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ORIGINAL PAPER

"To be or not to be" located in a cluster?—A descriptive meta-analysis of the firm-specific cluster effect

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Abstract

In the twenty-first century, clusters can be observed in most developed economies. However, the scientific results regarding the effect of clusters on firm performance are highly contradictive. The inconsistencies in the empirical results make it difficult to infer general conclusions about the firm-specific cluster effect, or in other words, the effect from being located in a cluster on firm performance (e.g. derived through the externalities within clusters). Therefore, this paper aims to reconcile the contradictory empirical findings. It investigates whether the prevalent assumption that clusters are a beneficial location for firms is unconditionally true or whether doubts about the alleged positive effect of clusters on firm performance are justified. By conducting a descriptive meta-analysis of the empirical literature, based on four different performance variables from four separate publication databases, the study investigates the direction of the effect as well as possible moderating influences. We find evidence for a rather positive firm-specific cluster effect. However, we identify several variables from the micro-, meso- and macro-level that directly or interactively moderate the relationship between clusters and firm success. For example, the results demonstrate that a negative firm-specific cluster effect occurs more frequently in low-tech industries than in high-tech industries. "To be or not to be" located in a cluster is therefore not the question, but it rather depends on the specific conditions.

JEL Classification L25 · O31 · O32 · R1

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1 Introduction

The co-location in regional clusters[1] is an economic reality that characterizes most developed economies in the twenty-first century. According to the European Cluster Observatory, just within the European Union (EU) there are 2.000 statistically relevant clusters that employ nearly 40% of the European workforce (Brown et al. 2007; Festing et al. 2012; Nathan et al. 2013). In view of conspicuous examples, such as Silicon Valley, the concept has become popular among politicians who are motivated to foster cluster initiatives in order to write a similar success story for their region. Therefore, many cluster initiatives receive financial support from national governments, the EU and other public institutions. For example, since 2005 the German government has launched several programmes with a total volume of 1.391 billion € to foster clusters in Germany (EFI 2015; Festing et al. 2012).

Given the already substantial financial support of cluster activities, it is reasonable to assume that scientists have identified a consistent positive cluster effect on the success of companies within a cluster. However, the scientific results about the firm-specific cluster effect are indeed highly contradictive (Malmberg et al. 2002; Martin et al. 2003). While authors such as Borowiecki (2013) as well as Basant et al. (2011) find evidence that companies located in clusters have a higher productivity than companies outside clusters, other researchers come to different results, ranging from negative performance effects (Pouder et al. 1996) to rather mixed effects (Knoben et al. 2015).

This inconsistency in the empirical results prevents general conclusions about the firm-specific cluster effect,[2] particularly with regard to the actual effect direction (Fang 2015). According to Frenken et al. (2015), one of the main challenges for future research lies in reconciling the contradictory empirical findings and thereby working towards closing the research gap on the alleged effect of clusters on firm performance. We respond to this call by integrating previous empirical results, thereby answering the following research question: Does being located in a cluster influence firm success? More specifically, we investigate whether the still prevalent assumption in the scientific literature and among policy-makers that clusters are a beneficial location for firms is unconditionally true or whether doubts about the alleged positive effect of clusters on firm performance are reasonable.

In order to answer this research question adequately, we conduct a descriptive meta-analysis of the empirical literature on the firm-specific cluster effect. A descriptive meta-analysis is an appropriate methodical approach in this context, because it is a meaningful way of combining empirical studies with contradicting results (Fang 2015). Yet, up to now, studies have employed a meta-analysis procedure only on the regional level (e.g. De Groot et al. 2007; Melo et al. 2009) and not in the context of firm-specific cluster effects. One important exception is the recent work by Fang (2015). However, this article differs from Fang (2015) in several important ways,

[1] The corresponding working definition for a cluster is presented in Sect. 2.1.

[2] Referring to the effect from being located in a cluster on firm performance (e.g. derived through the existing localization externalities within clusters such as knowledge spillovers).

for example, its explicit focus on the firm level, its scope of considered performance variables, its extensive literature collection based on four publication databases, as well as a more precise selection process that controls for, among others, a similar cluster understanding across the considered studies. As such, this article follows a clearer and more comprehensive approach to investigate the effect of being located in a cluster on firm success. In general, our results indicate a tendency towards a rather significant positive cluster effect on firm success. But at the same time, we also find evidence for heterogeneity across the individual studies considered in our descriptive meta-analysis, suggesting an influence of moderating variables. By identifying several variables from different levels of analysis (micro-, meso- and macro-level) that directly or interactively moderate the relationship between clusters and firm success, we conclude that, contrary to conventional thinking, being located in a cluster does not automatically lead to positive performance effects, but instead it rather depends on the specific conditions.

By providing an answer to the underlying research question through reconciling the contradictory empirical results, the paper not only provides a comprehensive overview that enriches the understanding about the alleged effect of clusters and serves as a crucial stepping stone to closing a still ubiquitous research gap, but also fulfils a practical demand by informing companies as well as policy-makers so they can gauge the concrete firm-specific effects of cluster initiatives.

The remainder of this paper is structured as follows: The second section introduces the theoretical background, highlighting the theoretical debate about cluster (dis-)advantages and establishing an adequate working definition of a cluster by reviewing the corresponding literature. The third section describes the applied methodical approach and data. Thereafter, the fourth section presents the empirical results. The paper will end with some concluding remarks, including limitations to this study as well as promising future research directions.

2 Theoretical background

In order to develop a useful working definition for the term cluster to analyse the contradictory empirical results regarding the firm-specific cluster effect, a literature overview about the various cluster definitions is undertaken to identify possible similarities. Furthermore, the ongoing theoretical discussion about cluster advantages and disadvantages is described.

2.1 Defining clusters

Although the term cluster is a very widespread and prevalent theme in economics at least since the two scientific papers of Porter (1990 and 1998), there are still fundamental differences in its definition as well as understanding (Brown et al. 2007; Malmberg et al. 2002; Martin et al. 2003). Even Michael Porter applies different kinds of definitions in his numerous articles about the cluster topic. As a consequence of the unclear definitional delimitation, the term has experienced a large

proliferation and thereby has lost some of its explanatory power (Brown et al. 2007; Martin et al. 2003; Šarić 2012; Sedita et al. 2012). For a correct implementation of a meta-analysis, this definitional inconsistency implies a serious problem, as it is required that the considered empirical studies have the same underlying understanding of what is meant by cluster when they analyse the firm-specific cluster effects. It is therefore essential to establish an adequate working definition of a cluster which serves as the baseline for the definitions of the empirical studies derived from the literature review.

Given the absence of a more or less mandatory definition, in line with Fornahl et al. (2015) a comparative empirical approach is applied that is explicitly inductive. Thus, this study does not intend to open "pandora´s box" of a theoretical discussion about a new (conceptual) cluster definition, instead a rather pragmatic approach is chosen. By conducting a profound literature overview about the various cluster definitions used in empirical as well as theoretical studies, several similarities could be identified. In general, these similarities can be summarized in the following four central elements:

(1) The spatial connection constitutes one of the most important elements of a cluster definition. It includes the sub-dimensions of (spatial) proximity as well as concentration. The latter one refers to a critical mass of actors which is a fundamental condition for the functioning of clusters (e.g. Brenner 2004). However, in most cases, this critical mass is not determined in detail (Fornahl et al. 2015). Additionally, it is also still unclear and highly debated which spatial scale is most appropriated to cover the proximity dimension (Asheim et al. 2006; Martin et al. 2003). In this context, empirical studies make use of different kind of levels of analysis, ranging from Nuts I, II or III to whole labour market regions (Fornahl et al. 2015). Besides these predefined areal units, some empirical studies also consider directly the geographical distance to the cluster in order to increase the geographic precision of their analysis (e.g. Bagley 2019a; Duranton et al. 2005; Maine et al. 2010; Rosenthal et al. 2008). Among others, Maine et al. (2010) indicate in this context that a firm´s geographical distance to a cluster is negatively related with its corresponding growth performance. In general, it can therefore be resumed that spatial proximity is widely acknowledged as a crucial dimension of clusters (Fornahl et al. 2015; Martin et al. 2003).
(2) The thematic connection covers the following three sub-dimensions: similar/complementary industries, value chain and specialization. These three sub-dimensions encompass similar value-chain activities of the firms within a cluster and their possible specialization. In accordance with the Marshall-Arrow-Romer (MAR) framework, arguing that the co-location of firms in a single industry fosters firm performance due to externalities,[3] clusters are often associated with the specialization around on specific industry (Marshall 1920; Maine et al. 2010).

[3] Apart from these externalities, Klepper proposed an alternative, although not mutually exclusive, explanation for the clustering of industries referring to spinoff dynamics (Boschma 2015; Klepper 2007a; Klepper 2010).

However, based on Jacobs (1969) it has been indicated that a single metropolitan area may contain several specialized clusters which may benefit from inter-industry related knowledge flows (Maine et al. 2010). Recently, contributions from the evolutionary economic geography (EEG) thinking school have moved beyond the localization versus urbanization debate and suggested in this context that related economic activities should also be considered as part of the regional specialization (Grillitsch et al. 2018; Kemeny et al. 2015; Neffke et al. 2011; Potter et al. 2014). Likewise in the case of spatial proximity it is therefore indeed rather complex for empirical studies to define potential thematically boundaries, especially in changing (e.g. new or diversifying) clusters (Boschma et al. 2011a; Fornahl et al. 2015).

(3) The element of interdependencies deals with the interconnectedness of various actors within a cluster and the resulting externalities, which are defined as the "net benefits to being in a location together with other firms increase with the number of firms in the location" (Arthur 1990, p. 237). The corresponding sub-dimension of co-location advantages thereby depicts the general existence of a firm-specific advantage, while knowledge/technology spillovers, cooperation and competition deal more with the mechanisms of clustering. Whether externalities arise from specialization, diversification or related variety has, however, not been put into concrete terms (Fornahl et al. 2015). At the same time, there exist several cluster mechanisms, such as spinoff formation (e.g. Klepper 2007a, 2007b) or labour mobility (e.g. Angel 1991), that cause the emergence of a cluster and the corresponding co-location advantages (Benner 2009).

(4) Complementary institutions and trust consist of formal/institutional relationships and establishments as well as informal exchange/trust. The first sub-dimension summarizes the role of institutions, such as universities or regional development agencies. The second sub-dimension is contrarily concerned with the informal exchange and its significance for cognitive proximity as well as trust.

The results of the literature overview, building on 25 identified cluster definitions, are illustrated in Fig. 1. It can be shown that especially the spatial connection, the thematic connection and the interdependencies are seen as central elements of a cluster definition. In contrast, complementary institutions and trust are only

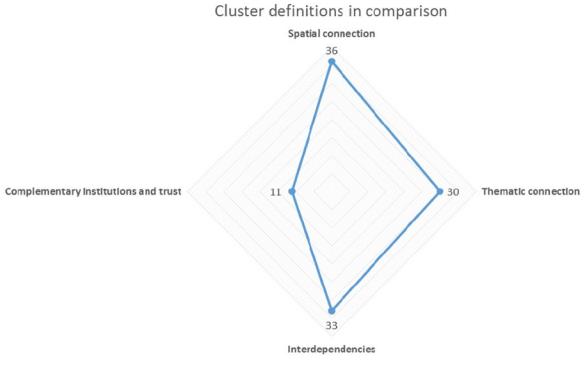

Fig. 1 Cluster definitions in comparison (own figure based on Fornahl et al. 2015. For a detailed list and classification of the considered cluster definitions, please see Table 4)

mentioned in a relatively small number of definitions. One explanation may be that not all clusters are built on informal relationships, social capital and trust, but just some specific forms of a cluster such as industrial districts in Italy (Fornahl et al. 2015). Complementary institutions and trust are therefore not further considered as key characteristics of a cluster.

Consequently, based on the results of the literature overview the following working definition for a cluster can be derived: "Clusters are defined as a geographical concentration of closely interconnected horizontal, vertical and lateral actors, such as universities, from the same industry[4] that are related to each other in terms of a common resource and knowledge base, technologies and/or product-market".

The here derived working definition for a cluster is therefore very close to Marshall´s understanding and more in line with economic perspectives focussing particularly on the externalities highlighted by Marshall (1920), such as Porter´s competitiveness school, than with socio-economic perspectives, e.g. Innovative Milieu literature stream (Šarić 2012). In light of our focus on firm performance, it is argued that such a theoretical classification is particularly appropriate (e.g. McCann et al. 2008). It therefore differs, on the one hand, from the conceptualization of pure agglomerations where firms are not necessary linked nor related to each other (Šarić 2012). On the other hand, it is also conceptually distinct from Jacob´s externalities (Jacobs 1969) and the further distinction in related and unrelated variety (Frenken et al. 2007), stressing the economic blessings of diversified regional industrial structures promoting the creation of new (rather radical) ideas and protecting against industry-specific shocks (Boschma et al. 2009; Frenken et al. 2007; Jacobs 1969). Even though this theoretical stream should be mentioned when dealing with clusters, in line with the results of Lazzeretti et al. (2014) it is argued that it does not constitute the core of the cluster understanding. Nevertheless, it is crucial to bear in mind that the here derived working definition is generalized in the way that it appropriately captures the definitional core elements of a good functioning cluster in the sustaining phase of the cluster life cycle. As such, across the cluster life cycle (e.g. Menzel et al. 2010) other elements (e.g. the spatial concentration in the emerging phase) may, however, become more important.

2.2 Cluster advantages and disadvantages

Similar to the definitional confusion, the theoretical discussion about cluster advantages and disadvantages is also characterized by a certain inconsistency. In this section, the most prominent arguments will therefore be presented.

Marshall (1920) was among the first to consider the benefits that firms can gain from being located in close proximity to similar firms. He presented four crucial types of localization externalities: access to specialized labour, access to specialized inputs, access to knowledge spillovers and access to greater demand by reducing the consumer search costs (Marshall 1920; McCann et al. 2008).[5]

[4] The same industry can thereby encompass narrowly defined industries (e.g. based on single industry codes) and/or broader industry classifications, such as the automotive industry, consisting of closely related sub-industry groups.

[5] Besides these externalities he also noted that the unique physical conditions of particular areas, such as limited natural resources, are the chief cause for the localization of industries.

Specialized labour refers to individuals that make industry-specific investments in their human capital (McCann et al. 2008). Krugman (1991) highlighted, in this context, that clusters create a common market pool for workers with specialized skills, benefiting both the workers as well as the hiring firms. On the one hand, a spatial concentration of similar types of firms reduces the risk for specialized workers able to attain work from multiple employers. On the other hand, this reduced risk also benefits employers by minimizing the risk premium as well as search cost components of workers` wages (David et al. 1990; Krugman 1991). Furthermore, it is also argued that specialized workers may be more willing to invest in industry-specific human capital when they believe that they have a greater ability to appropriate the benefits (Rotemberg et al. 2000). This is, however, a condition more likely to occur when there exist multiple companies pursuing the services of similar workers (McCann et al. 2011). In general, it has been indicated that the pooling of specialized employers and employees in close geographical distance also improves the overall matching process between both sides (Amend et al. 2008; Otto et al. 2010). This results in a pronounced labour mobility within clusters, being crucial for the inter-firm knowledge diffusion, fostering firm performance, due to the person-embedded knowledge (Erikson et al. 2009; Otto et al. 2010). A somehow special case refers in this context to spinoffs, which have been shown to exploit their knowledge of local employees, resulting in a higher probability of hiring employees from the entrepreneur´s prior employer as well as from other nearby firms from the same industry (Carias et al. 2010). While this entails a knowledge transfer from the incumbent firm to the spinoff (Bagley 2019b), it has also been demonstrated that the previous employer gains from this process, due to enduring social relationships with their former employees, contributing to sustained flows of knowledge (Agrawal et al. 2006).

Related to this is the access to knowledge spillovers. It is argued that geographic proximity can facilitate the transfer of knowledge in general (Jaffe et al. 1993) and specifically the transfer of tacit knowledge because it increases the likelihood of face-to-face contacts which is an efficient medium for the transfer of such knowledge (Daft et al. 1986). As such, the eased knowledge diffusion within clusters, particularly the tacit one, can in turn promote collective learning processes and innovation activities of the corresponding firms (Audretsch et al. 2004; Rigby et al. 2015; Terstriep et al. 2018).[6]

Many of the same reasons that firms in clusters have improved access to specialized labour hold also true for the improved access to specialized inputs in general. Due to its demand for specialized inputs, a cluster attracts input suppliers in larger numbers, which in turn provides access to services that firms could otherwise not afford individually (Feldman 1994; Marshall 1920; McCann 2008).

Apart from the previous mentioned supply-side advantages, companies in clusters can also gain from an access to greater demand. The underlying idea is that

[6] Recently, evidence has been found that due to the pronounced knowledge diffusion within clusters, especially regarding tacit knowledge, clusters promote the creation of radical innovations (Grashof et al. 2019), which can open up completely new markets and industries (Castaldi et al. 2015; Verhoeven et al. 2016).

geographical concentration facilitates the search and evaluation of the variety of options available from multiple firms. By reducing the corresponding consumer costs, the probability that consumers will purchase in specialized agglomerations in comparison with more isolated locations is increased (McCann 2008).

Another argument put forward for the benefits of clusters refers to the competition created by collocating with rivalries. The competition exposes firms to great pressure and in the end motivates them to innovate in order to stay competitive (Harrison et al. 1996; Porter 1998).

Furthermore, it has been highlighted that companies located within clusters can additionally profit from a common reputation (Molina-Morales et al. 2004; Wu et al. 2010), an information and communication ecology (Bathelt et al. 2004; Beaudry et al. 2003) as well as infrastructure benefits (Kuah 2002).

Although much of the discussion so far has focused almost exclusively on the advantages of clusters, there are also some authors highlighting potential disadvantages as a cluster grows larger and ages (Boschma et al. 2011b; McCann et al. 2008). The previously positive aspect of competition can become a negative one with a size increase of the cluster. The higher density of similar actors can lead to increased competition for input factors, which may result in scarcity of these factors as well as significantly price increases (Fang 2015; McCann et al. 2008).[7] In the case of human resources, such a fierce competition can lead to labour poaching, entailing costs for the corresponding firm. On the one hand, competitors can gain access to the firm´s own knowledge embodied in its employees, thereby increasing their relative competitive advantage over other firms. On the other hand, firms can prevent this and retain their human capital by raising their personnel expenses (e.g. paying higher wages or gratifications). Consequently, in both cases firms are negatively affected (Combes et al. 2006; Otto et al. 2010). Additionally, an increasing density can also lead to what some authors called congestion costs. These costs are typically expressed in outcomes such as increased traffic and transportation costs within a certain region (McCann et al. 2008). Another possible disadvantage refers to negative knowledge spillovers or in other words knowledge leakages that may discourage a firm to further innovate within a cluster, as other firms can actually free-ride on their knowledge (Fang 2015; Shaver et al. 2000). Furthermore, over time companies in clusters may face a certain inertia regarding market and technology changes. In this context, Pouder et al. (1996) argued that the performance decline over time can be explained with the convergent mental models of managers within the corresponding region. This kind of uniform thinking, a sort of group thinking behaviour, reinforces old behaviours and old ways of thinking. As a consequence, it prevents the recognition and adoption of new technological trends and new ideas in general (Martin et al. 2003; McCann et al. 2008; Porter 2000; Pouder et al. (1996)). Additionally, there are some authors suggesting that a simple reliance on local face-to-face contacts and tacit knowledge makes local networks of industry especially vulnerable to lock-in situations which in turn enforce again the inertia of companies within clusters (Boschma 2005; Martin et al. 2003).

[7] The concrete geographical distance has also be found to matter in this context (e.g. De Silva et al. 2012).

Summing up the theoretical discussion, it can be stated that clusters are supposed to comprise several advantages as well as disadvantages to the firms depending on the specific context, such as the firm's absorptive capacity and cluster size (Frenken et al. 2015; McCann et al. 2008).

3 Data and methodology

This rather mixed picture is also reflected in the empirical results. In order to reconcile the conflicting empirical results of the firm-specific cluster effect, a descriptive meta-analysis will be conducted. In general, a meta-analysis statistically integrates empirical results from different studies investigating a common research question (Florax et al. 2002; Quintana 2015; Wagner et al. 2014). It can therefore be defined as the "(…) analysis of analyses." (Glass 1976, p. 3). There exist indeed many reasons for applying meta-analysis as an appropriate alternative methodical approach to the traditional narrative review. One of the most important reasons refers to the proceeding of narrative reviews which is often insufficient standardized and therefore difficult, if at all, verifiable. It is quite common that the reviewer subjectively chooses which studies to include in his review and what weights to attach to the results of these studies. Contrarily, by its statistical nature meta-analysis can minimize subject bias and offer a great transparency as well as reproducibility (Fang 2015; Melo et al. 2009; Stanley et al. 1989; Wagner et al. 2014). Thus, it is supposed that a meta-analysis is an appropriate methodical approach to answer the underlying research question, whether being located in a cluster does influence firm success. In general, the meta-analysis method can be divided into two broad categories: descriptive meta-analysis and meta-regression (addressing sampling error or addressing both sampling error as well as other artefacts). In light of the available information and the relatively broad research question of this paper it is acceptable to apply a descriptive meta-analysis. This method offers the possibility of not only analysing the cluster effect on firm success, but also the corresponding moderating variables (Hunter et al. 1980; Wagner et al. 2014).

For the measurement of firm success, four different performance variables are taken into consideration: innovativeness, productivity, survival and employment growth. By considering four different performance variables, the effect of being located in a cluster on firm success can be analysed from a broader perspective. It is argued that the selected four performance variables capture most frequently and adequately firm success (Globerman et al. 2005; Sleutjes et al. 2012).[8]

The first step of the publication-based meta-analysis refers to collecting relevant data through a literature review. The empirical studies used in the meta-analysis are first of all collected from three different publication databases, namely Web of Science, Google Scholar as well as Ebsco. The application of various publication databases is crucial in order to avoid a possible database bias, meaning that one database may favour a specific

[8] Nevertheless, other performance variables, such as wages, may also be interesting to consider in future meta-analysis due to among other reasons the relatively high number of empirical studies (e.g. Andersson et al. 2016; Wennberg et al. 2010).

kind of literature and hence in the end contributes to a more meaningful literature collection. The search strategy is based on keyword combinations of "cluster" or "agglomeration"[9] (which is quite often used as a synonym[10]) and one of the four performance variables and "firm" or "company". The last two keywords are necessary to exclude empirical studies focusing only on the regional performance level. For the literature collection, only the 200 most relevant articles for each search query are considered.[11] Moreover, the search is conducted for all years and for all document types, as at the beginning a preferably comprehensive literature collection should be achieved. Since the above procedure returns mainly published articles, which may lead to a publication bias, it is explicitly necessary to include further working papers to mitigate this bias. The four combinations of keywords are therefore additionally used for a search query in the Social Science Research Network (SSRN). This publication database is especially convenient, as it implies an internal review process, even though it mainly deals with working papers (Elsevier Inc 2017). Hence, by choosing SSRN the quality of the data is ensured. Because the main purpose of this publication database is to include recent but not already published articles, only the results for the years 2014 until 2016 are considered.[12] Furthermore, in some instances relevant empirical studies from different search queries were also taken into consideration. For example, this would be the case if some results from the search query of innovation are also relevant for the performance variable productivity.

After this very broad collection of literature, specific results are sorted out by applying inclusion criteria. The inclusion criteria are as follows: first, the studies need to be empirical. Even though the findings of theoretical papers are briefly summarized in the theoretical discussion, they are not included in the overall meta-analysis. Second, to ensure that all selected studies have the same cluster understanding, the three identified key characteristics (spatial connection, thematic connection and interdependencies) have to be considered. As a consequence, studies focusing only on networks, industrial parks or urbanization are not included in the final sample. Third, relative cluster measures,[13] such as relative specialization indicators, have to be at least based on the national average in the corresponding industry and not on the regional average. In absence of this condition, one can hardly speak about a cluster, because on a county or city level a high specialization in a specific industry can be achieved quite easily. Fourth, the worker wages as well as the earnings at the establishment level are not seen as adequate measures for firm productivity. In contrast to traditional economic thinking, it is argued that a rise in productivity

[9] However, as highlighted later in the inclusion criteria, the three identified key characteristics of clusters (spatial connection, thematic connection and interdependencies) have to be fulfilled by the collected studies in order to be included in the final sample. This guarantees a similar conceptual cluster understanding, while ignoring the definitional inconsistency characterizing this particular research field.

[10] See, for example, Delgado et al. (2010), Martin et al. (2011) or McCann et al. (2011).

[11] The sorting by relevance is provided by the corresponding publication database and is based on the frequency of the search terms that appear in each record (in the title, abstract and keywords). As such, it is argued that only the most suitable (with respect to the research focus of this paper) articles are considered.

[12] The authors acknowledge that it is of course possible that older working papers may not, as assumed, convert itself in a journal article. Nevertheless, it is not illusory to assume that "good" working papers are likely to be published in journals.

[13] For a detailed overview about different cluster measures see for example Brenner (2017).

does not automatically imply a wage increase.[14] Empirical studies making use of these or similar measures are therefore not incorporated in the final sample. Last, the analytical focus of the empirical studies needs to be on the firm level and not on the regional level. Although already integrated in the search queries, in some cases this condition is not fulfilled. By knowing the essential meaning of the selection process for the overall meta-analysis, in case of doubt a second opinion is recognized.

Figure 2 depicts the concrete selection and exclusion process of the considered studies. In total, 2201 studies are collected that match the already mentioned search

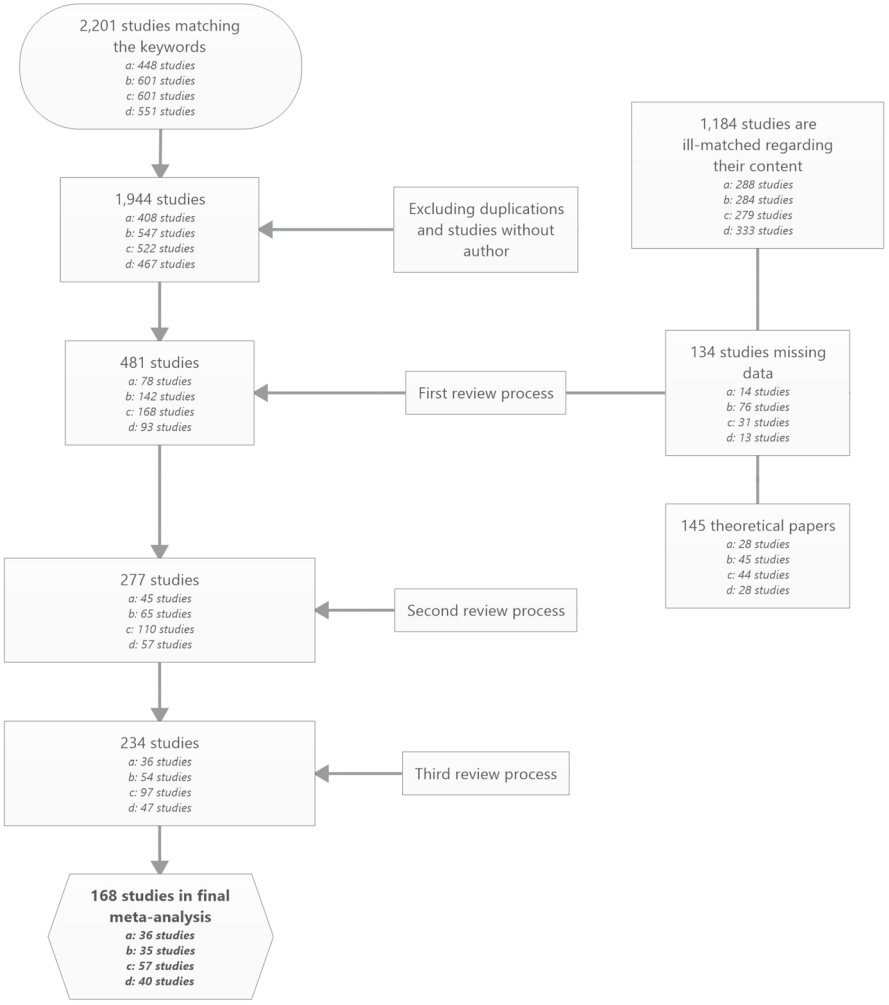

Fig. 2 Selection and exclusion process of the considered empirical studies (own illustration). Note: *a*: employment growth; *b*: innovativeness; *c*: productivity; *d*: survival

[14] For a comprehensive overview about this issue, please see Van Biesebroeck (2015).

queries. After excluding duplicate studies and studies without author, only 1944 results are considered in the first review process. In this first review process the title and the abstract are read in order to analyse whether the studies fulfil the inclusion criteria. Consequently, 1465 studies are sorted out, mainly due to their content which often deals with a cluster analysis or with the regional level. Subsequently, two more detailed reviews are implemented. In these more detailed reviews especially the statistical part is analysed. At the end, the final meta-analysis considers a population of 168 empirical studies.[15] This corresponds to 8.6% of the adapted population (studies without author and duplications excluded).

In general, it can be stated that up to now relatively few papers have applied such a meta-analysis in the context of a firm-specific cluster effect. One important exception refers to the recent work of Li Fang (2015) which provides a meta-analysis for relevant empirical studies on the relationship of clusters and the innovativeness of firms and regions. Yet, this scientific work differs from Li Fang (2015) in four mayor aspects. First, instead of mixing firm-level- and regional-level-oriented studies, this article explicitly focuses on the firm level. Consequently, the derived results are not biased by the regional effect of clusters and therefore provide more specific insights into the cluster effect on firms. Second, the meta-analysis here considers not only one performance variable, like innovativeness, but four different performance variables. By taking four different performance variables into account, the influence of the settlement in a cluster on firm success can be detected from a broader and more differentiated perspective. Furthermore, the literature collection of this meta-analysis is more extensive because the search is based on four different publication databases in total. Additionally, during the selection and exclusion process it is controlled whether the underlying cluster definitions of the empirical studies match with the three main elements of a cluster definition, shown in the previous section. Even though the strict definitional compliance is one of the principal reasons for the relatively large exclusion of articles, it is essential for a meaningful meta-analysis, as the firm-specific cluster effect does not get distorted by other network like effects. In other words, the true firm-specific cluster effect can be detected.

4 Empirical results

Before investigating this potential effect, it is, however, first of all interesting to have a closer look at the empirical studies of the final sample. Figure 3 illustrates the years of publication of the sample. At first glance, it becomes obvious that most of the studies in the final sample are relatively new. The oldest empirical record dates back to the year 1998. So, from the introduction of the term cluster by Michael Porter (1990) it took eight more years for an empirical study to test the relationship between clusters and firm performance. One explanation for this delay refers to the theoretical discussion and deepening of the concept. It is quite conventional that a new concept is first of all theoretical discussed within the research community. In this concrete case, it is additionally reasonable to suggest that the first empirical

[15] A detailed overview about the considered empirical studies is illustrated in Table 5.

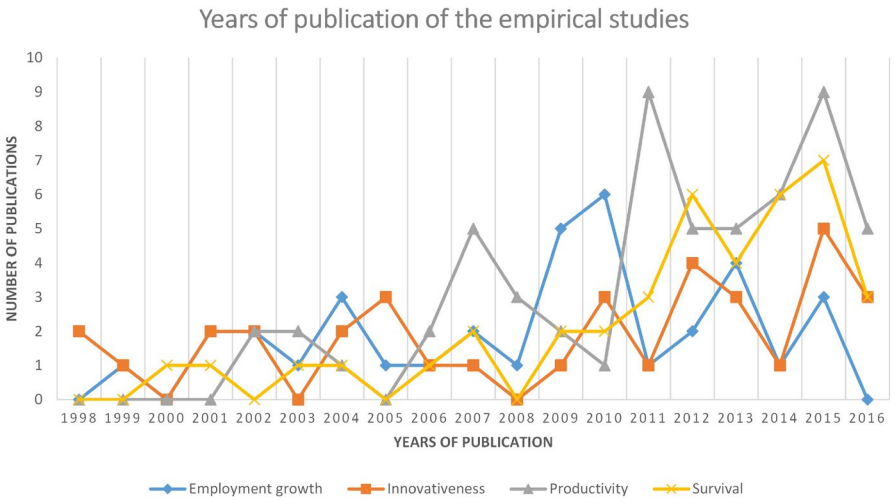

Fig. 3 Years of publication of the empirical studies (own illustration)

articles mainly focused on the regional level. Indeed, while widely been ignored for quite a long time, only in recent years researchers have shifted their focus of analysis on the firm-specific perspective (Brown et al. 2007; Šarić 2012; Steffen 2012). Apart from employment growth, more or less half of the empirical studies of the analysed performance indicators were published in the last five years (2012–2016). In more concrete terms, 46% of the empirical studies dealing with the cluster effect on firm innovativeness and even 65% of studies concerning the effect on firm survival were published in this period of time. Regarding the firm-specific cluster effect on employment growth at least 28% of the empirical studies were published in the last five years.

Having a closer look at the specific journals, one can state that the most frequent used journals come from the regional science. However, journals from the field of economics and management are also prevalent. Thus, it can be stated that the relationship between clusters and firm performance has received the attention from a multidisciplinary audience.[16]

Moreover, even though the considered studies in the final sample have analysed the firm-specific cluster effect in the context of various countries worldwide (in total 29 different countries), it can be observed that in most cases, except for productivity, the USA has been the most highly investigated country setting. Partially this can be explained by the fact that due to Michael Porters contributions (1990 and 1998) the roots of the cluster concept lay in the USA. Nevertheless, on a more aggregated level it can be stated that on average half of all considered studies base their empirical analysis in a European country, whereas countries from North America (USA, Canada, Mexico) account on average only for a quarter of all studies in the final sample. Despite some core countries of investigation

[16] For a detailed list of the journal distribution of the sample please see Fig. 6.

(e.g. USA, Netherlands, Italy), it can therefore be argued that the final sample of this study appears to be quite diverse in this context.[17]

In order to detect the estimated direction of cluster effects on the four considered performance variables, a vote counting method is applied (De Groot et al. 2007; Fang 2015). Since one study may use several regression models to measure, for example, different kinds of characteristics of the cluster, it can also identify several effects. To treat studies equally, a study-level vote counting is conducted, meaning that all findings regarding the effect direction of clusters on firms performance are for each study summarized. This is necessary in order to avoid a possible overvaluation of studies containing several regressions (Fang 2015). All the available estimates of each study are therefore grouped into seven classes:

- Sig. positive: Referring to significant positive cluster effects on firm performance.
- Insignificant: Referring to insignificant cluster effects on firm performance.
- Sig. negative: Referring to significant negative cluster effects on firm performance.
- Sig. positive and insignificant: Referring to significant positive and insignificant cluster effects on firm performance.[18]
- Sig. negative and insignificant: Referring to significant negative and insignificant cluster effects on firm performance.
- Sig. negative and sig. positive: Referring to significant negative and significant positive cluster effects on firm performance.
- Sig. negative, sig. positive and insignificant: Referring to significant negative, significant positive and insignificant cluster effects on firm performance.

However, at this point it is essential to highlight that the vote counting method has also been criticized, because the corresponding results are rather imprecise in comparison with the fixed effects model for example. The imprecision refers to the fact that the sample size of each study as well as the actual effect size are not considered at all (Hedges et al. 1980; Stanley 2001). Nevertheless, as already mentioned at the beginning of the previous chapter, in light of the relatively broad research question as well as the available information the vote counting method offers a suitable way of approaching the firm-specific cluster effect. As a consequence, it is suggested that vote counting serves the purpose to get first insights into this effect (Wagner et al. 2014).[19]

The results of the study-level vote counting for all four performance variables are presented in Fig. 4. What is striking the most are indeed the mixed empirical results for all four variables, indicating that there exist possible moderators, such as the industry context, shaping the relationship between cluster and firm performance. Interestingly, this holds also true for the results within the same underlying study.

[17] For a detailed illustration of the countries of investigation, please see Fig. 7.

[18] In other words, studies belong to this class if they find significant positive and insignificant results regarding the influence of clusters on firm performance.

[19] In the context of the localization and urbanization debate such an approach has for instance been applied by Beaudry et al. (2009).

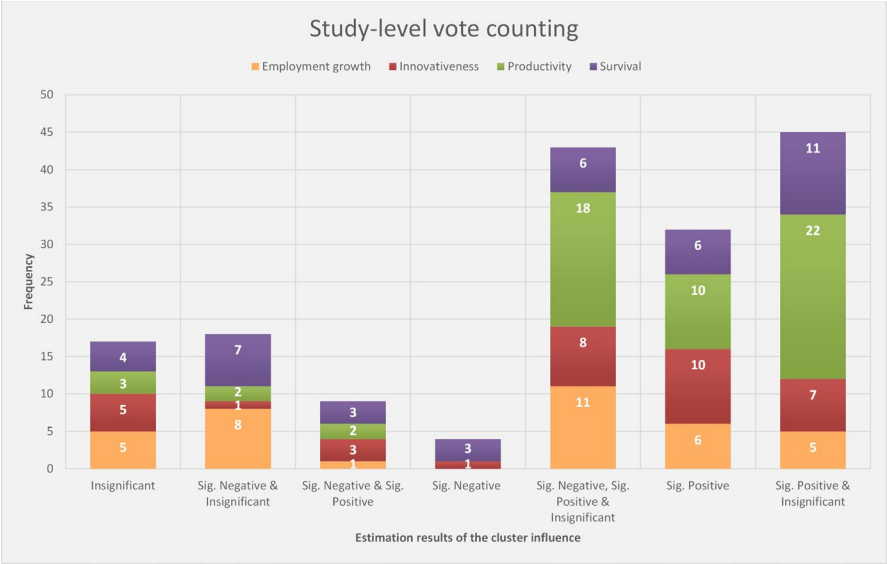

Fig. 4 Study-level vote counting (own illustration)

As such, 25.6% of the considered empirical studies determine at the same time sig. negative and sig. positive as well as insignificant firm-specific cluster effects. However, what can be further observed is that the majority of studies report either a sig. positive or a sig. positive and insignificant cluster effect. In total, 45.8% of the considered empirical studies note either one of these two directions. Contrary, only 22 studies (13.1%) find empirical support for a pure sig. negative or a sig. negative and insignificant effect. Thus, a tendency towards a rather sig. positive cluster effect on firm success can be asserted. Nevertheless, having a closer look at the four different performance variables some variation between the results can be found. While the empirical studies dealing with the innovativeness and the productivity of a firm find nearly no evidence for a rather sig. negative cluster effect, the results for the variables of employment growth and survival more frequently indicate to a sig. negative effect. Even though that there also exist evidence for a sig. positive firm-specific cluster effect in these both cases, the results appear to be more negative than for innovativeness as well as productivity. In more concrete terms, 22.2% of the empirical studies dealing with employment growth and even 25% of the studies dealing with survival report a pure sig. negative or a sig. negative and insignificant effect. In comparison, in the case of innovativeness and productivity only 5.7% of the considered empirical studies, respectively, 3.5% assert similar effects.

This can, on the one hand, be explained with differences in the consideration and importance of moderating variables, which are also highlighted later in Table 1. In general, it seems to be plausible that the realization of employment growth and survival depends on different and supposedly more on the specific context than innovativeness and productivity. On the other hand, the results may also indicate towards the two-sided effect of the high competition within clusters. While the high

Table 1 Moderating effects across all four performance variables (own illustration)

Estimation results	Employment growth			Innovativeness			Productivity			Survival			Total		
Moderation effects	+	±	-	+	±	-	+	±	-	+	±	-	+	±	-
Pure	17 (4.7%)	10 (2.4%)	10 (5.6%)	11 (12.5%)	15 (16.9%)	11 (28.9%)	36 (10.6%)	50 (17.2%)	5 (6.7%)	11 (10.9%)	3 (2%)	0	***75 (8.4%)***	***78 (8.2%)***	***26 (7.5%)***
Micro-level													***28 (3.1%)***	***39 (4.1%)***	***16 (4.6%)***
Firm size	0	0	2 (1.1%)				10 (2.9%)	12 (4.1%)	7 (9.3%)	1 (1%)	0	0	11 (1.2%)	12 (1.3%)	9 (2.6%)
Firm age	10 (2.8%)	0	1 (0.6%)				1 (0.3%)	6 (2.1%)	0				11 (1.2%)	6 (0.6%)	1 (0.3%)
Firm´s ownership				1 (1.1%)	3 (3.4%)	4 (10.5%)	2 (0.6%)	12 (4.1%)	2 (2.7%)				3 (0.3%)	15 (1.6%)	6 (1.7%)
Internal knowledge base							0	2 (0.7%)	0				0	2 (0.2%)	0
Firm´s organisational structure				3 (3.4%)	3 (3.4%)	0	1 (0.3%)	1 (0.3%)	0				3 (0.3%)	4 (0.4%)	0
Meso-level													***8 (0.9%)***	***5 (0.5%)***	***14 (4%)***
Cluster size				0	0	3 (7.9%)	7 (2.1%)	2 (0.7%)	9 (12%)				7 (0.8%)	2 (0.2%)	12 (3.4%)
Sector of specialization	1 (0.3%)	1 (0.2%)	1 (0.6%)							0	2 (1.3%)	1 (1.8%)	1 (0.1%)	3 (0.3%)	2 (0.6%)
Macro-level													***571 (64.2%)***	***533 (56.2%)***	***195 (56%)***
Industry	202 (56.1%)	280 (67.3%)	119 (66.9%)	59 (67.0%)	66 (74.2%)	7 (18.4%)	257 (75.4%)	150 (51.5%)	37 (49.3%)	51 (50.5%)	37 (24.3%)	31 (54.4%)	569 (64%)	533 (56.2%)	194 (55.7%)
Spatial regimes				2 (2.3%)	0	1 (2.6%)							2 (0.2%)	0	1 (0.3%)
Interaction effects													***207 (23.3%)***	***293 (30.9%)***	***97 (27.9%)***
Micro-level x Macro-level															
Firm size x industry	24 (6.7%)	14 (3.4%)	3 (1.7%)	0	0	1 (2.6%)	8 (2.3%)	10 (3.4%)	9 (12%)	2 (2%)	1 (0.7%)	1 (1.8%)	34 (3.8%)	25 (2.6%)	14 (4%)
Firm age x industry	0	3 (0.7%)	0				0	0	3 (4%)	1 (1%)	3 (2%)	0	1 (0.1%)	6 (0.6%)	3 (0.9%)
Firm´s ownership x industry							3 (0.9%)	5 (1.7%)	0	1 (1%)	5 (3.3%)	0	4 (0.4%)	10 (1.1%)	0
Knowledge intensity x industry	0	3 (0.7%)	1 (0.6%)										0	3 (0.3%)	1 (0.3%)
Firm´s innovation capabilities x industry				10 (11.4%)	1 (1.1%)	10 (26.3%)							10 (1.1%)	1 (0.1%)	10 (2.9%)
Subsidiary-status x industry	8 (2.2%)	6 (1.4%)	0				1 (0.3%)	3 (1%)	0	0	2 (1.3%)	0	9 (1%)	11 (1.2%)	0
Headquarter location x industry	2 (0.6%)	1 (0.2%)	1 (0.6%)							4 (4%)	17 (11.2%)	7 (12.3%)	6 (0.7%)	18 (1.9%)	8 (2.3%)
Geographical distance x industry	83 (23.1%)	77 (18.5%)	28 (15.7%)				12 (3.5%)	17 (5.8%)	0	23 (22.8%)	71 (46.7%)	8 (14%)	118 (13.3%)	165 (17.4%)	36 (10.3%)
Geographical location x industry	9 (2.5%)	7 (1.7%)	0										9 (1%)	7 (0.7%)	0
Plant type x size x industry							3 (0.9%)	20 (6.9%)	0				3 (0.3%)	20 (2.1%)	0
Meso-level x Macro-level															
Cluster life cycle x industry										3 (3%)	4 (2.6%)	0	3 (0.3%)	4 (0.4%)	0
Cluster size x industry				1 (1.1%)	0	0	0	1 (0.3%)	3 (4%)	2 (2%)	0	2 (3.5%)	3 (0.3%)	1 (0.1%)	5 (1.4%)
Degree of specialization x industry	0	11 (2.6%)	3 (1.7%)							2 (2%)	2 (1.3%)	6 (10.5%)	2 (0.2%)	13 (1.4%)	9 (2.6%)
Sector of specialization x industry	0	0	6 (3.4%)							0	5 (3.3%)	1 (1.8%)	0	5 (0.5%)	7 (2%)
Value chain of the cluster x industry				1 (1.1%)	1 (1.1%)	1 (2.6%)							1 (0.1%)	1 (0.1%)	1 (0.3%)
Macro-level x Macro-level															
Spatial regimes x industry	4 (1.1%)	3 (0.7%)	3 (1.7%)										4 (0.4%)	3 (0.3%)	3 (0.9%)

Note: + positive significant cluster effect; ± insignificant cluster effect; − negative significant cluster effect

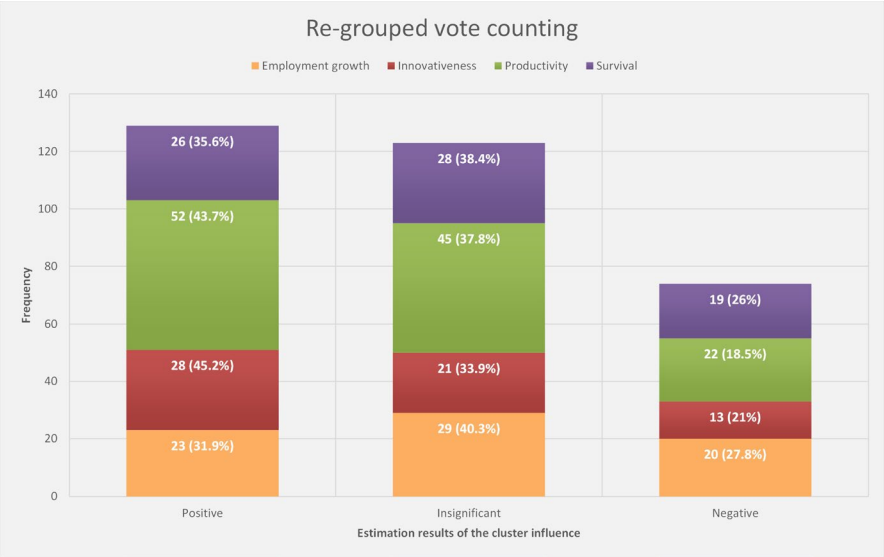

Fig. 5 Re-grouped vote counting (own illustration)

competition between similar firms fosters their innovativeness and productivity, it hampers their employment growth and survival through e.g. labour poaching (Audia et al. 2010; McCann et al. 2008; Porter 1998; Sorenson et al. 2000).

These tendencies can be solidified by re-grouping the vote counting into positive, insignificant and negative estimation results.[20] As a consequence, a study that previously reported sig. positive and insignificant effects will now appear twice, meaning that in the end it is counted one time for a sig. positive and a second time for an insignificant effect. The results of this re-organization of the data are outlined in Fig. 5.

By analysing the re-grouped data for the four different performance variables, it becomes obvious that nearly 40% of the considered empirical studies report at least once a positive cluster effect on firm performance. In contrast to this, only 23% of the studies find evidence for a negative effect. Thus, it can be stated that in general most studies indeed identify a rather positive firm-specific cluster effect.

Although, as already described before, there exists some variation between the four performance variables. In the cases of employment growth and survival the most dominant estimation results refer to an insignificant effect, whereas empirical studies dealing with innovativeness as well as productivity most frequently report a positive effect. One plausible explanation for these differences refers to the unequal consideration of different moderating variables. Even though there are moderating variables, such as the industry, that are considered across all four performance variables, some variables, such as a firm´s internal knowledge base, are only recognized

[20] Positive and negative estimation results refer in both cases to significant results.

in relatively few cases. Table 1 depicts the results for these and additional moderating variables.[21] Although all moderating variables have been collected, for a better visualization Table 1 presents only a selection of them. Since the focus lies on moderating variables, the actual level of analysis is thereby on the model level and not on the study level anymore. Consequently, the number of observations exceeds the number of considered empirical studies, because one study may potentially include several empirical models. In total, out of the 168 empirical studies 2.201 statistical models have been considered.

By analysing the moderating effects, shown within the considered empirical studies, it is interesting to note that there exists relatively few evidence for a pure firm-specific cluster effect, meaning a direct and generic cluster effect on firm performance in absence of potential moderating variables. Thus, being located in a cluster does not, at least in most cases, automatically lead to a positive or a negative firm-specific cluster effect. Instead, several variables from the micro-, meso- and macro-level directly or interactively moderate the relationship between clusters and firm performance. In other words, it is a rather complicated relationship which is influenced by a mix of different moderating variables. However, the specific industry is one of the most important moderating effects. Nearly across all four performance variables around 50% of the positive, insignificant and negative firm-specific cluster effects can be explained by the corresponding industry.

By grouping the different industries according to the classification of Eurostat (Eurostat 2014, 2017) and the OECD (OECD, 2011) into low-technologies, medium–low technologies, medium–high technologies and high technologies further interesting results can be derived in this context, which are presented in Table 2.

Across all four performance variables, it can be shown that a negative firm-specific cluster effect can be especially asserted in low-tech industries and not so much in high-tech industries. Indeed, 56.9% of the negative firm-specific cluster effects can be traced back towards low-tech industries, whereas for high-tech industries this share decreases to only 20%. Additionally, the results also point out that there exists a relatively high inter-industry variation (within the aggregated industry groups), indicating that the specific industry characteristics, such as pace of market and technology evolution, are highly important and therefore should be considered in more detail in future empirical studies.

Moreover, as can be seen in Table 1, in comparison with the macro-level, mainly consisting of the industry variable, are the variables of the micro- and meso-level only investigated in a relatively small number of empirical studies. Instead, interaction effects appear to be more important in this context, as 23.3% of the positive, 30.9% of the insignificant and 27.9% of the negative firm-specific cluster effects can be traced back towards different interaction effects.[22] Especially to highlight is the moderating effect of the geographical distance together with the industry context.

[21] Moderating variables encompass in this context interaction effects between the applied cluster measure and a contextual variable (e.g. firm size) as well as investigations of the cluster effect in subsamples (e.g. different industry settings), also implying a potential moderating effect.

[22] In this context, an interaction effect between e.g. firm age and industry means that the interaction term between firm age and the corresponding cluster measure in one particular industry setting has a certain influence on one of the four considered performance variables.

Table 2 Moderation effects according to the industry group (own illustration)

Estimation results	Industry effect		
Moderation effect	+	±	−
Industry	**405**	**395**	**160**
Low tech	170 (42%)	147 (37.2%)	91 (56.9%)
Mid-low tech	23 (5.7%)	46 (11.6%)	17 (10.6%)
Mid-high tech	26 (6.5%)	52 (13.2%)	20 (12.5%)
High tech	186 (45.9%)	150 (38%)	32 (20%)

Note: + positive significant cluster effect; ± insignificant cluster effect; − negative significant cluster effect

This interaction effect is of particular importance for employment growth as well as survival. Having a closer look at the concrete categories of this interaction effect, some interesting patterns can be observed, which are illustrated in Table 3.

For high-tech industries, it appears that a medium geographical distance between the corresponding actors contributes most frequently towards a positive firm-specific cluster effect. In more concrete terms, 33% of the asserted significant positive effects of the interaction between geographical distance and industry can be traced back to a medium distance and a high-tech industry. Although, in this context, it has to be stated that evidence is also found for an insignificant effect for this interaction term (33.6%), indicating towards an inter-industry variation likewise in the case of the sole moderating effect of the industry variable. Despite the inter-industry variation, it can be, however, seen that in high-tech as well as low-tech industries high geographical distance more frequently leads to an insignificant or even negative performance effect. Thus, it can be argued that high geographical distance is in general rather inhibitory for a positive firm-specific cluster effect in the context of both high-tech and low-tech industries. Regarding low geographical distance, the results become more mixed, especially for low-tech

Table 3 Interaction effect of distance and industry (own illustration)

Estimation results	Distance and industry effect		
Moderation effect	+	±	−
Distance x industry	**100**	**152**	**36**
High distance x High tech	19 (19%)	50 (32.9%)	9 (25%)
High distance x Low tech	0	10 (6.6%)	7 (19.4%)
Medium distance x High tech	33 (33%)	51 (33.6%)	4 (11.1%)
Medium distance x Low tech	10 (10%)	17 (11.2%)	5 (13.9%)
Low distance x High tech	28 (28%)	21 (13.8%)	7 (19.4%)
Low distance x Low tech	10 (10%)	3 (2%)	4 (11.1%)

Notes: Low distance refers to >1 mile; medium distance refers to 1–10 miles; high distance refers to 10–25 miles

+ Positive significant cluster effect; ± insignificant cluster effect; − negative significant cluster effect

industries. Whereas the results for high-tech industries indicate towards a rather positive moderating effect (28%), in the case of low-tech industries there exists nearly equally evidence for a positive (10%) as well as negative (11.1%) effect. Consequently, it can be asserted that low geographical distance and medium geographical distance are more frequently beneficial for companies in high-tech industries, while high geographical distance is rather detrimental for both industry groups.

In light of the results derived from the vote counting and the analysis of the moderating effects, in total it can be resumed that on the one hand there indeed exist evidence for a rather positive firm-specific cluster effect. But, on the other hand, the results remarkably differ in this context between the four considered performance variables. While the results are quite clear in the case of innovativeness and productivity, they are highly equivocal with regard to employment growth and survival. Additionally, strong moderating variables from different levels of analysis, shaping the relationship between clusters and firm performance, can also be asserted, thereby indicating that there exist firm performance differentials within clusters.

5 Conclusion

Even though cluster initiatives have received substantial financial support from national governments, the EU and other public institutions, it is still unclear whether being in a cluster really influences firm success (EFI 2015; Frenken et al. 2015; Martin et al. 2003). By conducting a meta-analysis of the empirical literature that investigates the firm-specific cluster effect, our paper reconciles the so far rather contradictory empirical results, thereby enriching the understanding about the alleged effect of clusters on firm performance. The descriptive analysis of the selected sample indicates that most empirical studies find evidence for the existence of a positive cluster effect on firm success. But at the same time, we also show that the empirical results are rather mixed, also between the four considered performance variables. This pattern can be explained by moderating influences of a mix of different variables from different levels of analysis. The industry context provides a particularly crucial moderating effect. The corresponding results point out that a negative firm-specific cluster effect occurs more frequently in low-tech industries than in high-tech industries. Besides the direct influence of moderating variables, we additionally identify variables from different levels of analysis that interactively moderate the relationship between clusters and firm success. For example, we determine that high geographical distance is in high-tech and low-tech industries rather inhibitory for a positive

firm-specific cluster effect, while low distance and medium distance are more frequently beneficial for companies in high-tech industries. In sum, this paper therefore moves beyond the limited focus on single levels of analysis and performance indicators, characterizing the current research on regional clusters (e.g. McCann et al. 2011; Hervas-Oliver et al. 2018). By systematically integrating previous empirical results, the limited perspective of individual studies can be overcome and a comprehensive overview about the effect of clusters on firm performance, particularly with regard to potential moderating variables, can be provided. With this synthesis of the rather inconclusive literature, our study thus contributes to a more sophisticated understanding about the firm-specific cluster effect, which can serve as a valuable starting point for future research in this field.

The derived results, especially the moderating effects, emphasize that future empirical studies about the firm-specific cluster effect have to account for different moderating variables in order to investigate the relationship between clusters and firm success in more detail. It is argued that multilevel analysis methods are for this context especially suitable (Burger et al. 2012). In view of the variation between the four considered performance variables, it is additionally promising for future studies to make use of several outcome measures in order to get a more detailed picture about the effects of regional clusters. This also includes rather alternative socio-economic indicators, focusing, for example, more on environmental pollution or social cohesion, which remain to be properly investigated in the cluster context.

However, there is also one current limitation to this paper. The presented results are only descriptive in nature. The descriptive meta-analysis can only be the first step for a more detailed meta-regression, as the actual magnitude of the effect still needs to be investigated (Koricheva et al. 2013). In this context, it is essential to take the diversity of applied methods into consideration. Furthermore, it would be interesting to analyse whether there exist national differences between the estimation results of the considered empirical studies.

Nevertheless, all in all it can be resumed that this paper makes a first step towards reconciling the contradictory empirical findings and thereby serving as a valuable stepping stone to closing the research gap concerning the alleged effect of clusters on firm performance. Or to say it with Shakespeare "to be or not to be" located in a cluster is not the question, it rather depends on the specific conditions.

Appendix

See Tables 4 and 5, Figs. 6 and 7.

Table 4 List and classification of different cluster definitions (own illustration based on Fornahl et al. 2015)

Cluster definitions													
Author	Definition	Dimensions											
		(Spatial) proximity	Concentration	Similar/ complementary industries	Value chain	Specialization	Interconnectedness/ Exchange relations[1]						
								Co-Location advantages	Knowledge / Technology spillovers	Cooperation	Competition	Formal/ institutional relationships	Informal exchange/ trust
Enright (1996: 191)	"A regional cluster is an industrial cluster in which member firms are in close proximity to each other."	x											
Baptista and Swann (1998: 525)	"A geographical cluster is defined here as a strong collection of related companies located in a small geographical area, sometimes centred on a strong part of a country's science base."	x	x					x	x				
Rosenfeld (1997:4)	"A 'cluster' is very simply used to represent concentrations of firms that are able to produce synergy because of their geographic proximity and interdependence, even though their scale of employment may not by pronounced or prominent."	x	x				x						
Feser (1998: 26)	"Economic clusters are not just related and supporting indus- tries and institutions, but rather related and supporting institutions that are more competitive by virtue of their relation- ships."			x			x						
Porter (1998: 78)	"Clusters are geographic concentrations of interconnected companies and institutions in a particular field."	x	x	x			x						

Table 4 (continued)

Cluster definitions													
Author	Definition	Dimensions											
		(Spatial) proximity	Concentration	Similar/ complementary industries	Value chain	Specialization	Interconnectedness/ Exchange relations[1]						
							Co-Location advantages	Knowledge / Technology spillovers	Cooperation	Competition	Formal/ institutional relationships	Informal exchange/ trust
Porter (2000: 15)	"Clusters are geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries and associated institutions (e.g., universities, standards agencies, trade associations) in a particular field that compete but also cooperate."	x	x	x		x			x	x	x	
Porter (2003: 562)	"We define a cluster as a geographically proximate group of interconnected companies, suppliers, service providers and associated institutions in a particular field, linked by externalities of various types."	x	x	x			x				x	
Swann et al. (1998: 1)	"A cluster means a large group of firms in related industries at a particular location."	x	x	x								

Table 4 (continued)

Cluster definitions

Author	Definition	Dimensions											
		(Spatial) proximity	Concentration	Similar/ complementary industries	Value chain	Specialization	Interconnectedness/ Exchange relations[1]						
								Co-Location advantages	Knowledge / Technology spillovers	Cooperation	Competition	Formal/ institutional relationships	Informal exchange/ trust
Bresnahan, Gambardella and Saxenian (2001: 836)	"We define a regional cluster simply as a spatial and sectoral concentration of firms; and we measure success by the ability of the cluster as a whole to grow, typically through the expansion of entrepreneurial start-ups."		x	x									
Simmie and Sennett (1999: 51)	"We define an innovative cluster as a large number of inter- connected industrial and/or service companies having a high degree of collaboration, typically through a supply chain and operating under the same market conditions."		x	x	x					x			
Crouch and Farrell (2001: 163)	"The more general concept of ''cluster'' suggests something looser: a tendency for firms in similar types of business to locate close together, though without having a particularly important presence in an area."	x		x									

Table 4 (continued)

Cluster definitions												
Author	Definition	Dimensions										
		(Spatial) proximity	Concentration	Similar/ complementary industries	Value chain	Specialization	Interconnectedness/ Exchange relations[1]					
							Co-Location advantages	Knowledge / Technology spillovers	Cooperation	Competition	Formal/ institutional relationships	Informal exchange/ trust
Van den Berg et al. (2001: 187)	"The popular term cluster is most closely related to this local or regional dimension of networks (…) Most definitions share the notion of clusters as localised networks of specialized organisations, whose production processes are closely linked through the exchange of goods, services and/or knowledge."	x	x		x	x		x				

Table 4 (continued)

Cluster definitions

Author	Definition	Dimensions											
		(Spatial) proximity	Concentration	Similar/ complementary industries	Value chain	Specialization	Interconnectedness/ Exchange relations[1]						
							Co-Location advantages	Knowledge / Technology spillovers	Cooperation	Competition	Formal/ institutional relationships	Informal exchange/ trust
Ketels (2003:3f.)	"Clusters are groups of companies and institutions co-located in a specific geographic region and linked by interdependencies in providing a related group of products and/or services. Because of the proximity among them – both in terms of geography and of activities – cluster constituents enjoy the economic benefits of several types of positive location-specific externalities. These externalities include, for example, access to specialized human resources and suppliers, knowledge spillovers, pressure for higher performance in head-to-head competition and learnings from the close interaction with specialized customers and suppliers."	x	x	x		x	x	x	x	x	x		

Table 4 (continued)

Cluster definitions													
Author	Definition	Dimensions											
		(Spatial) proximity	Concentration	Similar/ complementary industries	Value chain	Specialization	Interconnectedness/ Exchange relations[1]						
							Co-Location advantages	Knowledge / Technology spillovers	Cooperation	Competition	Formal/ institutional relationships	Informal exchange/ trust
European Commission (2003: 16)	"Clusters are groups of independent companies and associat- ed institutions that are: Collaborating and competing; Geographically concentrated in one or several regions, even though the cluster may have global extensions; Specialised in a particular field, linked by common tech- nologies and skills; Either science-based or traditional;	x	x	x		x		x	x	x	x	x
Cooke (2002: 121)	"Clusters are geographically proximate firms in vertical and horizontal relationships, involving a localized enterprise support infrastructure with shared developmental vision for business growth, based on competition and cooperation in a specific market field."	x		x		x	x		x	x	x	(x)
Stimson et al. (2002: 203)	There are three significant attributes associated with contem- porary notions of industry clusters: Shared end-markets (…) Strong buyer–supplier linkages (…)			x	x		(x)	x		(x)		

Table 4 (continued)

Cluster definitions													
Author	Definition	Dimensions											
		(Spatial) proximity	Concentration	Similar/ complementary industries	Value chain	Specialization	Interconnectedness/ Exchange relations[1]						
							Co-Location advantages	Knowledge / Technology spillovers	Cooperation	Competition	Formal/ institutional relationships	Informal exchange/ trust
Hill and Brennan (2000)	"We define a competitive industrial cluster as a geographic concentration of competitive firms or establishments in the same industry that either have close buy-sell relationships with other industries in the region, use common technologies, or share a specialized labor pool that provides firms with a competitive advantage over the same industry in other places."		x	x			x	x	x			
Fromhold-Eisebith and Eisebith (2005: 1251)	"We conceive a cluster as a regional agglomeration of sector or value chain related firms and other organizations (like universities, R&D centers, public agencies) which derive economic advantages from co-location and collaboration"	x	x	x	x				x		x	

Table 4 (continued)

Cluster definitions													
Author	Definition	Dimensions											
		(Spatial) proximity	Concentration	Similar/ complementary industries	Value chain	Specialization	Interconnectedness/ Exchange relations[1]						
							Co-Location advantages	Knowledge / Technology spillovers	Cooperation	Competition	Formal/ institutional relationships	Informal exchange/ trust
World Bank (2009: 1)	"An industrial cluster is an agglomeration of companies, suppliers, service providers and associated institutions in a particular field. Often included are financial providers, educational institutions and various levels of government. These entities are linked by externalities and complementarities of different types and are usually located near each other."	x	x	x			x				x	
Waits (2000: 37)	These industry clusters are geographical concentrations of competitive firms in related industries that do business with each other and that share needs for common talent, technology and infrastructure."		x	x				x	x		(x)	
Pietrobelli and Barrera (2002: 542)	"(…)a cluster is defined as a group of enterprises spatially close and specialized in the development of a similar or the same product."	x	x	x		x						

Table 4 (continued)

Cluster definitions

Author	Definition	Dimensions											
		(Spatial) proximity	Concentration	Similar/ complementary industries	Value chain	Specialization	Interconnectedness/ Exchange relations[1]						
								Co-Location advantages	Knowledge / Technology spillovers	Cooperation	Competition	Formal/ institutional relationships	Informal exchange/ trust
Bell (2005: 287)	"Industry clusters—groups of geographically proximate firms in the same industry—are a striking feature of the geography of economic activity(…)."	x	x	x									
Maskell and Kebir (2006: 1)	Clusters may be defined as non-random geographical agglomerations of firms with similar or closely complementary capabilities."		x	x			x						
Christensen et al. (2012: 14)	"Clusters are networks of interacting companies, R&D institutions, universities and other relevant stakeholders whose activities result in the generation of new knowledge which translates into new products and services as well as innovations in processes, organisations and markets."								x				

Table 4 (continued)

Cluster definitions													
Author	Definition	Dimensions											
		(Spatial) proximity	Concentration	Similar/ complementary industries	Value chain	Specialization	Interconnectedness/ Exchange relations[1]						
								Co-Location advantages	Knowledge / Technology spillovers	Cooperation	Competition	Formal/ institutional relationships	Informal exchange/ trust
Dalum et al. (2002: 7)	"A regional cluster is a geographically concentrated group of firms and related organisations active in similar or closely connected technologies. The firms are interconnected by formation of specialized local labour markets and institutional set-ups."	x	x	x			x					x	
Sum	N = 25	17	19	20	4	6	5 5	6 (1)	8	8	4 (1)	8 (1)	1 (1)

[1]Column 6: Interconnectedness/Exchange relations are mentioned, however missing concretization according to the following dimensions. **X**= explicitly mentioned; **(x)** = implicitly mentioned

Table 5 Overview about the studies considered in the final sample

Authors	Title of Publication	Year of Publication	Performance Variable	Database
Schimke, A; Teichert, N; Ott, I	Impact of local knowledge endowment on employment growth in nanotechnology	2013	Employment growth	Web of Science
Fingleton, B; Igliori, DC; Moore, B	Employment growth of small high-technology firms and the role of horizontal clustering: Evidence from computing services and R&D in Great Britain, 1991–2000	2004	Employment growth	Web of Science
Boshuizen, J; Geurts, P; Van der Veen, A	REGIONAL SOCIAL NETWORKS AS CONDUITS FOR KNOWLEDGE SPILLOVERS: EXPLAINING PERFORMANCE OF HIGH-TECH FIRMS	2009	Employment growth	Web of Science
van Oort, FG; Burger, MJ; Knoben, J; Raspe, O	MULTILEVEL APPROACHES AND THE FIRM-AGGLOMERATION AMBIGUITY IN ECONOMIC GROWTH STUDIES	2012	Employment growth	Web of Science
Escobar-Mendez, A	Employment growth in manufacturing industry in Mexico	2011	Employment growth	Web of Science
Gabe, TM	Establishment growth in small cities and towns	2004	Employment growth	Web of Science
Micucci, G; Di Giacinto, V	The Producer Service Sector in Italy: Long-term Growth and its Local Determinants	2009	Employment growth	Web of Science
Vor, Friso de; Groot, Henri L. F. de	Agglomeration externalities and localized employment growth: the performance of industrial sites in Amsterdam	2010	Employment growth	Google Scholar
van Soest, Daan P.; Gerking, Shelby; van Oort, Frank G	Spatial impacts of agglomeration externalities	2006	Employment growth	Google Scholar
van Soest, Daan P.; Gerking, Shelby D.; van Oort, Frank G	Knowledge externalities, agglomeration economies and employment growth in Dutch cities	2002	Employment growth	Google Scholar
Rosenthal, Stuart S.; Strange, William C	Geography, industrial organization and agglomeration	2003	Employment growth	Google Scholar
Gabe, Todd M.; Kraybill, David S	The effect of state economic development incentives on employment growth of establishments	2002	Employment growth	Google Scholar
Delgado, Mercedes; Porter, Michael E.; Stern, Scott	Clusters and entrepreneurship	2010	Employment growth	Google Scholar
Beaudry, Catherine; Swann, Peter	Growth in industrial clusters: A bird's eye view of the United Kingdom	2001	Employment growth	Google Scholar

Table 5 (continued)

Authors	Title of Publication	Year of Publication	Performance Variable	Database
Wennberg, Karl; Lindqvist, Göran	The effect of clusters on the survival and performance of new firms	2010	Employment growth	Google Scholar
van Oort, Frank G	Spatial and sectoral composition effects of agglomeration economies in the Netherlands	2007	Employment growth	Google Scholar
Paci, Raffaele; Usai, Stefano	Agglomeration economies, spatial dependence and local industry growth	2008	Employment growth	Google Scholar
Duschl, Matthias; Scholl, Tobias; Brenner, Thomas; Luxen, Dennis; Raschke, Falk	Industry-specific firm growth and agglomeration	2015	Employment growth	Google Scholar
Blasio, Guido de; Di Addario, Sabrina	Do workers benefit from industrial agglomeration?	2005	Employment growth	Google Scholar
Bishop, Paul; Gripaios, Peter	Spatial externalities, relatedness and sector employment growth in Great Britain	2010	Employment growth	Google Scholar
Baptista, Rui; Swann, G. PeterM	A comparison of clustering dynamics in the US and UK computer industries	1999	Employment growth	Google Scholar
Yamada, Eri; Kawakami, Tetsu	Assessing dynamic externalities from a cluster perspective: the case of the motor metropolis in Japan	2015	Employment growth	Ebsco
MARTINEZ, JOSE; MCPHERSON, MICHAEL A.; MOLINA, DAVID J.; ROUS, JEFFREY J	Geography and microenterprises: clustering, networking and knowledge spillovers	2013	Employment growth	Ebsco
Bonte, Werner	Innovation and Employment Growth in Industrial Clusters: Evidence from Aeronautical Firms in Germany	2004	Employment growth	Ebsco
Beaudry, Catherine; Swann, G. M. Peter	Firm Growth in Industrial Clusters of the United Kingdom	2009	Employment growth	Ebsco
Beaudry, Catherine	Entry-Growth and Patenting in Industrial Clusters: A Study of the Aerospace Industry in the UK	2001	Employment growth	Ebsco

Table 5 (continued)

Authors	Title of Publication	Year of Publication	Performance Variable	Database
Shuai, Xiaobing	Will Specialization Continue Forever? A Case Study of Interactions between Industry Specialization and Diversity	2013	Employment growth	Ebsco
Kowalewski, Julia	Inter-industrial Relations and Sectoral Employment Development in German Regions	2013	Employment growth	Ebsco
George Deltas, Dakshina G. De Silva, Robert P. McComb	Industrial Agglomeration and Spatial Persistence of Employment in Software Publishing	2015	Employment growth	SSRN
van Oort, Frank G.; Stam, Erik	14. Agglomeration economies and firm growth: testing for spatial externalities in the Dutch ICT industry	2010	Employment growth	Google Scholar
Lindqvist, Göran	Disentangling clusters: agglomeration and proximity effects	2009	Employment growth	Google Scholar
Kunkle, Gary Monroe	Cluster requiem and the rise of cumulative growth theory	2009	Employment growth	Google Scholar
van Geenhuizen, Marina; Reyes-Gonzalez, Leonardo	Does a clustered location matter for high-technology companies' performance? The case of biotechnology in the Netherlands	2007	Employment growth	Web of Science
Sleutjes, B; Van Oort, F; Schutjens, V	A PLACE FOR AREA- BASED POLICY? THE SURVIVAL AND GROWTH OF LOCAL FIRMS IN DUTCH RESIDENTIAL NEIGHBORHOODS	2012	Employment growth	Web of Science
Audia, PG; Rider, CI	Close, but not the same: Locally headquartered organizations and agglomeration economies in a declining industry	2010	Employment growth	Web of Science
Deltas, George; Silva, Dakshina G. de; McComb, Robert P	Agglomeration Spillovers and Industry Dynamics: Firm Entry, Growth and Exit in the Software Publishing Industry	2014	Employment growth	Google Scholar
Gjelsvik, Martin; Haus-Reve, Silje	Capabilities for innovation in a globalizing world: to be or not to be in clusters	2015	Innovativeness	Web of Science

Table 5 (continued)

Authors	Title of Publication	Year of Publication	Performance Variable	Database
Jose Ruiz-Ortega, Maria; Parra-Requena, Gloria; Manuel Garcia-Villaverde, Pedro	Do Territorial Agglomerations Still Provide Competitive Advantages? A Study of Social Capital, Innovation and Knowledge	2016	Innovativeness	Web of Science
Smit, Martijn J.; Abreu, Maria A.; de Groot, Henri L. F	Micro-evidence on the determinants of innovation in the Netherlands: The relative importance of absorptive capacity and agglomeration externalities	2015	Innovativeness	Web of Science
Huang, Kuo-Feng; Yu, Chwo-Ming Joseph; Seetoo, Dah-Hsian	Firm innovation in policy-driven parks and spontaneous clusters: the smaller firm the better?	2012	Innovativeness	Web of Science
De Beule, Filip; Van Beveren, Ilke	DOES FIRM AGGLOMERATION DRIVE PRODUCT INNOVATION AND RENEWAL? AN APPLICATION FOR BELGIUM	2012	Innovativeness	Web of Science
Ozer, Muammer; Zhang, Wen	The effects of geographic and network ties on exploitative and exploratory product innovation	2015	Innovativeness	Web of Science
He, Zheng; Rayman-Bacchus, Lez	Cluster network and innovation under transitional economies An empirical study of the Shaxi garment cluster	2010	Innovativeness	Web of Science
Boasson, V; MacPherson, A	The role of geographic location in the financial and innovation performance of publicly traded pharmaceutical companies: empirical evidence from the United States	2001	Innovativeness	Web of Science
Shefer, D; Frenkel, A	Local milieu and innovations: Some empirical results	1998	Innovativeness	Web of Science
van Geenhuizen, Marina; Reyes-Gonzalez, Leonardo	Does a clustered location matter for high-technology companies' performance? The case of biotechnology in the Netherlands	2007	Innovativeness	Web of Science
Bell, GG	Clusters, networks and firm innovativeness	2005	Innovativeness	Web of Science
Zhang, Hongyong	How does agglomeration promote the product innovation of Chinese firms?	2015	Innovativeness	Web of Science
Folta, TB; Cooper, AC; Baik, Y	Geographic cluster size and firm performance	2006	Innovativeness	Web of Science

Table 5 (continued)

Authors	Title of Publication	Year of Publication	Performance Variable	Database
MacPherson, A; Boasson, V	Patent activity and financial performance of publicly traded companies in the US pharmaceutical industry: The role of local economic conditions	2004	Innovativeness	Web of Science
Whittington, Kjersten Bunker; Owen-Smith, Jason; Powell, Walter W	Networks, Propinquity and Innovation in Knowledge-intensive Industries	2009	Innovativeness	Web of Science
Fang, Jianguo; Guo, Huiwu	Electronic information industry, clustering and growth: empirical study of the Chinese enterprises	2013	Innovativeness	Web of Science
Lo, Hsuan; Chung, Hsien-Jui	The Impact of Complementary Agglomeration and Multi-unit Systems on New Product Introduction	2010	Innovativeness	Web of Science
Antonietti, Roberto; Cainelli, Giulio	The role of spatial agglomeration in a structural model of innovation, productivity and export: a firm-level analysis	2011	Innovativeness	Web of Science
Zhang, Peng; He, Canfei; Sun, Yifei	Agglomeration economies and firm R&D efforts: an analysis of China's electronics and telecommunications industries	2014	Innovativeness	Web of Science
Quintana-Garcia, C; Benavides-Velasco, CA	Agglomeration economies and vertical alliances: the route to product innovation in biotechnology firms	2005	Innovativeness	Web of Science
Galliano, Danielle; Magrini, Marie-Benoit; Triboulet, Pierre	Marshall's versus Jacobs' Externalities in Firm Innovation Performance: The Case of French Industry	2015	Innovativeness	Web of Science
van Oort, Frank	Innovation and agglomeration economies in the Netherlands	2002	Innovativeness	Google Scholar
Propris, Lisa De	Types of innovation and inter-firm co-operation	2002	Innovativeness	Google Scholar
Molina-Morales, Francesc Xavier; Martínez-Fernández, María Teresa	Social networks: effects of social capital on firm innovation	2010	Innovativeness	Google Scholar
Feldman, Maryann P.; Audretsch, David B	Innovation in cities:: Science-based diversity, specialization and localized competition	1999	Innovativeness	Google Scholar

Table 5 (continued)

Authors	Title of Publication	Year of Publication	Performance Variable	Database
Baptista, Rui; Swann, Peter	Do firms in clusters innovate more?	1998	Innovativeness	Google Scholar
Lecocq, Catherine; Leten, Bart; Kusters, Jeroen; van Looy, Bart	Do Firms Benefit from Being Present in Multiple Technology Clusters? An Assessment of the Technological Performance of Biopharmaceutical Firms	2012	Innovativeness	Ebsco
Huang, Fang; Rice, John	Does Open Innovation Work Better in Regional Clusters?	2013	Innovativeness	Ebsco
Cook, Gary A. S.; Pandit, Naresh R.; Loof, Hans; Johansson, Borje	Clustering, MNEs and Innovation: Who Benefits and How?	2013	Innovativeness	Ebsco
Bönte, Werner	Innovation and employment growth in industrial clusters: evidence from aeronautical firms in Germany	2004	Innovativeness	Ebsco
Bindroo, Vishal; Mariadoss, Babu John; Pillai, Rajani Ganesh	Customer Clusters as Sources of Innovation-Based Competitive Advantage	2012	Innovativeness	Ebsco
Prim, Alexandre Luis; Amal, Mohamed; Carvalho, Luciano	Regional Cluster, Innovation and Export Performance: An Empirical Study	2016	Innovativeness	Ebsco
Martínez-Pérez, Ángela; García-Villaverde, Pedro M.; Elche, Dioni	The mediating effect of ambidextrous knowledge strategy between social capital and innovation of cultural tourism clusters firms	2016	Innovativeness	Ebsco
Boschma, RA; Weterings, ABR	The effect of regional differences on the performance of software firms in the Netherlands	2005	Innovativeness	Web of Science
Beaudry, Catherine	Entry-Growth and Patenting in Industrial Clusters: A Study of the Aerospace Industry in the UK	2001	Innovativeness	Ebsco
Lin, HL; Li, HY; Yang, CH	Agglomeration and productivity: Firm-level evidence from China's textile industry	2011	Productivity	Web of Science
Knoben, J; Arikan, AT; van Oort, F; Raspe, O	Agglomeration and firm performance: One firm's medicine is another firm's poison	2016	Productivity	Web of Science

Table 5 (continued)

Authors	Title of Publication	Year of Publication	Performance Variable	Database
Hu, C; Xu, ZY; Yashiro, N	Agglomeration and productivity in China: Firm level evidence	2015	Productivity	Web of Science
Lee, Y; Chyi, YL; Lin, ES; Wu, SY	Do local industrial agglomeration and foreign direct investment to China enhance the productivity of Taiwanese firms?	2013	Productivity	Web of Science
Sanfilippo, M; Seric, A	Spillovers from agglomerations and inward FDI: a multilevel analysis on sub-Saharan African firms	2016	Productivity	Web of Science
Arimoto, Y; Nakajima, K; Okazaki, T	Sources of productivity improvement in industrial clusters: The case of the prewar Japanese silk-reeling industry	2014	Productivity	Web of Science
Yang, CH; Lin, HL; Li, HY	Influences of production and R&D agglomeration on productivity: Evidence from Chinese electronics firms	2013	Productivity	Web of Science
Nakamura, R	Contributions of local agglomeration to productivity: Stochastic frontier estimations from Japanese manufacturing firm data	2012	Productivity	Web of Science
van Oort, FG; Burger, MJ; Knoben, J; Raspe, O	MULTILEVEL APPROACHES AND THE FIRM-AGGLOMERATION AMBIGUITY IN ECONOMIC GROWTH STUDIES	2012	Productivity	Web of Science
Bekes, G; Harasztosi, P	Agglomeration premium and trading activity of firms	2013	Productivity	Web of Science
Cainelli, G	Spatial agglomeration, technological innovations and firm productivity: Evidence from Italian industrial districts	2008	Productivity	Web of Science
Hashiguchi, Y; Tanaka, K	Agglomeration and firm-level productivity: A Bayesian spatial approach	2015	Productivity	Web of Science
Drucker, J; Feser, E	Regional industrial structure and agglomeration economies: An analysis of productivity in three manufacturing industries	2012	Productivity	Web of Science

Table 5 (continued)

Authors	Title of Publication	Year of Publication	Performance Variable	Database
Lall, SV; Shalizi, Z; Deichmann, U	Agglomeration economies and productivity in Indian industry	2004	Productivity	Web of Science
Martin, P; Mayer, T; Mayneris, F	Spatial concentration and plant-level productivity in France	2011	Productivity	Web of Science
Autant-Bernard, C; Guironnet, JP; Massard, N	Agglomeration and social return to R&D: Evidence from French plant productivity changes	2011	Productivity	Web of Science
Cainelli, G;Ganau, R; Iacobucci, D	Do Geographic Concentration and Vertically Related Variety Foster Firm Productivity? Micro-Evidence from Italy	2016	Productivity	Web of Science
Rigby, DL; Essletzbichler, R	Agglomeration economies and productivity differences in US cities	2002	Productivity	Web of Science
Widodo, W; Salim, R; Bloch, H	The effects of agglomeration economies on technical efficiency of manufacturing firms: evidence from Indonesia	2015	Productivity	Web of Science
Antonietti, R; Cainelli, G	The role of spatial agglomeration in a structural model of innovation, productivity and export: a firm-level analysis	2011	Productivity	Web of Science
Tveteras, R; Battese, GE	Agglomeration externalities, productivity and technical inefficiency	2006	Productivity	Web of Science
Andini, M; de Blasio, G; Duranton, G; Strange, WC	Marshallian labour market pooling: Evidence from Italy	2013	Productivity	Web of Science
Fazio, G; Maltese, E	Agglomeration Externalities and the Productivity of Italian Firms	2015	Productivity	Web of Science
Cainelli, G; Fracasso, A; Marzetti, GV	Spatial agglomeration and productivity in Italy: A panel smooth transition regression approach	2015	Productivity	Web of Science
Widodo, W; Salim, R; Bloch, H	Agglomeration Economies and Productivity Growth in Manufacturing Industry: Empirical Evidence from Indonesia	2014	Productivity	Web of Science

Table 5 (continued)

Authors	Title of Publication	Year of Publication	Performance Variable	Database
Graham, DJ	Variable returns to agglomeration and the effect of road traffic congestion	2007	Productivity	Web of Science
Fukao, K; Kravtsova, V; Nakajima, K	How important is geographical agglomeration to factory efficiency in Japan's manufacturing sector?	2014	Productivity	Web of Science
Di Giacinto, V; Gomellini, M; Micucci, G; Pagnini, M	Mapping local productivity advantages in Italy: industrial districts, cities or both?	2014	Productivity	Web of Science
Pan, ZH; Zhang, F	Urban productivity in China	2002	Productivity	Web of Science
Long, C; Zhang, XB	Cluster-based industrialization in China: Financing and performance	2011	Productivity	Web of Science
Eriksson, R; Lindgren, U	Localized mobility clusters: impacts of labour market externalities on firm performance	2009	Productivity	Web of Science
Rigby, DL;Brown, WM	Who Benefits from Agglomeration?	2015	Productivity	Web of Science
Aranguren, MJ; de la Maza, X; Parrilli, MD; Vendrell-Herrero, F; Wilson, JR	Nested Methodological Approaches for Cluster Policy Evaluation: An Application to the Basque Country	2014	Productivity	Web of Science
Graham, DJ; Kim, HY	An empirical analytical framework for agglomeration economies	2008	Productivity	Web of Science
Koo, J; Lall, S	New economic geography: Real or hype?	2007	Productivity	Web of Science
Antonietti, R; Cainelli, G	KIBS and the City: GIS Evidence from Milan	2012	Productivity	Web of Science
Siba, Eyerusalem; Söderbom, Måns; Bigsten, Arne; Gebreeyesus, Mulu	Enterprise Agglomeration, Output Prices and Physical Productivity: Firm-Level Evidence from Ethiopia	2012	Productivity	Google Scholar
Maré, David C.; Timmons, Jason; Economic, M	Geographic concentration and firm productivity	2006	Productivity	Google Scholar
Madsen, Erik Strøjer; Smith, Valdemar; Dilling-Hansen, Mogens	Industrial clusters, firm location and productivity	2003	Productivity	Google Scholar
Henderson, J. Vernon	Marshall's scale economies	2003	Productivity	Google Scholar

Table 5 (continued)

Authors	Title of Publication	Year of Publication	Performance Variable	Database
Graham, Daniel J.; Melo, Patricia S.; Jiwattanakulpaisarn, Piyapong; Noland, Robert B	Testing for causality between productivity and agglomeration economies	2010	Productivity	Google Scholar
Graham, Daniel J	Agglomeration, productivity and transport investment	2007	Productivity	Google Scholar
Damijan, Jože P.; Konings, Jozef	Agglomeration Economies, Globalization and Productivity: Firm Level Evidence for Slovenia	2011	Productivity	Google Scholar
Raspe, Otto; van Oort, Frank G	Firm heterogeneity, productivity and spatially bounded knowledge externalities	2011	Productivity	Google Scholar
Feser, Edward J	Agglomeration, enterprise size and productivity	2011	Productivity	Google Scholar
Drucker, Joshua M.; Feser, Edward	Regional industrial dominance, agglomeration economies and manufacturing plant productivity	2007	Productivity	Google Scholar
Chang, Chia-Lin; Oxley, Les	Industrial agglomeration, geographic innovation and total factor productivity: The case of Taiwan	2009	Productivity	Google Scholar
Baldwin, John R.; Beckstead, Desmond; Mark Brown, W.; Rigby, David L	Agglomeration and the geography of localization economies in Canada	2008	Productivity	Google Scholar
Thabet, Khaled	Industrial Structure and Total Factor Productivity: The Tunisian Manufacturing Sector between 1998 and 2004	2015	Productivity	Ebsco
HAILU, GETU; DEATON, B. JAMES	AGGLOMERATION EFFECTS IN ONTARIO'S DAIRY FARMING	2016	Productivity	Ebsco
Borowiecki, Karol J	Agglomeration economies in classical music	2015	Productivity	Ebsco
Backman, Mikaela	Human Capital in Firms and Regions: Impact on Firm Productivity	2014	Productivity	Ebsco
Antonelli, Cristiano; Scellato, Giuseppe	Complexity and Technological Change: Knowledge Interactions and Firm Level Total Factor Productivity	2013	Productivity	Ebsco
Guiso, Luigi; Schivardi, Fabiano	What Determines Entrepreneurial Clusters?	2011	Productivity	Ebsco

Table 5 (continued)

Authors	Title of Publication	Year of Publication	Performance Variable	Database
Becchetti, Leonardo; Panizza andrea de; Oropallo, Filippo	Role of Industrial District Externalities in Export and Value-added Performance: Evidence from the Population of Italian Firms	2007	Productivity	Ebsco
Anthony J. Howell	Do Marshallian Sources Drive Technological Relatedness? Implications for Firm Survival and Subsequent Success in China	2016	Productivity	SSRN
Mushtaq A. Khan, Hadia Majid, Amina Riaz, Masood Sarwar	Cluster Based Industrialization and its Effect on Firm Productivity in Pakistan	2015	Productivity	SSRN
Pe'er, A; Keil, T	Are all startups affected similarly by clusters? Agglomeration, competition, firm heterogeneity and survival	2013	Survival	Web of Science
Wennberg, K; Lindqvist, G	The effect of clusters on the survival and performance of new firms	2010	Survival	Web of Science
Audia, PG; Rider, CI	Close, but not the same: Locally headquartered organizations and agglomeration economies in a declining industry	2010	Survival	Web of Science
Shaver, JM; Flyer, F	Agglomeration economies, firm heterogeneity and foreign direct investment in the United States	2000	Survival	Web of Science
De Vaan, M; Boschma, R; Frenken, K	Clustering and firm performance in project-based industries: the case of the global video game industry, 1972–2007	2013	Survival	Web of Science
Wang, L; Madhok, A; Li, SX	AGGLOMERATION AND CLUSTERING OVER THE INDUSTRY LIFE CYCLE: TOWARD A DYNAMIC MODEL OF GEOGRAPHIC CONCENTRATION	2014	Survival	Web of Science
De Silva, DG; McComb, RP	Geographic concentration and high tech firm survival	2012	Survival	Web of Science
Sasatani, D; Zhang, DW	The Pattern of Softwood Sawmill Closures in the US South: A Survival Analysis Approach	2015	Survival	Web of Science

Table 5 (continued)

Authors	Title of Publication	Year of Publication	Performance Variable	Database
van Oort, FG; Burger, MJ; Knoben, J; Raspe, O	MULTILEVEL APPROACHES AND THE FIRM-AGGLOMERATION AMBIGUITY IN ECONOMIC GROWTH STUDIES	2012	Survival	Web of Science
Heebels, B; Boschma, R	Performing in Dutch book publishing 1880–2008: the importance of entrepreneurial experience and the Amsterdam cluster	2011	Survival	Web of Science
Pe'er, A; Vertinsky, I; Keil, T	Growth and survival: The moderating effects of local agglomeration and local market structure	2016	Survival	Web of Science
Cainelli, G; Montresor, S; Vittucci Marzetti, G	Spatial agglomeration and firm exit: a spatial dynamic analysis for Italian provinces	2014	Survival	Web of Science
Renski, H	External economies of localization, urbanization and industrial diversity and new firm survival	2011	Survival	Web of Science
Jaffee, J	Law firm office location and firm survival in Silicon Valley, 1969 to 1998	2003	Survival	Web of Science
Neffke, FMH; Henning, M; Boschma, R	The impact of aging and technological relatedness on agglomeration externalities: a survival analysis	2012	Survival	Web of Science
Brouder, P; Eriksson, RH	Staying Power: What Influences Micro-firm Survival in Tourism?	2013	Survival	Web of Science
Renski, H	Externalities or Experience? Localization Economies and Start-up Business Survival	2015	Survival	Web of Science
Burger, MJ; van Oort, FG; Raspe, O	Agglomeration and New Establishment Survival: A Mixed Hierarchical and Cross-Classified Model	2011	Survival	Web of Science
Puig, F; Gonzalez-Loureiro, M; Ghauri, PN	Internationalisation for Survival: The Case of New Ventures	2014	Survival	Web of Science

Table 5 (continued)

Authors	Title of Publication	Year of Publication	Performance Variable	Database
Staber, U	Spatial proximity and firm survival in a declining industrial district: The case of knitwear firms in Baden-Wurttemberg	2001	Survival	Web of Science
Sleutjes, B; Van Oort, F; Schutjens, V	A PLACE FOR AREA- BASED POLICY? THE SURVIVAL AND GROWTH OF LOCAL FIRMS IN DUTCH RESIDENTIAL NEIGHBORHOODS	2012	Survival	Web of Science
Boschma, RA; Wenting, R	The spatial evolution of the British automobile industry: Does location matter?	2007	Survival	Web of Science
Okamuro, Hiroyuki	Survival of New Firms in an Industry Agglomeration: An Empirical Analysis Using Telephone Directory of Tokyo	2004	Survival	Google Scholar
Lindqvist, Göran	Disentangling clusters: agglomeration and proximity effects	2009	Survival	Google Scholar
Kunkle, Gary Monroe	Cluster requiem and the rise of cumulative growth theory	2009	Survival	Google Scholar
Folta, Timothy B.; Cooper, Arnold C.; Baik, Yoon-suk	Geographic cluster size and firm performance	2006	Survival	Google Scholar
Ferragina, Anna Maria; Mazzotta, Fernanda	Local agglomeration economies: what impact on multinational and national Italian firms' survival?	2014	Survival	Google Scholar
Buenstorf, Guido; Guenther, Christina	No place like home? Location choice and firm survival after forced relocation in the German machine tool industry	2007	Survival	Google Scholar
Nasir, Marjan	Agglomeration and Firm Turnover	2013	Survival	Google Scholar
Moreno-Monroya, Ana I.; Arauzo-Carodb, Josep-Maria	Firm dynamics and intra-metropolitan agglomeration: an empirical analysis for Spain 2006–2012	2015	Survival	Google Scholar
He, Canfei; Guo, Qi; Rigby, David	Industry Relatedness, Agglomeration Externalities and Firm Survival in China	2015	Survival	Google Scholar

Table 5 (continued)

Authors	Title of Publication	Year of Publication	Performance Variable	Database
Deltas, George; Silva, Dakshina G. de; McComb, Robert P	Agglomeration Spillovers and Industry Dynamics: Firm Entry, Growth and Exit in the Software Publishing Industry	2014	Survival	Google Scholar
Costa, Carla; Baptista, Rui	The Impact of Clusters on Firm Performance in the Growth and Sustainment Stages of the Cluster Lifecycle	2015	Survival	Google Scholar
Cainelli, Giulio; Montresor, Sandro; Vittucci, Marzetti Giuseppe	Firms' death rate and spatial agglomeration. Evidence on the resilience of Italian local production systems	2012	Survival	Google Scholar
Basile, Roberto; Pittiglio, Rosanna; Reganati, Filippo	Do Agglomeration Externalities Affect Firm Survival?	2016	Survival	Google Scholar
Nasir, Marjan	Effects of Agglomeration and Trade Liberalization On Firm Entry and Exit	2012	Survival	Google Scholar
Wrobel, Martin	'One for all and all for one': Cluster, employment and the global economic crisis. Evidence from the German mechanical engineering industry	2015	Survival	Ebsco
Weterings, Anet; Marsili, Orietta	Spatial Concentration of Industries and New Firm Exits: Does This Relationship Differ between Exits by Closure and by M&A?	2015	Survival	Ebsco
Anthony J. Howell	Do Marshallian Sources Drive Technological Relatedness? Implications for Firm Survival and Subsequent Success in China	2016	Survival	SSRN
George Deltas, Dakshina G. De Silva, Robert P. McComb	Industrial Agglomeration and Spatial Persistence of Employment in Software Publishing	2014	Survival	SSRN

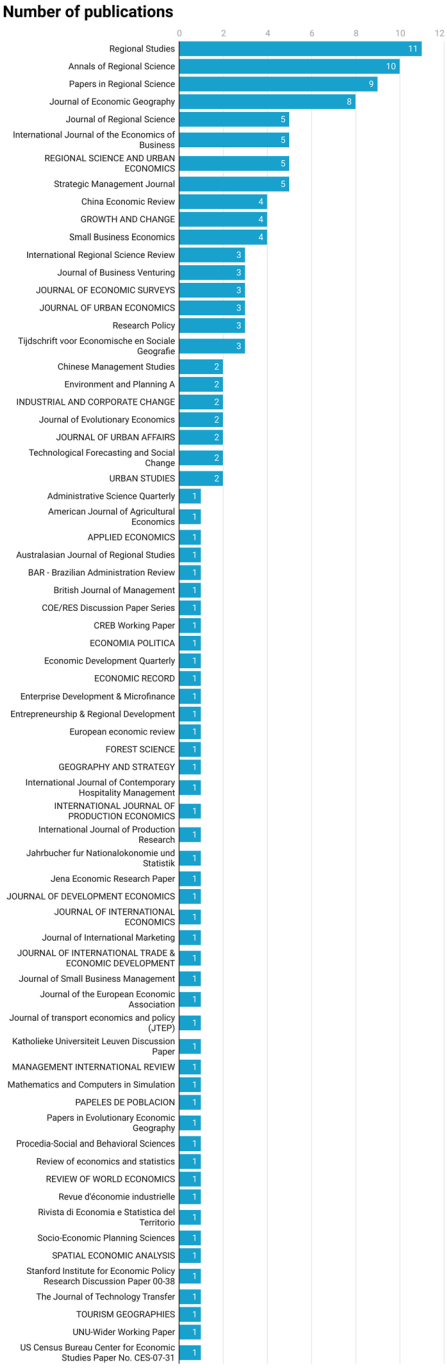

Fig. 6 Journal distribution of the final sample (own illustration created with Datawrapper)

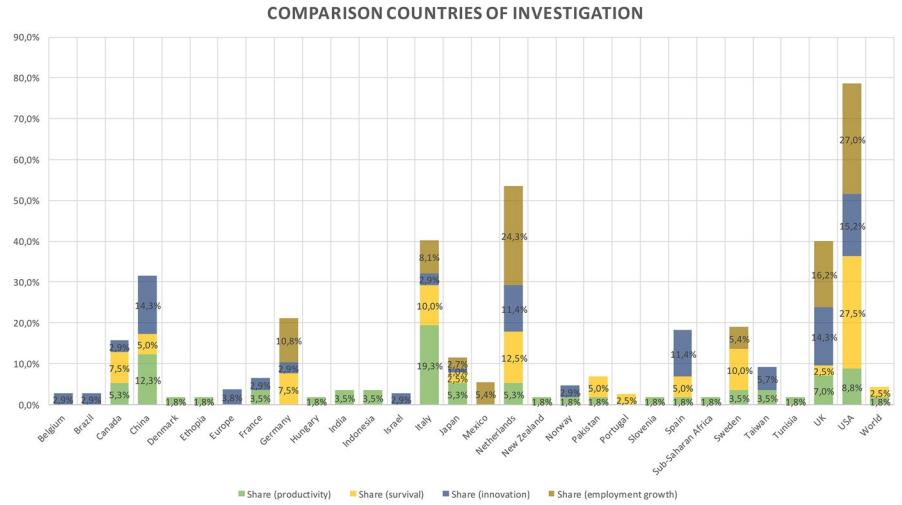

Fig. 7 Countries of investigation of the final sample (own illustration)

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Declarations

Conflict of interest No potential conflict of interest was reported by the authors.

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