicitly target this problem.

However, another important obstacle to internationalization, *regulatory barriers to entry*, cannot be effectively tackled by *InterClust* and needs to be addressed by higher policy layers.

4.3.4. Expected advantages and drawbacks at the firm level

Figure 7 displays expected firm-level advantages from cluster-internationalization.¹³ Getting *improved access to information* and *improved access to networks* are mentioned most often, followed by *opening up of new sales markets*.

There are no significant differences between firms of different size classes concerning the importance of most categories. In those cases where there are differences, these mirror the stated barriers to internationalization from before. This implies that firms in general expect to benefit from cluster-internationalization in specific areas where they face problems that have until now been harder for them to overcome on their own. The same holds for research institutes: The most frequently mentioned benefit by research institutes is *improved access to financing opportunities* which again mirrors a pressing barrier to internationalization from before.

Concerning expected drawbacks from cluster internationalization, 42.2% of firms expect that there will be no drawbacks at all. The most frequently mentioned drawback is a *high use of resources due to development and implementation of the internationalization strategy* (28.9%), followed by *outflow of human capital* (19.8%) and *stronger competition from foreign firms* (16.2%). The potential drawback of a high use of resources is shared by research institutes (49.4%).

4.3.5. Expected advantages and drawbacks at the cluster level

In addition to *advantages and drawbacks* for their own organization, firms and research institutes were asked to assess the effects of the new policy on the cluster as a whole. Figure 8 shows that the majority of organizations expect the *cluster* to be *more visible*

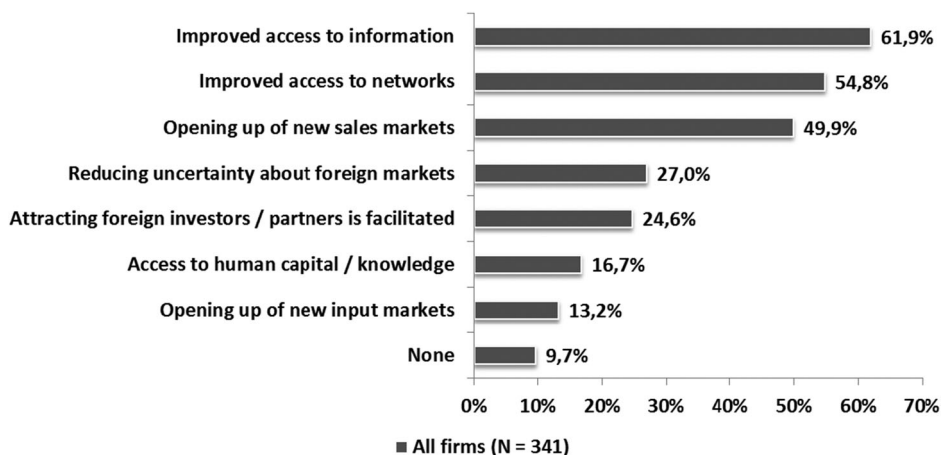


Figure 7. Expected firm advantages from cluster-internationalization. Source: Own survey.

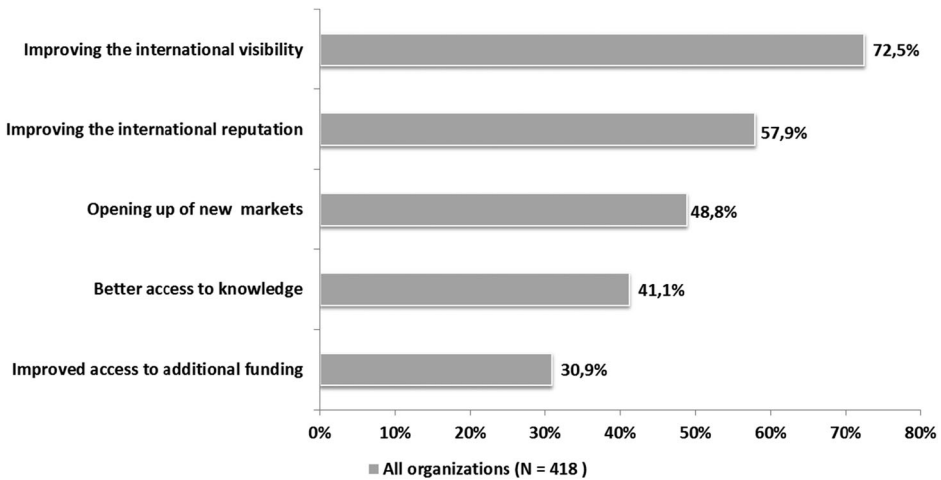


Figure 8. Selected expected cluster advantages. Source: Own survey.

and to *improve its reputation towards international players*. These advantages would be accessible for all firms and research institutes within the cluster. This is in line with arguments from Section 3.3 where it was discussed that especially young and small firms can benefit from better visibility and cluster reputation, as it reduces the perceived risk of dealing with little-known SMEs in the eyes of foreign investors and cooperation partners. Further important benefits perceived at the cluster level are *opening up of new markets* and the *better access to knowledge*.

41% of surveyed organizations do not expect any drawbacks at the cluster level. The only drawback mentioned by more than 15% of respondents is the risk that knowledge can leak out of the cluster as a result of cluster-internationalization (30.4%). Thus, before starting international R&D cooperation it is vital to take provisions regarding intellectual property protection. The problem of intellectual property protection is being dealt with as part of the *InterClust* measure, as cluster managements are offered workshops on these issues specifically and in turn, offer workshops for their organizations, as well.

5. Critical discussion of the new policy

In this section we link back to the third research question stated in the introduction and provide a discussion of some critical features of the new policy instrument.

5.1. Mobilization effects and sustainability

The long-term and indirect effects of the public funding are at the core of the programme and are one of the main differentiating elements when *InterClust* is compared to other internationalization support programmes. The purpose of the *internationalization strategy* which is embedded in the overall cluster strategy is to guarantee that many firms in the cluster profit from the *InterClust* programme and not only those involved in the funded R&D projects.

However, that non-funded firms benefit from the programme cannot be taken for granted. Only a small fraction of firms and research institutes in each cluster receives funding from these R&D projects. To make sure that benefits ‘spill over’ to other actors, the region-wide diffusion of knowledge, contacts and best practices that facilitate internationalization should have a high priority in the internationalization strategies as well as in the agenda of the cluster managements. A common good shared by all cluster agents is the international reputation of their respective cluster (see Section 3.3 and 4.3.5). Hence, the selection of suitable partner regions abroad, thick information flows within the regions and the creation of an international reputation are crucial determinants of successful internationalization at the regional level (Dohse & Vehrke, 2017).

In order to make internationalization sustainable, i.e. to make sure that the newly established international cooperation and contacts are still productively used when *InterClust* funding will run out, it is crucial that the international partners (and the partner countries) are chosen in such a way that they benefit a larger group of organizations within the cluster and not only those that receive funding. Moreover, several firms and cluster managers emphasized the importance of political and institutional stability in the partner countries, and stated that unexpected political events like ‘Brexit’ cause substantial problems for international R&D cooperation. In view of the critical importance of finding the right international partners, we will next analyze what role path dependencies may play in this context.

5.2. Potential path dependencies in partner selection

During the concept development phase, clusters decide on which foreign partners to collaborate with. This is a crucial step in the internationalization strategy, since bridging distances comes with a cost which makes it unlikely that the geographic and the thematic boundaries are opened at the same time. Due to the costs of having to bridge physical and often cultural distances, clusters should target partners who operate in the same or a related thematic field (see Section 3.2).

Subsequently, valuable information is gathered, either in the process of selecting completely new cooperation partners or by intensifying and formalizing already existing contacts abroad. This choice has to be made with a specific trade-off in mind: Choosing partners with whom there exist prior business collaborations can yield higher levels of familiarity and trust, thus resulting in potentially faster decision processes and a higher willingness to share technological know-how. At the same time, the level of new, heterogeneous knowledge gained can be comparably low (see ‘relatedness’ in Section 3.1 and 3.2). When the targeted partner possesses knowledge that is too similar, it is possible that positive effects fail to materialize. If completely new business partners are chosen, the scope to get access to radically new knowledge is potentially higher than in the previous scenario, and so is the probability to gain new insights into foreign markets. However, the level of trust has to be built from the ground up. This can decelerate decision processes and make the sharing of knowledge more challenging. At the same time, clusters need to pay attention that the targeted knowledge is not too different from their own, either, if positive effects are to materialize from this partnership.

Clusters in the *InterClust* programme employed different partner selection processes. While some started with an analytical information collection process on regions and

clusters to identify those partners best fitting, others trusted on pre-existing connections to partners abroad.¹⁴ The time limit of one year to find fitting partners was in some cases very pressing. This was partly due to the necessity to find new partners, establish trustful relationships, come up with project ideas, etc. but especially the necessity to find funding for all partners abroad set limitations since not all of them could receive public support or were willing to finance R&D activities on their own. Hence, there might exist some trade-off between the willingness to find the most appropriate partners and the rules of the *InterClust* programme.

5.3. Small pool of non-winning regions

In round 1 of the competition, 29 clusters or networks applied for a funding and 11 were selected. In round 2, the respective numbers were 18 applicants and 11 winners, and in round three it were 18 applicants and 10 winners. Hence, the percentage of non-winning regions was 62% (round 1), 39% (round 2) and 44% (round 3).¹⁵

As non-winning regions in round 1 and 2 had the opportunity to apply again in later rounds (and some of them actually did), the overall percentage of non-winning regions is clearly below 50%, which is relatively small, compared to other measures such as the Spitzcluster-Wettbewerb. This does not necessarily mean that the funding measure is unattractive, but rather that the requirements with respect to the quality of the international partners are high and hard to match. Moreover, while the overall amount of funding appears appropriate to stimulate internationalization of German high tech clusters, the maximum amount of funding available per cluster (4 million Euro) is not particularly high. One might thus ask whether it would have been better to restrict the number of winning clusters to have a tougher competition and more funding available for each winning cluster.

5.4. The 'hidden export subsidy' argument

Another possible objection to the new policy is that subsidizing the R&D capabilities of domestic firms is kind of a *hidden export subsidy*, as knowledge-intensive firms on international markets compete on innovation rather than on prices. Subsidizing R&D by domestic firms may thus be seen as an instrument of giving domestic firms a 'competitive edge' over foreign competitors. The 'hidden export subsidy' argument applies, in principle, to any kind of technology policy. However, the new funding measure *InterClust* does not only benefit German firms, but also their international partners, such that it is in fact more open and less 'partisan' than most other forms of R&D subsidization.

6. Conclusions

This paper has analyzed the internationalization turn in German technology policy and, in particular, the new policy measure *InterClust*, designed to combine the strengths of place-based innovation policy with the benefits of internationalization.

Contemporary theories like the cluster life-cycle model suggest that internationalization is one possible way to stimulate cluster heterogeneity and to keep up cluster dynamics. Whether internationalization will lead to a long-term success of a cluster or not will,

however, depend strongly on the mobilization of local resources, the spillover of benefits from the actors directly funded to other firms and research institutes within the cluster and on the right choice of international partner regions (see Section 5). Whereas the policy measure *InterClust* appears, in principle, suitable to foster the internationalization of German high-tech clusters, the long-run success and sustainability of a cluster's internationalization strategy depends critically on the local actors (firms, research institutes and cluster managements) and is thus likely to vary substantially across regions.

The empirical analysis in Section 4 of this paper suggests that firms and research institutes in the winning regions of *InterClust* face various obstacles to internationalization. Among the most frequently named obstacles are barriers to market entry, lack of reliable business partners abroad, lack of experience in managing international activities, lack of financing opportunities, and cultural and language barriers. The *InterClust* funding might thus be helpful in overcoming key obstacles to internationalization, such as lack of reliable and suitable partners abroad, problems of managing international activities or cultural and language barriers. By demanding clusters to develop a sophisticated internationalization strategy, it helps them identify their own strengths and weaknesses and in the process, find areas in which international cooperation can be particularly useful for them. Cluster-internationalization might be helpful in gaining international reputation and it might decrease the costs of entering foreign markets. If the proposed link between cluster reputation and firm reputation holds, then it will be in particular young and small firms that stand to benefit most from the increased attention that clusters gain. Foreign investors will be more inclined to collaborate with firms if they know that these firms are embedded in a successful local structure with similar players that operate in the same sector.

However, not all problems related to internationalization can be solved by cluster-internationalization. Regulatory barriers to entry, for instance, need to be addressed by higher policy layers such as international trade and IP policies. Moreover, whether regional mobilization effects emerge and whether the internationalization strategy is sustainable depends crucially on the proper selection of international partners, the interaction of local players and the density of knowledge flows within the cluster. Hence, the long-run success of *InterClust* is likely to vary substantially across winning regions.

Finally, it is necessary to emphasize that this research is not without limitations. Keeping in mind that the *InterClust* programme has started just two years ago (and will run until the end of 2021) the current paper is meant as a timely discussion of innovative features and critical aspects of the new policy. It is not meant as a final assessment of the new policy and it can definitely not replace a careful ex post evaluation, which will only be possible after the *InterClust* programme has expired.

Notes

1. For the sake of readability, in the following only the word 'clusters' will be used instead of referring to both 'clusters and networks'.
2. Well known examples within Germany include the *BioProfile* contest and the *InnoRegio* contest as well as the *Leading-Edge Cluster Competition* launched in 2007. Examples outside Germany include the French policy of *Competitive Clusters* or the French *Local Productivity System (LPS) cluster* programme.
3. We focus our analysis on the first two competition rounds, since data on the third round is not yet available.

4. International partners need to bring in their own project funding.
5. The following paragraphs make use of the available information on the BMBF homepage. For more details, see: <https://www.bmbf.de/en/internationalisation-of-leading-edge-clusters-forward-looking-projects-and-comparable-1416.html>.
6. The number of targeted countries per cluster ranges from one to five, with the average being 2.3.
7. In total, there are 22 winner regions in the first two competition rounds. All of them were contacted but the survey in one winner region of the second round yielded no sufficient response, such that it had to be excluded from the sample.
8. The different firm-size categories are defined according to the European Commission Recommendation of 6 May 2003. For comparison, see: http://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition_de.
9. Nonetheless, those respondents gave useful answers for other questions, which is why they are kept in the sample.
10. The group of firms in the lowest age quartile comprises 91 firms, whereas the group of older firms consists of 273 firms.
11. It should be noted that although there is a large difference with respect to FDI in the displayed numbers, the high number for young firms results from a very low number of overall young firms that are engaged in FDI. Differences between these groups for imports, FDI and human capital development are all insignificant.
12. It should not come as a surprise that the current measures are less well known than the overall internationalization strategy, since it was only recently that the clusters have established a strategy for *InterClust*, whereas the cluster's internationalization strategy has been in place for a longer period of time in many cases.
13. Note that only those answers will be presented which have been mentioned by more than 10% of all firms.
14. Which selection process is chosen can vary with clusters' prior experience with international partners. This, in turn, depends on the stage of development of the respective cluster. Those in earlier development stages still have a stronger focus on internal learning processes and on establishing regional connections (see Section 3.1). In more mature clusters the focus can shift more easily towards international partners. Since median cluster age ranges from 4 to 66 years and median firm age in those clusters ranges from 9 to 74.5 years, it seems like clusters in *InterClust* are quite heterogeneous in terms of their maturity. A recent study by Elola, Valdaliso, Franco, & López, 2017 analyzing cluster policies for the Basque country suggests that not taking into account the different development phase of the clusters might reduce the overall effectiveness of the policies.
15. Source: Communication with BMBF Projektträger Jülich (PtJ).
16. This figure is only available on the German website version. See: <https://www.bmbf.de/de/cluster-netzwerke-international-547.html>.

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Appendix

Table A1. Overview of all winning clusters and networks and the respective response rates for the organization survey.

Cluster	Round	Total number of responses	Response rate in %
Biotech Cluster Rhine-Neckar (BioRN)	1	19	30.6
CLIB2021 Cluster Industrielle Biotechnologie	1	23	24.7
Cluster Leistungselektronik im ECPE	1	21	33.3
Hamburg Aviation	1	46	51.1
Institute of Plastics Processing (IKV)	1	50	27.9
Kunststoff-Institut Lüdenscheid	1	44	16.1
Medical Valley EMN	1	32	19.5
MERGE	1	10	21.3
OptoNet	1	23	21.3
Organic Electronics Saxony	1	13	44.8
Software-Cluster	1	14	15.2
BioEconomy Cluster	2	11	14.9
BioM	2	39	53.4
Cool Silicon	2	11	18.3
Cluster Electric Mobility Southwest	2	21	19.4
Forum Organic Electronics	2	7	21.9
MAI Carbon	2	19	9.5
Medical Mountains	2	37	22.7
SINN	2	6	13.3
Wetzlar Network	2	8	9.8
WIGRATEC	2	2	16.7

Source: Own survey.