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CLUSTERS IN DESIGNING S3-ORIENTED POLICIES

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Abstract: Enhancing economic performances of regions is currently perceived as a priority. Given these needs, the role of regional clusters has been recently coupled with the concept of Smart Specialization Strategy (S3). This paper aims at contributing to the debate on the role of clusters in the arduous implementation of S3, towards investigating the potentials of the clusters life cycle (CLC) and spatial analysis to guide the Entrepreneurial Discovery Process (EDP). This argument is theoretically discussed on the base of literature evidence. Firstly, the concept of S3, its relation to clusters and the emerging EDP gaps are presented. Secondly, the potentials of CLC and spatial analysis are investigated by (i) studying the literature and selecting a set of indicators, accounting for clusters stage-specific and spatial attributes. (ii) framing the indicators into a model and providing a qualitative judgment of their strength at each stage of the CLC (iii) interpreting the model towards testing whether the CLC and spatial analysis display the potential to input EDP.
The authors find that CLC and spatial analysis can play a significant role towards supporting EDP operationalization. This finding calls for the consideration of policymakers as a valuable source of information towards tackling EDP gaps.

Keywords: Clusters, Design, Maps-Led, Policy, S3.

1. INTRODUCTION

During the last decades, the concepts of competitiveness and innovation, at the regional level, gained a growing consideration becoming key topics of both academic and political debates. The urge to enhance regional economic performances, through the creation of appropriate context-conditions, is perceived as a priority, which would enable territories to tackle the challenges posed by globalisation (Farrell et al., 1999; Doloreux and Parto, 2005; Foray et al., 2009; Camagni and Capello, 2013). Given these emerging needs, the role of regional clusters has become progressively more significant (Porter, 2000, 2003; Martin and Sunley, 2003) and recently it has been coupled with the policy concept of Smart Specialization Strategy (S3). The latter is a relatively new academic idea, which has enjoyed a fast success towards suddenly turning into a crucial element of the EU 2020 innovation plan (Dominque Foray, David, and Hall, 2011). S3 brings into prominence an innovative territorial development policy framework, which enhances the place-based approach. S3 policies are mainly advocated in EU regions. The attention is pushed on whether the core toolkit provided by the experience with clusters and cluster policies could potentially guide the challenging design and implementation of S3. As much research confirms, while Cluster policy and S3 are not completely corresponding, it is still reasonable identifying many synergies between the two policy constructs (Foray, David, and Hall, 2011; Foray et al., 2012; Aranguren and Wilson, 2013; Castillo, Paton and Saez, 2013; Ketels et al., 2013). Notwithstanding the valuable contribution of many scholars on the subject of Cluster and S3, the academic debate still falls somewhat short of addressing some issues. In particular, various scholars observed that one of the S3's policy principles, the so-called Entrepreneurial Discovery Process (EDP), is affected by significant implementation gaps (Hermosa and Elorduy, 2015; Rodríguez-Pose

and Wilkie, 2015; Gheorghiu, Andreescu, and Curaj, 2015; Capello and Kroll, 2016). The emerging issue, mentioned above, calls attention to the need to disclose new perspectives on the relationship between Cluster and S3.

This work aims at exploring new perspectives on the role of clusters in S3 design and implementation, with a focus on EDP. The theoretical constructs, presented in the following sections, are meant to provide policymakers with valuable insights to adequately tackle EDP-related challenges. The authors believe that S3 and, particularly, EDP implementation could highly benefit clusters' stage-specific and spatial analysis. Considering the research purpose, the article structure is the following. The second section reflects on the concept of S3, its relation with clusters and the emerging EDP gap. The third section investigates the potential role of the clusters life cycle (CLC) and spatial analysis in the way of EDP. The fourth section presents the conclusions.

2. A BACKGROUND ON S3 AND CLUSTERS: CONCEPTS AND CHALLENGES

The discussion on S3 has originated from the work of the Knowledge for growth experts group, which highlighted the need for re-thinking EU regional development policies to bridge the so-called transatlantic gap. Accordingly, the academic concept of S3 defines an innovative, place-based development policy framework. S3 primary objectives pertain to (i) production of smart, sustainable and inclusive growth, (ii) promotion of research potential, and (iii) maximisation of the usage of innovations (Foray et al., 2009, 2012; Foray and Goenega, 2013). This strategy also emphasises the urge to prioritise policy initiatives by operating with a vertical logic and defining methods to *"identify (...) desirable areas for (...) intervention"*(Foray and Goenega, 2013: p.1). Since its birth, the concept of S3 has had an extraordinary career and rapidly became a crucial element of the EU 2020 innovation plan. However, translating such academic idea in practice is not a trivial matter and poses many implementation barriers. In the way of facilitating the operationalization of S3, the EU Commission has produced a sort of implementation handbook, entitled *"Guide to Research and Innovation Strategies for Smart Specialization (RIS3)"* (Foray et al., 2012). This guide sets a quite demarcated implementation framework, including six steps (Foray et al., 2012): (i) analysis of the national/regional context and the potential for innovation, (ii) set-up of a sound and inclusive governance structure, (iii) production of a shared vision for the future of the country/region, (iv) selection of a limited number of priorities for national/regional development, (v) establishment of suitable policy mixes, and (vi) integration of monitoring and evaluation mechanisms (Foray et al., 2012). Besides the implementation steps mentioned above, the work of Foray et al. (2012) also offers an important reflection on the relationship between clusters and S3. Clusters are intended by the authors as a valuable source of knowledge, which has to be cautiously deployed in the way of S3. EU Regions' experience with clusters and cluster policies is seen as an essential "building block" to implementing S3 policies. The importance of clusters' contribution to S3, is particularly acknowledged for: (i) identifying regional competencies and assets, (ii) meeting the objectives of S3, and (iii) reinforcing local and international cooperation (Foray et al., 2012). Comparable arguments are later recalled in the EU Commission's report on *"The role of clusters in Smart Specialisation Strategy"* authored by Ketels et al. (2013), which defines similarities and differences between clusters and S3. This report claims that, while both clusters and S3 focus specifically on productivity and innovation as drivers of competitiveness and aim to foster regional embeddedness, there are still many differences in emphasis between the two policy constructs. Clusters, it is said, focus more on: (i) the critical mass of economic activities, ii)

the performance of a set of linked companies (iii) the external effects through shared infrastructure and input markets, and (iv) the groups of companies operating in related industries (Ketels et al.; 2013). Instead, S3 refers to (i) the exploration of emerging market opportunities, (ii) the facilitation of knowledge spillovers between knowledge domains, (iii) the exploitation of related variety, and (iv) the generation of structural changes in regional economies (Ketels et al.; 2013). After comparing clusters and S3, the report of Ketels et al. (2013) streamlines clusters' potential support to S3 implementation, through a six-leverage-point framework. The latter includes : (i) prioritization process (ii), design of integrated policy mixes, (iii) evidence-based policy-making, (iv) multi-level governance, (v) cross-border dimension, and (vi) stakeholders engagement (Ketels *et al.*, 2013: p.5). Finally, the report on "The role of clusters in Smart Specialisation Strategy" provides some early suggestions on the need to take into consideration the level of clusters development as an element potentially supportive to S3 implementation. On a similar line of thoughts, Araguren and Wilson (2013) observed correspondences and distinctions between Cluster and S3. The latter authors report three key differences between the two policy constructs, namely (i) scale, (ii) focus and (iii) tools. Araguren and Wilson noticed that cluster policies usually aim at supporting cooperation among distinct groups of agents, focusing on the enhancement of competitiveness at the cluster level by employing relatively narrow tools. Instead, S3 has a broader scope than cluster policies and aim at fostering processes of economic prioritisation which will eventually lead regions towards economic restructuring. However, Araguren and Wilson (2013) still affirm that there are potential synergies between clusters and S3. Indeed, the two scholars observed that both the policy constructs have a place-specific feature, seek to promote cooperation among actors that develop complementary economic activities and aim to support the existent and building new competitive advantages. In conclusion, Aranguren and Wilson (2013) actualize the study about clusters and S3 on the case of the Basque country. In contrast whit the studies mentioned above, an on-field analysis conducted by Perło (2015), in the Polish regions, reveals that *"the development of clusters with smart specialisations (...) proves that it is difficult to detect a practical correlation between these concepts"*(Perło, 2015: p.107).

Despite the extensive literature on the subject, the operationalization of S3 remains arduous. The difficulties are due both to the experimental nature of the concept, and the complexity of the policy construct itself. The most severe challenges seem to concern the EDP, which is discussed in the next subsection.

2.2 EDP: process and gaps

EDP is undoubtedly the peculiar element of S3 policies. According to Foray's perspective, EDP is the key engine enabling the success of S3 by disclosing regions' hidden potential to specialise (Foray et al., 2009, 2012; Foray and Goenega, 2013; Bevilacqua et al., 2015). Foray stresses that the key EDP inputs are *"framework conditions for innovation", "relational density",* and *"diversity of economic actors"* (Foray, 2015: p.61). These inputs should drive EDP towards the (i) integration of entrepreneurial and economic knowledge, (ii) engagement of stakeholders, and (iii) exploration of new economic domains at the regional level. Tersely, EDP is meant to territorially detect economic priorities, by engaging a broad group of local stakeholders (entrepreneurial agents, policy makers and the remainder of the society), to enlarge the local knowledge-base and produce relevant information to S3. Given these considerations, it has to be observed that EDP requires a bottom-up approach, which implies a paradigmatic shift in the traditional conception of *"administration and politics [as]*

omniscient planners" (Foray, 2015: p.3). Accordingly, the significance of administrators' role is downscaled, while the position of other local actors (particularly, entrepreneurial agents) is enhanced. Because of its very nature, EDP is as much essential as challenging to S3. Foray first, observed that the identification of entrepreneurial discoveries *"[is] not [an] easy empirical investigation"* (Foray, 2015: p.61). Since then, various academics noted the difficulties associated with EDP implementation. Recently, Capello and Kroll (2016) extensively discussed the barriers limiting S3 implementation. The same academics highlighted that, among other factors, *"the lack of concrete elaboration of the entrepreneurial discovery process (...) c[o]me[s] to play a hindering factor"*(Capello and Kroll, 2016: p.6). Gheorghiu, Andreescu, and Curaj (2015) offer a similar finding, by lamenting the lack of a *"functional blueprint for the entrepreneurial discovery process"* (p.2). The pieces of evidence, mentioned above, call for consideration from both scholars and practitioners to tackle such EDP-related issues. It reasonable to affirm that disclosing new perspective on the relationship between clusters and S3, could potentially contribute towards resolving EDP implementation gaps.

3. EXPLORING NEW PERSPECTIVES: CLUSTERS' LIFE CYCLE AND SPATIAL ANALYSIS

The processes of policy design and implementation are rarely concerned with the different phases of the clusters life cycle. However, considering that clusters dynamics and spatial configurations change over time, it is expectable *"that different policy measures vary in their effectiveness over the clusters life cycle"* (Brenner and Schlump, 2011: p.1364). The latter idea seems to apply, to some extent, also to S3. Consistently, it is reasonable to suppose that some clusters' stage-specific attributes (in term of innovative dynamism, cooperation among firms, diversity of knowledge and actors, and spatial significance) can be considered, much then others, suitable to support the operationalization of S3, and in particular of EDP. This theoretical argument, which is the core of the present study, is tested through the methodological approach that follows. Firstly, the study of the literature on the CLC allows the authors to understand which are the leading indicators accounting for the evolution of clusters. Secondly, the indicators drawn from the literature study, are used to build a theoretical model, and a qualitative judgment is assigned by the authors to each indicator at every stage of the CLC. Thirdly, the discussion on the model logically compares stage-specific features (in term of innovative dynamism, cooperation among firms, diversity of knowledge and actors, and spatial significance) of clusters with key inputs and characteristics (according to Foray) of EDP, in order to test if and which stage of the CLC display a potential towards inputting EDP.

3.1 Literature study

While the academic literature has plenty of studies dissecting the functioning of clusters, there are still relatively few pieces of work adequately explaining the dynamics of clusters evolution. Various academics claim that clusters evolve through a precise life cycle consisting of different stages. However, such stages are not univocally identified yet. The literature indeed, offers different models, which treat clusters' evolution according to three-stage- (Bianchi, Miller and Bertini, 1997; Mario A Maggioni, 2004; Maskell and Kebir, 2006), four-stage- (Press, 2006; Bergman, 2008; Menzel and Fornahl, 2009; Handayani et al., 2012) or even five-stage-based frameworks (Andersson et al., 2004; Brenner and Schlump,

2011). This article describes the CLC, according to a three-stage taxonomy, including the phases of (i) emergence, (ii) development and (iii) maturity of clusters. This study does not consider the stage after maturity as it is not precisely predictable whether clusters are going to transform or decline after reaching the mature stage.

Emergence. This stage is usually triggered by an exogenous economic shock, caused by the introduction of a process- or product- innovation (Mario A. Maggioni, 2004). The exogenous shock induces the take-off of the clustering process and consequently drives a limited number of small companies to agglomerate in certain geographical areas (Bianchi, Miller, and Bertini, 1997; Andersson et al., 2004; Maggioni, 2004; Menzel and Fornahl, 2009). Such early agglomeration phenomenon presents a scattered spatial configuration and lacks consistency because the locational benefits are not evident yet (Mario A Maggioni, 2004). However, the more the innovation, which sparked the clustering process, spreads out, the more firms enter the cluster being encouraged by involuntary knowledge spillover. Indeed, the flow of knowledge and information at this stage is mainly involuntary and informal as it does rely nor on structured networks neither on consolidated partnerships. Despite the lack of sharpened inter-firm organisational forms, nonetheless, a stock of heterogeneous knowledge circulates among insider businesses. At this stage, it is reasonable to identify four key factors potentially leading the new-born cluster to success, namely: (i) number of start-ups and imitative businesses entering the market (Brenner and Schlump, 2011; Suire and Vicente, 2014); (ii) heterogeneity of accessible knowledge which *"facilitates continuous adjustment to changing external circumstances"*(Shin and Hassink, 2011: p.1390); (iii) local political/institutional context, in terms of policy environment and the presence of high quality Public Institutions, Universities and research centres (Menzel and Fornahl, 2009); (iv) local industrial context, in terms of the presence of related industries (Porter, 1998). The two former factors function actively to support clusters development. Instead the two latter play a background role (Brenner and Schlump, 2011). This explorative stage of the CLC is also characterised by significant Venture Capital (VC) and Research and Development (R&D) investments. To summarise, the emergence is a very early, upstream and explorative phase of the CLC and it is featured by a marked tendency of firms towards innovativeness. The role of start-ups, as well as the values of creativity, and willingness to risk added by entrepreneurs, are crucial to further the prosperity of clusters. The benefits deriving from network activities and knowledge spillovers are somehow available, and the stock of accessible knowledge is highly heterogeneous.

Development. In this stage clusters expand through both a substantial proliferation of the companies entering the market and a significant increase in employment. The locational benefits become incredibly high towards fostering up the spatial agglomeration phenomenon. Accordingly, the profitability of insider businesses rises, reaching its peak. In this phase, the agglomeration economies, theorised by Marshall, are the key engine enabling the endogenous growth of the cluster (Mario A Maggioni, 2004). Consequently, many positive externalities take place, including (i) specialised labour pooling; (ii) interactions among stakeholder, and (iii) knowledge spillovers. In addition to the Marshallian externalities, another factor contributing to the cluster prosperity is the medium/high level of heterogeneity of available knowledge within the clusters' environment (Shin and Hassink, 2011). Tersely, the success of clusters at this stage seems boldly rooted in regional self-reinforcing processes (such as networking activities, interactions, and cooperation) occurring among local firms and institutions. The number of Start-ups and entrepreneurs is still relevant but no longer crucial. The R&D and VC investments remain significant as well as the level of heterogeneity of accessible knowledge.

Maturity. In this stage clusters reach a stable configuration, towards focusing on specific business segments, consolidating networks' structure and acquiring cooperative routines (Menzel and Fornahl, 2009; Brenner and Schlump, 2011). This state of quasi-equilibrium of clusters is featured by a severe decrease in frequency and number of entries, which in turn makes the clusters' growth rate dropping down. At this point, while locational benefits and self-reinforcing effects are still somehow accessible, they tend inevitably to attenuate and slowly dissolve (Mario A. Maggioni, 2004; Brenner and Schlump, 2011). Moreover, clusters at this stage are usually featured by a tendency towards high specialisation (if not over-specialisation), which narrows the variety of economic activities as well as the heterogeneity of available knowledge (Shin and Hassink, 2011). To sum up, in the maturity clusters reach the maximum size, have a well-shaped network structure, and a precisely-defined core business. In this context, the entry of Start-ups in the clusters becomes irrelevant, R&D and VC investments decrease, and the knowledge accessible becomes homogeneous.

In conclusion this literature study provides a description of clusters stage-specific attributes, allowing the authors at deducing that clusters evolution can be explained, to some extent, by variations in the following indicators: R&D investment; VC investment, new firms (start-ups) birth rate (Bergman, 2008; Brenner and Schlump, 2011); intensity of network activities (Brenner and Schlump, 2011); heterogeneity of available knowledge (Menzel and Fornahl, 2009; Shin and Hassink, 2011); specialization and agglomeration (Maggioni, 2002; Maggioni, 2004). These elements will be deployed to outline a theoretical model which is ultimately meant to present the potential of CLC and spatial analysis in inputting EDP.

3.2 Theoretical model

Outlining such a theoretical model presents some difficulties. Firstly, because the lack of established conventions on indicators for the study of clusters makes the selection of the variables a relatively arbitrary process. Secondly, because nor clusters neither the CLC can be satisfyingly explicated through a single model. Given these premises, while the model cannot fully explain the CLC and the related spatial dynamics, it can still adequately present the potential of CLC and spatial analysis in inputting EDP. Accordingly, the model is designed as follows: (i) a set of indicators is selected by drawing insights from the literature study (see subsection 3.1). This set includes: R&D investment, VC investment, new firms birth rate as indicators of clusters dynamism (Bergman, 2008; Brenner and Schlump, 2011), intensity of network activities as indicator of cooperation (Brenner and Schlump, 2011), heterogeneity of available knowledge (Menzel and Fornahl, 2009; Shin and Hassink, 2011) specialization and agglomeration as indicator of spatial significance (Maggioni, 2002; Mario A Maggioni, 2004); (ii) the strength of each indicator at each stage of the CLC is qualitatively scored. The scores are assigned by the authors on the base of the insights drawn from the literature. For the scoring, the authors used a scale based on five degrees of intensity: low, medium/low, medium, medium/high and high.

Tersely, the model both systematises clusters' stage-specific and spatial attributes, and opens to a discussion.

Table 1: Strength of the indicators by CLC stage

DYNAMISM	COOPER	VARIET	SPATIAL

				ATION	Y	SIGNIFICANCE	
	R&D investment	**VC investment**	**Start-ups birth rate**	**Intensity of network activities**	**Heterogeneity of available knowledge**	**Specialization**	**Agglomeration**
Emergence	high	high	high	medium	high	low	low
Development	medium/high	medium/high	medium/high	medium/high	medium/high	medium	medium/high
Maturity	low	low	low	medium/high	low	high	high

3.3 Discussion on the model

The model presented in Table 1 opens to a discussion: firstly, provides an interpretation of the indicators and their variation in strength over the CLC stages, and secondly, highlights the relevance of clusters stage-specific and spatial features relatively to EDP's key inputs and characteristics (according to Foray). The finding emerging from the discussion are summarised in Table 2.

Table 2: Findings

	DYNAMISM			COOPERATION	VARIETY	SPATIAL SIGNIFICANCE		COMPARISON TO EDP
	R&D investment	**VC investment**	**Start-ups birth rate**	**Intensity of network activities**	**Heterogeneity of available knowledge**	**Specialization**	**Agglomeration**	**Potential input to EDP**
Emergence	high	high	high	medium	high	low	low	high
Development	medium/high	medium/high	medium/high	medium/high	medium/high	medium	medium/high	high
Maturity	low	low	low	medium/high	low	high	high	low

R&D investments target a broad range of creative activities, including *"basic research, applied research, and experimental development"* (OECD, 2013: p.1). These activities aim at expanding *"the stock of knowledge (...) and the use of this knowledge to devise new applications"*(OECD, 2013: p.1). According to the literature R&D investment is considered as a reliable indicator of clusters innovativeness (Davis et al., 2006), and as a determinant of entrepreneurship (OECD, 2013, 2016). Tersely, R&D catalyses the generation and diffusion of new knowledge, towards creating a vibrant entrepreneurial environment and supporting inventions. The benefits of R&D spread over regions by availing entire groups of firms. However, it has been found that R&D seems to play a particularly prominent role *"during the*

early life course of (...) firms" (Stam and Wennberg, 2009: p.79). Furthermore, new-born firms (such as start-ups) tend to use the innovative inputs (investment on R&D) more efficiently than the old ones. Consequently, clusters featured by a high number of start-ups, attract and call for R&D investment, which in turn generate remarkable innovative outputs. Given these considerations, it seems logically more convenience to operate R&D investments during the initial phases of the CLC, namely emergence and development. These two initial stages appear to be more suitable for entrepreneurial discoveries, because of a high start-ups' birth rate (which will be discussed in the next paragraph) within a flourishing innovative environment. Conversely, clusters in their maturity rely on aged firms, which operate according to consolidated, if not stagnating, industrial practices. Henceforth, envisioning that EDP is meant to *"(...) logically identify (...) the domains where new R&D and innovation projects will (...) create future domestic capability"* (Dominque Foray, David and Hall, 2011: p.4), it is reasonable to conclude that emergent and developing clusters offer optimal context conditions for EDP implementation. The same conclusion is also valid when taking in consideration Venture Capital (VC) investments. VC investments refer to *"a form of equity financing particularly important for young companies with innovation and growth potential but untested business models and no track record"*(OECD, 2016: p.142). This funding system is seen both as a marker of clusters innovative potential, as well as an essential factor nourishing clusters' entrepreneurial environment (Breschi and Malerba, 2005). Indeed, VC is especially advocated in, and attracted by, highly pioneering territorial contexts (Bevilacqua, Pizzimenti and Maione, 2017). Such setting coincides with those of emerging and developing clusters. Therefore, VC investments, by focusing especially on the explorative stages of the CLC (Bergman, 2008), trigger potential innovations which could be intercepted in the way of EDP. Both the indicators discussed so far, R&D and VC investments, are tightly related to the presence of entrepreneurs and new businesses within the clusters' environment. Specifically, the incidence of start-ups birth rate, within clusters' environment, seems to be particularly relevant. Start-ups include all newly born firms that are up to two years old (OECD, 2016). Such "young" and usually small-sized businesses, because of their very explorative, and potentially innovative nature, are crucial endogenous drivers of territorial development. Indeed, start-ups birth rate is an important indicator signalling both the dynamism of clusters (Davis et al., 2006) and the overall goodness of the entrepreneurial environment (OECD, 2016). High values of the indicator start-ups birth rate also mean that entrepreneurial actors (the holders of entrepreneurial knowledge) are particularly active. To sum up, there is a positive correlation at the territorial level between high values of the indicator start-ups birth rate (which usually attributes emerging and developing clusters), high density of entrepreneurs and high availability of entrepreneurial knowledge. Given that EDP has *a "(...)special focus on the regional entrepreneurial environment, assessing whether it is lively and can generate a significant flow of experiments, innovation ideas (...)"* (Foray et al., 2012: p.20), it is reasonable to deduce that emerging and developing clusters could provide valuable inputs in the way of entrepreneurial discoveries. As already stressed, high values of the indicator start-ups birth rate are a marked feature of clusters' emergence and development stage. Instead, the entry of start-ups, and their importance in the functioning of the cluster, drastically decreases during maturity. This theoretical evidence suggests that EDP can be effectively supported by the bold entrepreneurial, innovation-oriented, cross-sectoral environment manifested at the two initial stages of clusters' evolution.

Networks activities embrace the broad range of actions aiming at generating or nourishing *"organisational forms] of economic activities that may allow firms to cope with market failures (...)."* (OECD, 2004: p.20). The intensity of network activities provides a measure of knowledge exchange and firms connectedness, within certain geographic boundaries (which

are mutable and permeable). Empirical studies demonstrate that increases in network activities are positively correlated with the rise of firms' innovativeness (OECD, 2001). However, the same studies also prove that the willingness to engage in knowledge-based networks has a negative correlation with firms' size. These two latter pieces of evidence, suggest that network activities are more intense in the presence of new-born, small-sized firms (such as start-ups). The latter (usually concentrating in emergent or developing clusters) orientate towards more flexible, sometimes informal, network forms. On the contrary, big firms (usually concentrating in mature clusters) rely on routine-based, formally-regulated networks. These differences in the structure and willingness to engage in networks make small firms' more innovative, more adaptable and less sector-specific than big ones. The features of networks are also tightly tied to Marshallian spillovers. In a life cycle perspective, one should consider that networks and the related knowledge spillover evolve over the different stages of the CLC. As previously highlighted (see subsection 3.1), networks are mostly informal, and spillovers often happen involuntarily during clusters' emergence. This is due both to the scattered configuration of the spatial agglomeration of firms and to the explorative nature of the businesses entering the market (mainly start-ups). When clusters move on to the development stage, networks get gradually more structured and spillovers more formal. This condition evolves further on during the maturity stage. At this point clusters are composed mainly of big firms, there is no start-ups entry, and consequently, networks become rigid and spillovers significantly decrease. Given these considerations, it is reasonable to affirm that EDP should focus on emergent and eventually developing clusters, which are featured by the *"relational density"* postulated by Foray. Indeed, the significant density of start-ups and entrepreneurs, the marked attitude of firms towards innovative activities and knowledge sharing, make emergent and developing clusters an exceptional source of various entrepreneurial and economic knowledge.

The heterogeneity of knowledge (Shin and Hassink, 2011), indicates the variety of the available knowledge-stock inside clusters. Considering that knowledge is detained by entrepreneurial actors, the variety of accessible knowledge seems also indicating, to some extent, the assortment of entrepreneurial actors. The more such assortment is diversified, the more clusters manifest a marked attitude towards adjusting to changing conditions. It has been said (see subsection 3.1) that the heterogeneity of knowledge and actors evolve over the CLC. Specifically, while the initial phases of the CLC are featured by high and medium heterogeneity of accessible knowledge, during maturity, this variety tends to attenuate toward homogenization. This shift from heterogeneous to homogeneous knowledge is due both to a decrease in the number of diverse entrepreneurial actors entering the clusters and to an increase in specialisation. Considering that EDP calls for a diversity of economic actors and knowledge, the best match in the way of EDP operationalization seems to be manifested by the features of emerging and developing clusters.

Specialisation is expressed through a location quotient. The latter defines the share of regional employment in a sector, relative to the national context. This indicator is widely endorsed in literature as a marker of spatial concentration of industries (Mayer, 2003; Mario A Maggioni, 2004; Maggioni and Riggi, 2008). The discourse on specialisation presents a split-screen view. On the one hand, low specialization: (i) prevents clustered firms from exploiting the full potential of competitive advantages and (ii) allows clustered firms to benefit a vibrant, cross-sectoral and diversified entrepreneurial environment (typical attribute of emergent and developing clusters). On the other hand, high specialisation leads clustered firms to exploit competitive advantages fully, while eventually leading to stagnation and lock-in (a common attribute of mature clusters). Tersely, high specialisation can lead towards

flattening clusters' economic vibrancy and innovativeness as well as losing the positive effects of the variety externalities theorised by Jacob. Once again, the best fitting ecosystem for EDP is expectedly the one provided by emergent and developing clusters. Indeed, considering that EDP pertains to the detection of potential domains for future regional specialisation, targeting already specialised clusters would mean pointing out traditional industrial sectors instead of S3-type domains. Another indicator accounting for the spatial configuration of clusters is the agglomeration. The latter indicates the number of firms concentrating in some geographical regions (Mario A Maggioni, 2004). This indicator's value increases as clusters get holder, till reaching its peak during the maturity stage. At this point, the mass of economic activities located in a specific geographic area reaches its maximum. As a consequence, the attractiveness of such areas starts decreasing due to a scarce availability of locational benefits (Mario A Maggioni, 2004). Conversely, in cases when spatial agglomeration presents a configuration not saturated yet, businesses from outside are encouraged to locate inside clusters because of potentially high locational benefits. These considerations reveal that the locational attractiveness should be found in clusters that have not reached the spatial agglomeration peak yet, namely: emerging and developing clusters.

In conclusion, this discussion theoretically confirmed that the CLC and spatial analysis have a potential to impact EDP operationalization. In detail, the authors find that emergent and developing clusters can provide a number of significant inputs towards implementing EDP: (i) the significant strength (medium and high) of dynamism and innovativeness (in terms of R&D and VC investment, and start-ups' birth rate) signal high quality framework conditions for innovation; (ii) the medium and high strength in intensity of network activities indicates a significant relational density among clusters insiders and a tendency towards innovative, cross-sectoral cooperation; (iii) the medium and high heterogeneity of available knowledge, which also indicate the variety in the assortment of economic actors, enables the opportunity to enlarge the regional knowledge-base, gathering economic and entrepreneurial knowledge; finally, (iv) the low/medium levels of firms' agglomeration and specialization suggest the existence of a territorially localized economic potential, which has not been fully exploited yet.

4. CONCLUSION

This article presented a theoretical discussion on the role of clusters and cluster policies to support S3 and specifically EDP implementation. Although a significant body of scientific literature confirms that EU experience with clusters and cluster policies is a crucial element towards supporting the implementation of S3, nonetheless many operational gaps keep standing out. One of the most problematic factors pertains to the operationalization of the EDP. Consistently the authors intended to test whether the CLC and spatial analysis could eventually guide the discovery of regional economic potentials. This problem is approached theoretically and discussed on the base of literature evidence. Firstly, the concept of S3, its relation to clusters and the emerging EDP gap is presented. Secondly, the potentials of clusters' life cycle and spatial analysis is tested by: (i) deducing from a literature study a set of indicators accounting for clusters stage-specific and spatial attributes. (ii) framing the indicators into a model and providing a qualitative judgment of their strength at each stage of the CLC, finally (iii) interpreting the model to test if and which stages of the CLC display a potential towards inputting EDP.
The authors conclude that the EDP implementation could significantly benefit the framework conditions for innovation, relational density, and diversity of knowledge and actors provided

by some specific stages of the CLC. Moreover, the identification of the variations in the spatial configuration of clusters, during different phases of the CLC, can offer valuable information about the existence of a territorially localised economic potential. Particularly, the authors find that, according to the logical comparison of clusters' stage-specific attributes and EDP's key inputs and features, it is reasonable to target emerging and developing clusters as a suitable breeding ground towards favouring EDP implementation. These findings call for consideration of policy-makers, to reflect more consciously both on clusters' evolution and spatial configuration, to overcome EDP implementation issues, and consequently get to a fully effective implementation of S3.

5. LIMITATIONS OF THE STUDY

The main limitations of this study pertain to the theoretical model presented. Firstly, because the lack of established conventions on the indicators for the study of cluster makes the selection of the variables a relatively arbitrary process. Secondly because nor clusters neither their life cycle can be satisfyingly explicated through a single model. Given these considerations, some potentially influential factors are ignored (for example the propensity of the big companies to internalise the functions of R&D, the consequences of the global crisis on investment flows, and others), while the variables that are most frequently endorsed in the literature are included. Moreover, given that industries are not alike, and that different variables have different importance in the industries, it might be that the model does not represent the mechanism of some industrial sector (for example the industrial sectors controlled by monopolist holdings and others). However, the theoretical literature provides evidence that a detailed modelling of all relevant processes might not be of crucial importance. From this, it is reasonable to conclude that while the model is not fully explanatory, it still reflects appropriately the potential contribution of the CLC and spatial analysis in the way of S3 and EDP.

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