BASQUE INDUSTRIAL CLUSTERS: LIFE CYCLES, PATH DEPENDENCY AND REGIONAL COMPETITIVENESS

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ÁREA TEMÁTICA: Industrial Districts, Territorial Clusters and Industrial Policy
RESUMEN: This paper presents the partial results of an ongoing research project which seeks to analyze the historical trajectory of Basque industrial clusters and the evolution of both their competitive position and that of the region as a whole. Following literature that is increasingly acknowledging that dynamic and historical perspectives are needed in order to fully understand the existence and structure of clusters (Menzel and Fornahl, 2009; Boschma and Fornahl, 2011; Ter Wal and Boschma, 2011; Staber and Sautter, 2011), we aim at evaluating the role of path-dependent forces in cluster origins and evolution. The present work builds on a previous article published by the authors, based on four clusters: papermaking, electronics and ICT, shipbuilding, and aeronautics) (see Elola et al, 2012). Now, we add two further qualitative historical in-depth case studies of another two clusters -machine tools and energy- to those included in the previous work. Thus, we combine the analysis of three clusters that belong to industries of the first industrial revolution that trace back their origins to the 19th century (papermaking, shipbuilding and machine tools) and three clusters that belong to young industries that have emerged in the second half of the 20th century (electronics and ICT, aeronautics, and energy). We consider both aspects related to cluster dynamics and those related to the regional environment. The paper uses a qualitative meta-study approach (Van der Linde, 2003; Belussi and Sedita, 2009)) in order to summarize the knowledge gathered in the case studies. We conclude that, even if clusters may be influenced by similar initial conditions and/or resource endowments and opportunities, they do not follow homogeneous evolutionary patterns. Clusters respond differently to the same external factors (e.g., international demand and global competition) and evolve differently according to their capabilities.

1. INTRODUCTION

This paper is part of a wider project, which aims at analyzing the historical origins, evolution and current situation of industrial clusters in the Basque Country (Spain). Through qualitative historical in-depth case studies, we examine to which concrete historical factors Basque clusters owe their existence, which was the evolution they experienced with the passage of time, and on what factors they based and now base their competitive advantage. This analysis will allow us to understand the current competitive advantages of the clusters and evaluate up to what point such advantages may be sustainable in the future. In the last resort, our study attempts to shed new light on the
process of long-term economic development of the Basque Country, as there is a clear and direct link between clusters’ performance and regional economic evolution (Boschma, 2004; Martin, 2009; Martin and Sunley, 2006).

The case of the Basque Country proves to be particularly interesting in this regard. It was an old industrialized region, very specialized in heavy industries (iron and steel, shipbuilding, mechanical engineering), which faced a severe economic crisis and an industrial restructuring in the 1980s. Following Porter’s model, in the early 1990s the regional government pioneered within the EU a competitiveness policy based on clusters, with proven and recognized results in R&D, innovation and competitiveness (Aranguren and Navarro, 2003; Ketels, 2004; OECD, 2007). The Basque Country managed to avoid lock-in situations, renewing its industrial base by upgrading some of its mature clusters and by promoting new high technology ones (Trippl and Tödtling, 2009; Aranguren et al., 2012).

The present work builds on a previous article published by the authors, where we analyzed the factors that accounted for the origins and evolution of four clusters, including papermaking, electronics and ICT, shipbuilding, and aerospace clusters (see Elola et al., 2012). Now, we add two new cases to the study, machine tools and energy. Thus, in this paper we combine the analysis of three clusters that belong to industries of the first industrial revolution that trace back their origins to the 19th century (papermaking, shipbuilding and machine tools) and three clusters that belong to young industries that have emerged in the second half of the 20th century (electronics and ICT, aeronautics, and energy). Following Menzel and Fornahl (2009), we first identify clusters’ life cycles, that is, the stages of development of each cluster, employing quantitative (number of firms and employment) and qualitative indicators (cluster and industry life cycle, cluster diversity). Then, we analyse the factors that account for the origin, development, maturity and, if so, decline or renewal of the cluster, considering factors related to the cluster dynamics, and factors related to the regional environment.

We employ a qualitative meta-study approach, akin to that conducted by Van der Linde (2003) for world clusters and by Belussi and Sedita (2009) for Italian industrial districts, in order to summarize the knowledge gathered in the case studies.

In the next section of the paper we briefly review literature on cluster life cycles and sources of regional path dependency. We then analyze, in the empirical section, the evolution and the current situation of the six clusters, identifying the driving factors in
each stage of the life cycle. Finally, we depict some initial conclusions of our study and offer some food for thought for policy makers interested in industrial policy in general, and cluster policy in particular.

2. THEORETICAL BACKGROUND

Over the last years, specially after Michael Porter’s (1990) introduction of the geographical dimension to his cluster idea, the role of clusters and spatial networks for economic development has been widely acknowledged in economic and business literature (e.g., Malmberg and Maskell, 2002; Martin and Sunley, 2003; Porter, 1998). Evidence shows that clustered firms experience stronger growth and faster innovation than non-clustered ones, and that clusters attract more start-ups than regions without a cluster (Audretsch and Feldman, 1996; Baptista, 2000; Baptista and Swann, 1998; Klepper, 2007; Swann et al., 1998). These characteristics cause clusters to be considered a prerequisite for regional prosperity (Bathelt, 2001; Porter, 2003), so that cluster policy is widely used by policy-makers as a tool for promoting regional growth and competitiveness (Martin and Sunley, 2011).

Both at the theoretical and empirical level, much of the existing literature focuses on understanding the existence and functioning of contemporary successful clusters (Bergman, 2009). However, not all clusters appear to be in the same development stage and not all of them are equally successful in a given point in time (Martin and Sunley, 2011). Some clusters are still in an incipient phase, some others present high growth rates and may play an important role in the growth and prosperity of their respective regional economy, and other clusters may be in a decline phase. Thus, economic advantages that stem from cluster dynamics are not permanent (Grabher, 1993) and factors explaining the present functioning of a cluster may not explain its evolution. The few existing insights on the emergence of clusters, for example, lead to the conclusion that the processes responsible for the functioning of a cluster cannot explain its emergence (Bresnahan et al., 2001; Orsenigo, 2001). Also, the decline of clusters seems to be caused by factors that were advantages in the past (Jacobs, 1969; Martin and Sunley, 2006). Thus, life-cycle considerations need to be included in cluster theory, understanding how and why clusters actually become clusters, and how do they develop and decline (Feldman 2001; Feldman et al., 2005; Maskell and Kebir, 2005).
Based on existing literature (Belussi & Sedita, 2009; Brenner & Muhlig, 2007), in our previous paper we analyzed which factors determine cluster emergence and evolution. In each case, we considered both factors that are endogenous and exogenous to the territory where the cluster is located (local and global factors, respectively). In the next paragraphs we summarize those factors (see Elola et al., 2012 for further discussion).

2.1. Factors driving cluster emergence

Among the local factors, and drawing on existing literature, we distinguish a category of historical legacies (tradition and historical preconditions), another category related to regional factor endowment (natural resources, qualified labour, infrastructure…), and some triggering factors (local demand, local and national policies, and anchor firms and local entrepreneurship (see Brenner & Muhlig, 2007; Belussi & Sedita, 2009; and Elola et al., 2012, for further discussion).

Following Belussi and Sedita (2009), we also consider that global factors, such as the entry of foreign firms and entrepreneurs, with capital, technology and/or knowledge may play an important role in the emergence of a cluster. Additionally, we also take into account the role of international demand growth as a triggering factor for the emergence of a cluster.

2.2. Factors driving cluster evolution

Among the local factors, we distinguish one category related to the cluster prior trajectory, where we consider the development of factors specific to the cluster; another one related to the development of capabilities by cluster firms (strategic capabilities in strict sense, and dynamic capabilities); and two other referred to other local agents (local sophisticated demand and local/national policies) (see Elola et al., 2012, for a more detailed discussion).

Globalization (in the form of internationalization, entry of MNCs, relocation processes) can also play an important role in cluster evolution. It is considered one of the most difficult challenges for clusters today (Belussi & Sedita, 2009). The absorption of extra-cluster knowledge, and the interplay between intra- and extra-cluster knowledge systems gain special importance for the sustainment of cluster competitive advantage, avoiding cluster insulation or myopia (Giuliani, 2005; Maskell & Malmberg, 2007). Cluster leading firms and cluster associations may act as technological gatekeepers of extra-cluster knowledge, which they channel into the cluster. Actors from outside, too,
such as MNCs, can also drive the inflow of external knowledge into a cluster (Giuliani, 2005; Valdaliso et al., 2011).

3. **EMPIRICAL FINDINGS**

3.1. **Methodology**

The empirical base of this paper draws from in depth case studies on six industrial clusters: papermaking, maritime industries, machine tools, electronics and ICT, energy, and aeronautics. The former three belong to industries of the first industrial revolution that go back to the 19th century. Nevertheless, the origins of those clusters can be traced back to the late 18th century in the case of paper-making, to the 12th century as for shipbuilding and related activities, and to the 16th century as for machine tools (when a fire arms industry appeared). The last three correspond to young industries and clusters that have emerged in the second half of the 20th century. In the electronics cluster the first firms appeared in the 1940s and 1950s; in the case of aeronautics and energy, they were created in the 1980s, growing out of an already existent manufacturing industry of automobile components and parts, engines, and of a few engineering companies. Then, we have three “mature” clusters that have followed the entire life cycle of creation, development and maturity, and another three “younger” that have gone from the emergence to the development phase (see Table 1).

The current size of the clusters is quite heterogeneous. The clusters of electronics and ICT, and maritime industries comprise 330 and 405 firms, respectively, while those of aeronautics, energy, machine tool, and paper-making are quite smaller, with 55, 83, 74, and 15 firms each one. In terms of employees and turnover, the biggest cluster is that of energy, with 22,000 employees (although its figures of employees and turnover should be reduced as they include the whole Iberdrola group). Electronics and ICT ranks second, with 14,600 employees and more than 4,100 million €. Then, come aeronautics and maritime industries, with similar figures: more than 9,000 employees and a turnover between 1,200 and 1,500 million €. The smaller ones are the machine tools and paper making clusters, with 4,500 and 2,134 employees, respectively, and a turnover of 839 and 500 million € (see Table 2).

For each cluster, we conducted a historical (longitudinal) and qualitative in-depth case study, based on different sources of information, in order to obtain stylized facts from
which we can infer more general propositions (for a similar methodology, see Bresnahan and Malerba, 1999; Bresnahan et al., 2001; Feldman, 2001), with a deeper and more extensive historical analysis. After that, we employ a qualitative meta-study approach, akin to that conducted by Van der Linde (2003) for world clusters and by Belussi and Sedita (2009) for Italian industrial districts, in order to pool the results from these studies. This paper adds on the findings of a previous one, already published, by incorporating two further clusters into the analysis.

2.2. Factors driving the emergence and evolution of Basque clusters

Drawing on the case studies, we identify the most significant factors behind the emergence and evolution of each cluster (see Tables 3 to 8; Table 9 sums up the driving factors for each life cycle). From their origins, the evolution of the six clusters analysed is determined by a multiplicity of factors, rather than by a single one. Contrary to what Belussi and Sedita did for their sample of Italian industrial districts (Belussi & Sedita, 2009), we argue that a qualitative analysis does not allow to establish a single factor that accounts for the origin of each cluster.

Cluster origin (emergence) is the initial stage where the bases for a cluster are established. In the case of Basque clusters, a combination of local factors (demand, entrepreneurship and anchor firm, factor conditions, tradition and historical preconditions, plus local policies) along with the inflow of external knowledge and technology accounted for the origins. Our findings on the significance of local demand and factor conditions for the origins of clusters broadly agree with those of Van der Linde (2003) for a large sample of world clusters, although his classification does strictly follow Porter’s diamond vectors.

Local demand played a key role in all the cases studied: it came from a playing cards manufacturer in the paper-making cluster at the end of the 18th century (and from the 1840s onwards, from the final demand associated to the regional economic development); from the merchant shipping and fishing fleets of the Basque Country, the first and the second largest fleets of Spain at the beginning of 20th century, respectively, in the maritime cluster; from multiple well developed industrial sectors in the machine tool and electronics clusters, in the first third of the 20th century and in the 1940s and 1950s, respectively (and in the latter, from the electrical sector as well); from both national and foreign demand in the aeronautics one; and is vital in the second step of the
energy cluster, when there was a huge increase of the national and international demand of removable energy equipments in the 1990s.

With regard to factor conditions, except for one case related to the physical endowment of the region (availability of water for the paper-making industry), the rest was linked to the previous industrial trajectory of the region that brought about the existence of a qualified labour force, of a local entrepreneurship and technical expertise from related sectors (in the maritime, machine tools, electronics, energy and aeronautics clusters), and of a hydraulic (in the paper-making cluster) and transport infrastructure (in the maritime cluster). Belussi and Sedita’s (2009) work stresses two factors above all, ancient craft traditions and anchor firm, in this order.

In our case studies, more important than a single anchor firm is the existence of local entrepreneurship, frequently from related sectors and industries, what in its turn, is associated, again, with the long historical tradition of the Basque Country in many industrial activities (hence, the importance of historical preconditions). Local entrepreneurs created a pool of founding firms that played a driving role in the subsequent stages of cluster development, setting up a technological trajectory, shaping the cluster borders, promoting new firm creation by spin-off processes, and/or creating new institutions and organisations for the cluster’s benefit (Feldman, 2001; Feldman et al., 2005): the first paper-making firms of the Tolosa region in the 1840s to 1870s; the two large shipyards of Euskalduna (1900) and La Naval (1915) in the maritime cluster; firms such as Sacia (1910) and Ciarán, Estarta & Ecenarro (1913) in the machine tool cluster; a group of firms in the electronic sector in the 1940s and 1950s (Arteche, JEMA, Ikusi, Fagor Electrónica, GEPCE); the triangle of firms SENER-Gamesa-ITP in the aeronautics cluster; and the role of Iberdrola in the renewable energy initiatives.

Local and national policies also played a triggering role, but their nature was very different depending on the time when they were employed (and so their implications for long-term cluster development too). Tariffs were the most widely policy instrument for promoting the paper-making and maritime industries in the 19th and in the first half of the 20th century, and also applied to the machine tool case, although its role was less important. While their positive impact in the emergence of both clusters is clearly acknowledged, its long-term maintenance contributed to isolate them and to erode the competitive capabilities of their firms. When Spain entered the European Economic Community and had to open its economy, the firms in both clusters had to face a new
situation of fierce global competition to which they were, put it simply, not able to respond. On the contrary, policies devoted to promote (technological learning, R&D activities, internationalization), rather than to protect, have played a very positive role in the machine tools, electronics and aeronautics clusters since the 1980s, and in the maritime one since the 2000s. The case of renewable energy needs a special mention: without doubt, the governmental aid and the legal support to the renewable energies had a tremendous positive impact in the energy cluster.

Local factors provided the necessary conditions, but that was not enough. In a relatively backward country such as Spain, it was also needed the inflow of external knowledge and technology that originally came from France, in the case of the first craft paper-making mills of the late 18th and early 19th centuries; from Britain in the shipbuilding industry in the late 19th century; or from international leaders as in the machine tools, electronics and aeronautics clusters. The energy cluster drew on two sources of knowledge: the own technological knowledge of one of the biggest Spanish MNCs (Iberdrola), and extra cluster knowledge from other Basque related clusters (electronics and aeronautics). In some cases, the direct involvement of MNCs in local firms (Palmer in Astilleros del Nervión in 1889; Vickers in La Naval since its creation; General Electric in GEPCE in the 1960s; or Rolls Royce in ITP in the 1980s) made the transference of external knowledge and technology easier in those early stages. As we see it, the sheer combination of local and global factors is an essential prerequisite for cluster formation.

In the development phase, along with the local demand, more (as in the electronics, aeronautics and energy) or less (as in the paper-making and shipbuilding) sophisticated, other local driving factors played a more important role: the development of cluster specific factors and the strategic capabilities developed by the clustered firms. The former, among which it stands the accumulation of social capital, may be akin to what Belussi and Sedita call ‘local institutions’, the most important triggering factor in the development of Italian industrial districts (Belussi and Sedita, 2009) and of the Basque clusters as well. The most common specific factors that appear during this stage are: specialised educational and training centres (centres of technical education for the paper-making, maritime, machine-tool and electronics clusters); PROs (research associations, technological centres and universities, particularly important in the machine tool and electronics cluster); and related and supporting industries
(manufacturers of equipment and machinery for the paper-making and shipbuilding industries; engineering firms for the shipbuilding, electronics, energy and aeronautics clusters; electrical and industrial companies for the electronics and energy clusters; metal and fire arms industries for the machine-tool cluster). The latter is particularly important as it enhances and diversifies the knowledge base of the cluster, thus making it easier to escape from possible situations of lock-in (Martin, 2009; Martin and Sunley, 2006). Social capital seems to play a driving role in five of the six clusters studied (machine tools, electronics and ICT and aeronautics since their origins, maritime industries and energy since the mid 1990s), enhancing their knowledge base and increasing their absorptive capacity. Industry and later cluster associations have been key agents in social capital formation, having fostered inter-firm cooperation in several fields, and coordinated interaction between firms, universities and PROs and policy makers (Valdaliso et al., 2011), in a way similar to that of trade associations for some Italian industrial districts (Carbonara, 2002). Two of the six cluster associations, AFM (machine tools) and GAIA (electronics and ICTs) were formerly industry associations created in 1946 and in 1983, respectively, that transformed into cluster associations in the 1990s.

Firms’ strategic capabilities were developed around two broad strategies: cost leadership (and scale economies) and product upgrading and differentiation and diversification (scope economies). The former one involved more specialization and entailed a higher probability to drive the cluster to a lock-in situation in its maturity stage, as was the case of the paper-making and maritime industries’ clusters. The companies of both clusters faced a new situation of fierce global competition from lower cost producers from the mid 1970s onwards, to which they were not able to react. Interestingly enough, only the small and medium shipyards that followed in the development and maturity stages a strategy of product differentiation and scope economies were able to survive to the great shipping crisis of the 1970s and 1980s, and to drive the cluster as a whole to a new stage of renewal in the 2000s, as it also has happened in other European shipbuilding clusters (Karlssøn, 2005). Firms of the machine tool cluster, quite the contrary, followed since their very beginning a strategy of product differentiation and diversification, and during the maturity stage have strengthened substantially their R&D and innovative capabilities, what, in its turn, has renewed substantially the knowledge base and competitive advantage of the cluster as a
whole. With regard to the younger clusters, more R&D and knowledge intensive, the clustered firms developed a solid base of resources and capabilities allocating high sums to R&D activities, following a strategy of technological innovation, product upgrading and differentiation and sometimes diversification, and creating larger business groups. This different strategy may also be explained by the fact that the three clusters appeared and developed in an economy much more open to foreign competition (from 1970s onwards) than that of the three mature clusters (in the second half of the 19th century or the first decades of the 20th century).

Accordingly, almost since their origins firms in the younger clusters had to build up absorptive capacities, augmented and developed by the internationalization process that speeded up in the 1990s. It must be stressed that the firms that developed an absorptive capacity in the two older clusters were precisely those more dependent and/or linked to the international market and to the external sources of knowledge: the manufacturers of equipment goods for the paper-making firms and shipyards, and the small and medium shipyards. With regard to the machine tool cluster, since the 1960s the regular presence of firms in international fairs, the creation of an international trade fair in Bilbao (BIEMH) and the integration of AFM into CECIMO, channelled foreign sources of knowledge to the cluster and contributed to the development of absorptive capacities, further enhanced hereafter by the increasing participation in joint R&D international programs and technological platforms. In the case of the energy cluster, it holds a notable attraction as a clear option of change for the companies of the other clusters. A significant case is the firm of maritime diesel engines Guascor, which geared their products towards renewable energies.

In relation to the global factors, while the inflow of external knowledge and technology and the entry of MNCs were the two most important in the origin and development stages, global competition and international demand growth played an increasingly prominent role since the 1990s, no matter the phase involved, something that Belussi and Sedita (2009) do also stress for the Italian industrial districts. The responses of the Basque firms have differed according to the cluster examined: in the energy cluster Iberdrola's international expansion has allowed demand pull for companies like Gamesa, but the cluster is dependent on the Spanish policy on renewables; in the machine tool, electronics and ICT, and the aeronautics clusters, the companies have strengthened their R&D and innovative capabilities and have focused on global
sophisticated customers and markets. They have gone international too, setting up commercial and manufacturing (even R&D) facilities abroad, and building up large and powerful business groups (Valdaliso, 2010), as it also happened in the Italian industrial districts (Cainelli, 2009; Carbonara, 2002). In the paper making and maritime industries, only a small segment of the clustered firms were able to survive and grow: the aforementioned small and medium shipyards and, in both clusters, the manufacturers of equipment goods and solutions. In both clusters, these companies from the related and supporting industries, started to develop their own products and solutions in the 1960s and 1970s to serve the local and national market, and transformed into world class manufacturers in the 1980s and 1990s (Valdaliso et al., 2008 and 2010).

4. CONCLUSIONS

This paper builds on a previous one, already published (Elola et al., 2012), by adding two further clusters on our sample of Basque industrial clusters, now comprised of those of paper-making, maritime industries, machine tools, electronics and ICT, aeronautics, and energy, particularly representative of the industrial trajectory of the Basque Country in the 19th and 20th centuries. The paper aims at analysing the factors that account for the long term evolution and change of clusters over their life cycle, making a particular stress of the competitiveness factors in each stage. Drawing on in depth case studies, we employ a meta-study approach to select the factors responsible for the emergence, development, maturity and, if that is the case, decline and/or renewal of clusters. The paper shows how different clusters changed over time and how their growth patterns were partially determined by initial conditions and by heterogeneous capabilities cultivated by clustered firms.

Cluster origins are explained by factors such as local demand and factor conditions together with local entrepreneurship and the inflow of external knowledge and technology, plus the influence of the historical legacy. Cluster development stage is mainly driven by the existence path-dependent mechanisms (development of factors specific to the cluster, MAR-Porter-Jacobs dynamic external economies) and by an increasing demand, either local and/or international. However, as clusters evolve from development to maturity, it seems that former local factors no longer provide sources of competitive advantages to the firms and to the cluster as a whole, and that both the firms and the cluster must ‘reinvent’ themselves to differentiate in the global market. At this stage, the strategic capabilities at the firm- and cluster-level to build up new competitive
advantages, to quickly react to the changes (dynamic capabilities) and to setting-up of
global pipelines to other clusters and firms (absorptive capacities), seem to be crucial to
escape from lock-in situations and to drive the cluster to a renewal phase (Ter Wal and
Boschma, 2009).

As Belussi and Sedita (2009) already put forward for the case of the Italian districts, our
analysis shows that the existence of a life cycle does not imply a straightforward growth
path. Basque clusters follow a multiple growth pattern in their development. In this
sense, they could fit easily within the concept of complex adaptative systems proposed
by Martin and Sunley (2011). The heterogeneity of growth patterns may be, in some
cases, due to different initial conditions. However, despite similar initial conditions
and/or resource endowments and opportunities for development, we can observe
heterogeneous evolutionary patterns. Clusters react differently to the same external
shocks (e.g., international demand, technological change and global competition) and
evolve differently according to their learning capabilities (Belussi and Sedita, 2009;
Martin and Sunley, 2011). Thus, cluster evolution cannot be accommodated only within
the role of Marshallian external economies (agglomeration economies), but also
depends on the local firm-specific mechanisms of learning and introduction of
technological innovation, referring to the importance of organizational, product and
process innovation (Belussi and Gottardi, 2000). In the two more mature clusters of our
sample that have followed an entire life cycle, the firms that have been able to escape
from the path dependency of the industry life cycle were those smaller and less
specialized, more flexible and innovative than the larger ones. Another factor that seems
to play a very strong de-locking role is the existence of absorptive capacities (Giuliani,
2005; Ter Wal and Boschma, 2009). In this regard, the external openness of the firms to
global competition and the building up of global pipelines avoid the dangers of an
excessive specialization and insulation (Porter 1998; Bathelt et al., 2004).

In sum, the results of this study add new insights to the present literature on
evolutionary economic geography. On the one hand, we contribute to the literature on
cluster life cycles indicating some factors that influence both the origin and evolution of
clusters. On the other hand, we provide additional empirical evidence, coming from a
region with a long trajectory of industrial development, for the multiple path
dependency argument (Belussi and Sedita, 2009; Porter, 1998) and/or for the existence
of several possible evolutionary trajectories (Martin and Sunley, 2011).
Another issue in our research agenda is to analyse the driving role played by factors more related to the regional environment, such as the extent of local external economies, economies of agglomeration and related variety in the regional economy, the existence of social capital and region-specific institutions, and the role of government policies, all of them possible sources of regional path dependence (Martin and Sunley, 2006). In this respect, an extensive empirical research across our sample of clusters has to be done (for a exploratory analysis of public policies, see Franco et al., 2012). In any case, the analysis of the two younger clusters, those of aeronautics and energy points out that both clusters seem to have benefited substantially of the previous accumulation of agglomeration economies and related variety stemmed from previous cluster developments in other industries.

Acknowledgments

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TABLE 1. BASQUE CLUSTERS’ LIFE-CYCLES

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Formation/Emergence | Development | Maturity | Decline | Renewal |

Source: authors’ elaboration, following Belussi and Sedita’s criteria to take the historical trend of the number of firms and employees to establish the different stages of clusters’ life cycles (Belussi and Sedita, 2009, footnote 2).

TABLE 2. MAIN FIGURES OF THE BASQUE CLUSTERS IN 2008

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<td>820</td>
</tr>
<tr>
<td>Maritime industries</td>
<td>405</td>
<td>9,100</td>
<td>1,500</td>
<td>950</td>
</tr>
<tr>
<td>Paper making</td>
<td>15</td>
<td>2,134</td>
<td>839</td>
<td>310</td>
</tr>
<tr>
<td>Energy*</td>
<td>83</td>
<td>25,000</td>
<td>10,000</td>
<td>2,200</td>
</tr>
<tr>
<td>Machine tools</td>
<td>74</td>
<td>4,500</td>
<td>800</td>
<td>523</td>
</tr>
</tbody>
</table>

Source: SPRI, Observatorio de Coyuntura Industrial. Data on turnover and exports in million €. * Notice that the figures for the energy cluster include the whole numbers of Iberdrola group.

TABLE 3. DRIVING FACTORS OF THE PAPER-MAKING CLUSTER LIFE-CYCLE

19
<table>
<thead>
<tr>
<th>Driving factor</th>
<th>Origins (c. 1779-1870s)</th>
<th>Development (1870s-1930s)</th>
<th>Maturity (1940s-1970s)</th>
<th>Decline (1980s-)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LF. Tradition and historical preconditions</strong></td>
<td>The first paper mills are installed on former iron foundries (bloomeries) facilities</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LF. Factor endowment</strong></td>
<td>Availability of water and hydraulic energy</td>
<td>Availability of water and hydraulic energy Good railway and port connections allowed the industry to obtain easily and cheaply key raw materials (wood pulp, coal) imported and to serve the whole Spanish market Local banks provide capital to the industry</td>
<td>Local entrepreneurs create new firms (1870s to 1890s)</td>
<td>Local entrepreneurs create new firms (1940s and 1950s)</td>
</tr>
<tr>
<td><strong>LF. Anchor firms and entrepreneurship</strong></td>
<td>Basque merchants invest in this industry from 1841 onwards</td>
<td>Local entrepreneurs create new firms (1870s to 1890s) Local entrepreneurs create new firms (1940s and 1950s)</td>
<td>Local entrepreneurs create new firms (1870s to 1890s) Local entrepreneurs create new firms (1940s and 1950s)</td>
<td></td>
</tr>
<tr>
<td><strong>LF. Local/national demand</strong></td>
<td>Increasing local demand</td>
<td>Increasing national demand</td>
<td>Increasing national demand</td>
<td>Decreasing national demand</td>
</tr>
<tr>
<td><strong>LF. Local and national policies</strong></td>
<td>Tariffs from 1841 which protect the domestic market from foreign competition and encourage the import of new technology</td>
<td>Progressive openness of the Spanish market (from 1960s) High regulation (low domestic rivalry)</td>
<td>External openness of the national market (from 1986 onwards)</td>
<td></td>
</tr>
<tr>
<td><strong>GF. Entry of MNCs, foreign investment and entrepreneurship</strong></td>
<td>French entrepreneurs invest in the Basque Country (to avoid the new tariffs)</td>
<td></td>
<td>MNCs buy many Basque firms (1980s)</td>
<td></td>
</tr>
<tr>
<td><strong>GF. Inflow of external knowledge and technology</strong></td>
<td>French qualified labour and technology (since late 18th century)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>LF. Development of factors specific to the cluster</strong></td>
<td>Promotion of training schools by local/regional authorities and firms (1885, and from 1900 onwards) Availability of a pool of qualified labourers and technicians Creation of specialised firms which repair and produce equipment goods and machinery for this industry (1910s and 1920s) Social capital: trade association (c. 1900)</td>
<td>Creation of the Paper School of Tolosa (1964) Availability of a pool of qualified labourers and technicians Development and upgrading of an specialised manufacturing industry of equipment goods (1960s) Social capital: trade association (1960s) and inter-firm cooperation in human capital formation and commercialization</td>
<td>Development of an specialised manufacturing industry of equipment goods</td>
<td></td>
</tr>
<tr>
<td><strong>LF. Strategic capabilities</strong></td>
<td>Cost leadership of large firms specialised in press paper (LPE) Product differentiation of small and medium firms (writing paper) Constant renewal of equipment goods and machinery</td>
<td>Cost leadership of large firms specialised in press paper Large firms (LPE and Sarrió) diversify into new products Product differentiation of small and medium firms (writing paper)</td>
<td>Increasing differentiation and specialization to survive Mergers and concentration to achieve larger scale economies and to compete internationally</td>
<td></td>
</tr>
</tbody>
</table>
Constant renewal of equipment goods and machinery

**Constant renewal of equipment goods and machinery**

GF. International demand growth

Large Basque firms began to export to the European market (1970s)

**GF. International demand growth**

GF. Global competition

Increasing imports from European competitors

**GF. Global competition**

TABLE 4. DRIVING FACTORS OF THE MARITIME INDUSTRIES’ CLUSTER LIFE-CYCLE

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>LF. Tradition and historical preconditions</td>
<td>Ancient craft tradition in shipbuilding that goes back to the 12th Century</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
| LF. Factor endowment | Concentration of the most important iron and steel works and metal industries in the region Port infrastructure | Local entrepreneurship creates new small and medium shipyards in the 1940s and 1950s | | Local entrepreneurship buys former nationalized shipyards and creates new firms in the auxiliary industry (2000s)
| LF. Anchor firms and entrepreneurship | Creation of two big shipyards: Euskalduna (1900) and La Naval-Sestao (1915), leading firms in the Basque and Spanish shipbuilding industry New firm creation during World War I years Local entrepreneurship (mostly from merchant shipping in the shipyards, and from the iron and steel industry in the auxiliary industry) | | |
| LF. Local/national demand | Large local demand from highly dynamic shipping and fishing fleets (Bilbao hosts half of the Spanish merchant fleet in 1900) | Increasing local demand from dynamic shipping and fishing fleets | Increasing local/national demand from highly dynamic shipping and fishing fleets | Decreasing national demand due to the heavy crisis of shipping and fishing industries in Spain and in the Basque Country (1980s)
| LF. Local/national policies | Ley de Escuadra 1887 (warships for the Spanish Navy built in Spanish shipyards) Domestic market protected by tariffs | Tariffs, and reserved domestic market (in the 1940s and 1950s) | Reserved domestic market until 1986 Export subsidies Promotion of national champions (AESA 1969) | Spain enters the EEC (1986): external openness and liberalization of the national market
| GF. Inflow of external knowledge and technology | Astilleros del Nervión (1889) hired qualified labour and technicians from Scotland | Import of foreign technology (licenses and patents) in the 1920s | | |
Foreign technology imported

**LF. Development of factors specific to the cluster**
- Development of an auxiliary industry (metal products, naval painting, steam and diesel engines, pumps, radio communications...)
- Bilbao, the first Spanish city in having a Lloyd’s Register of Shipping’s Inspector (1920s)
- Appearance of naval engineering and naval consultancy firms
- Development of an auxiliary industry (electronics, machinery)
- Educational centres
- Social capital: industry associations (CONSTRUNAVES, INDUNAVES) in the 1960s
- Technological centres have developed specialised research lines (2000s)
- Social capital: industry association (ADIMDE, 1993); cluster-association (FORO MARÍTIMO, 1997); joint research projects among firms and technological centres (2000s); inter-firm cooperation in human capital formation programs (2000s)

**LF. Strategic capabilities**
- Larger shipyards: cost leadership and diversification (into another transport equipment in the 1920s)
- Small and Medium shipyards: diversification into several types of vessels
- Larger shipyards: cost leadership, specialization and standardization (tankers and bulk carriers)
- Small and Medium shipyards: diversification into several types of vessels
- Technological innovation in the auxiliary industry (Sener, Cargocover, Guascor, Vicinay, Indar...)
- Product differentiation (and product upgrading) and diversification in niche markets of specialist and highly sophisticated vessels by the surviving shipyards (2000s)
- Technological innovation and product differentiation in the auxiliary industry (1990s and 2000s)

**GF. International demand growth**
- Increasing exports to European and American markets
- Increasing exports
- Some auxiliary firms have started to set up commercial and manufacturing facilities abroad (2000s)

**GF. Global competition**
- Cut throat competition from East Asian shipyards (from 1980s onwards)

<table>
<thead>
<tr>
<th>TABLE 5. DRIVING FACTORS OF THE MACHINE-TOOLS’ CLUSTER LIFE-CYCLE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Driving factor</strong></td>
</tr>
<tr>
<td><strong>LF. Tradition and historical preconditions</strong></td>
</tr>
<tr>
<td><strong>LF. Factor endowment</strong></td>
</tr>
<tr>
<td><strong>LF. Anchor firms and entrepreneurship</strong></td>
</tr>
<tr>
<td>GF. Inflow of external knowledge and technology</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>GF. International demand growth</td>
</tr>
<tr>
<td>LF. Strategic capabilities</td>
</tr>
<tr>
<td>LF. Development of factors specific to the cluster</td>
</tr>
<tr>
<td>LF. Local/national policies</td>
</tr>
<tr>
<td>LF. Local demand</td>
</tr>
</tbody>
</table>

Guernica…) that played a key role training new labourers and technicians that later on created new firms...
<table>
<thead>
<tr>
<th>Driving factor</th>
<th>Origins (1940s-1970s)</th>
<th>Development (1980s)</th>
</tr>
</thead>
</table>
| LF. Factor endowment                  | Availability of a pool of qualified labourers and technicians trained in a dense educational system and in-house of large MNC firms established in the Basque Country (GE & Westinghouse)  
Dense system of professional and technical education  
Creation of technological centres by firms and industry associations in the 1960s and 1970s  
Faculties of Physics (1967) and Computing (late 1970s), Schools of Engineering                                                                 | Venture-capital and seed-capital firms linked to the Basque saving banks and to the Basque Government                                                                                                                                                                               |
| LF. Anchor firms and entrepreneurship  | Local entrepreneurs create most of the new firms  
Creation of a group of firms that became leaders and key drivers of the cluster afterwards (Arteche, JEMA, Ikusi, Fagor Electrónica, GEPCE)                                                                 | Local entrepreneurs create most of the new firms, some of them spin-offs of the incumbent ones (created by former technicians and employees of those)                                                                                                                                   |
| LF. Local/national demand             | Increasing local demand for electric and electronic products, equipments and solutions (from the industry, the electrical companies and the financial sector)                                                                 | Increasing local and national sophisticated demand for electronic products, equipments and solutions, and for software solutions                                                                                                                                                     |
| GF. Inflow of external knowledge and technology | Founding entrepreneurs import and imitate foreign technology in the 1940s, 1950s and 1960s  
Technological divide in the industry that destroy the entry barriers of the large MNC incumbent firms worldwide in the 1970s                                                                 | Stanford Research Institute provides consultancy services to the SPRI (Basque Government) in the 1980s  
High absorptive capacity of the leading firms that participate in joint R&D international programs and have gone international                                                                                                                                     |
| LF. Local/national policies           |                                                                                                                                                                                                                       | Regional policy to foster collective learning and technological catch-up in microelectronics in the 1980s (IMI program by SPRI, a government agency)  
Network of technological parks and centres promoted by the Basque Government and Diputaciones (provincial governments)  
Creation of an industry-association (AIEPV, 1983), promoted by the Basque Government                                                                                                                     |
| LF. Development of factors specific to the cluster | Creation of new faculties, schools and universities; creation of new technological centres  
Cooperation with universities and PROs in R&D programs and projects, in human capital formation  
Joint efforts of firms, industry-association and universities to promote human capital formation (masters, postgraduate courses, doctoral programs…)  
Incorporation to the cluster of the telecommunications, software, Internet and media companies (mid 1990s-)  
Accumulation of social capital: driving role of the industry-association (AIEPV) later cluster-association (GAIA); inter-firm cooperation in human capital formation, R&D activities and internationalization; frequent interaction among firms, U&PRO, local policy makers and other agents… |
**LF. Strategic Capabilities**

Increasing expenses devoted to R&D, creation of R&D units and laboratories by many firms
Basque firms develop their own products and solutions with the aim to be at the forefront of the industry (and to dominate the standard in niche markets)
The founding leading firms create from the late 1990s onwards larger business groups following an strategy of diversification, vertical integration and internationalization

**GF. Entry of MNCs, foreign investment and entrepreneurship**

Philips creates in 1984 a joint-venture with Telefónica and other firms set up in the Zamudio Technology Park, later acquired by Ericsson. After the closure of the factory in 2002, several former employees create many spin-offs

**GF. International demand growth**

Increasing exports of the Basque firms from 1980s onwards
From the 1990s onwards, the leading firms set up commercial, manufacturing and R&D facilities abroad
Creation of almost born-global firms

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**TABLE 7. DRIVING FACTORS OF THE AERONAUTICS’ CLUSTER LIFE-CYCLE**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>LF. Tradition and historical preconditions</strong></td>
<td>Knowledge of the iron, steel, new materials, and metallurgical alloys in the auxiliary industry</td>
<td></td>
</tr>
<tr>
<td><strong>LF. Factors’ endowment</strong></td>
<td>Labour: Qualified workers from the metallurgical sectors.</td>
<td>Support of local banks: BBVA’s investments on Gamesa and ITP</td>
</tr>
<tr>
<td><strong>LF. Local/national demand</strong></td>
<td>Increasing demand from the main national buyer, CASA, as a result of its integration into Airbus and EADS consortia</td>
<td></td>
</tr>
<tr>
<td><strong>LF. Local/national policies</strong></td>
<td>SPRI commissions SENER-Monitor Company to make a first report on the creation of an aerospace cluster in the Basque Country (1992); creation of HEGAN, the cluster association (1996)</td>
<td>Strategic support of the Basque Government to this sector (credit lines to Gamesa and ITP)</td>
</tr>
<tr>
<td><strong>GF. Entry of MNCs, foreign investment and entrep</strong></td>
<td>Rolls Royce participation in ITP</td>
<td>Access to the common research resources of ESA and Airbus Participation of HEGAN and the cluster firms in several European R&amp;D projects and platforms Participation of cluster firms in GVCs (as 1st or 2nd tier suppliers)</td>
</tr>
<tr>
<td><strong>GF. Inflow of external knowledge and technology</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**LF. Development of factors specific to the cluster**

PROs: CTA, Fatronik, and Tecnalia Aerospace.

Accumulation of knowledge on electronics (guidance systems) and new materials

Absorption of workers from the metallurgical and electronic sectors

Local specialization in a national cluster (Madrid-Bilbao-Seville) within the European consortium (ESA and Airbus)

Social capital formation: driving role of the cluster association (HEGAN); strategic alliances and collaboration between the key leading firms (SENER-Gamesa-ITP)

**LF. Strategic capabilities**

Cluster firms get inserted in Global Value Chains as 1st or 2nd tier suppliers

Participation of cluster firms into European aerospace consortium (ESA and Airbus)

**GF. International demand growth**

Increasing foreign demand

Demand from the European space consortium and the rest as a supplier

**GF. Global competition**

Big aircraft manufacturers create global value chains with different suppliers all over the world

Global competition between Airbus and Boeing

Relationships with Bombardier, Boeing, and Embraer

---

**TABLE 8. DRIVING FACTORS OF THE ENERGY CLUSTER LIFE-CYCLE**

|---------------|-----------------------------------------------------------|----------------------------------------------------------|---------------------------------------------|
| **LF. Tradition and historical preconditions** | Legacy of the old electric power sector under the paradigm of output maximization | Existence of an industry of electrical equipment, electronics and new materials in the region that move into renewables | Iberdrola as MNC Other firms from related sectors that reinforce their orientation to renewables (Elenor, Ormazabal, Sener, Ingeteam…)
|
| **LF. Factor endowment** | Local and national schools of industrial and electrical engineers (UPV, Deusto, and ICADE) Increasing importance of local banks as providers of capital to the industry (BBK) | | |
| **LF. Anchor firms and entrepreneurship** | Role of Iberduero (later Iberdrola) Iberdrola as MNC Other firms from related sectors that reinforce their orientation to renewables (Elenor, Ormazabal, Sener, Ingeteam…)
| **LF. Local/national demand** | Low increase national demand of renewable energy equipments | Huge increase of national and international demand of renewable energy equipments. | Decreasing national demand |
|
| **GF. Entry of MNCs** | The big producers of equipment of power electric MNCs purchase Basque firms (2011 Dresser Rand buys... | | |

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foreign investment and entrepreneurship are in the local and national market (AEG, Siemens, ABB, Alston, and GE) in the local and national market (AEG, Siemens, ABB, Alston, and GE)

**LF. Development of factors specific to the cluster**

- High development of the formation in renewable technologies in universities and technical colleges
- Creation of INKOLAN PROs: CIC EnergyGune and BIMEP (with the maritime cluster)
- Development of own technologies with a high grade of diversified industrial options
- Companies dedicated specifically to renewable energy
- Increasing differentiation and specialization to survive Mergers and concentration. Overseas manufacturing and outsourcing to Asia and Americas (Gamesa in USA)

**LF. Strategic capabilities**

- Development of own technologies with a high grade of diversified industrial options
- Companies dedicated specifically to renewable energy
- Increasing differentiation and specialization to survive Mergers and concentration. Overseas manufacturing and outsourcing to Asia and Americas (Gamesa in USA)

**GF. International demand growth**

- Fast increase of international demand of renewable energy equipments

**GF. Global competition**

- Fast increase of Asiatic competition

### TABLE 9. STRENGTH OF THE DRIVING FACTORS FOR EACH PHASE OF THE CLUSTER LIFE CYCLE

<table>
<thead>
<tr>
<th>Nature of the driving factor</th>
<th>Origins</th>
<th>Development</th>
<th>Maturity</th>
<th>Decline (and renewal)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Local factors</strong></td>
<td>Tradition and historical preconditions (5)</td>
<td>Factor endowment (2)</td>
<td>Factor endowment (1)</td>
<td>Factor endowment (1)</td>
</tr>
<tr>
<td></td>
<td>Factor endowment (6)</td>
<td>Anchor firms and entrepreneurship (4)</td>
<td>Anchor firms and entrepreneurship (1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Anchor firms and entrepreneurship (6)</td>
<td>Local/national (sophisticated) demand (5)</td>
<td>(Increasing) Local/national demand (2)</td>
<td>(Decreasing) Local/national demand (2)</td>
</tr>
<tr>
<td></td>
<td>Local/national policies (4)</td>
<td>Local/national policies (4)</td>
<td>Local/national policies (3)</td>
<td>Local/national policies (3)</td>
</tr>
<tr>
<td></td>
<td>Local/national policies (4)</td>
<td>Development of factors specific to the cluster (6)</td>
<td>Development of factors specific to the cluster (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Development of factors specific to the cluster (6)</td>
<td>Strategic capabilities (6)</td>
<td>Strategic capabilities (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Strategic capabilities (6)</td>
<td>Strategic capabilities (3)</td>
<td>Strategic capabilities (3)</td>
<td></td>
</tr>
<tr>
<td><strong>Global factors</strong></td>
<td>Entry of MNCs, foreign investment and entrepreneurship (3)</td>
<td>Entry of MNCs, foreign investment and entrepreneurship (1)</td>
<td>Entry of MNCs, foreign investment and entrepreneurship (1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Inflow of external knowledge and technology (3)</td>
<td>Inflow of external knowledge and technology (5)</td>
<td>Inflow of external knowledge and technology (1)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>International demand growth (1)</td>
<td>International demand growth (4)</td>
<td>International demand growth (3)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Global competition (1)</td>
<td>Global competition (2)</td>
<td>Global competition (3)</td>
<td></td>
</tr>
</tbody>
</table>