COMPETITIVE LOW-TECH CLUSTERS IN HIGH-COST CONTEXTS: LOCATION DYNAMICS OF FUR PRODUCTION IN AND WITHIN DENMARK

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ABTRACT

The paper discusses two interrelated economic geography issues. Firstly, it explains why Denmark is by far the major fur producer in the world despite the fact that the fur industry constitutes a low-tech, low entry-barrier, labour-intensive type of production and Denmark is a small, high-cost country. The second issue relates to explaining why the fur production is spatially concentrated within Denmark. Earlier literature point to that even if industries are classified as low-tech they are often innovative, which is important in explaining competitiveness. A second type of explanation points to advantages from agglomeration and clustering. However, based on qualitative industry studies, plausible explanations that are derived from literature on industrial competitiveness and from the cluster literature are generally rejected in the present case and alternative explanations provided. Contrary to common understanding innovation and collaboration on the level of producers play a minor role. Instead, the cooperative organisation and governance of the industry is an important factor in explaining the ability of Danish producers to remain competitive despite low entry barriers and fluctuating prices. Whereas some literature points to innovation systems and clustering as an important framework for understanding industrial dynamics the paper point to that 'system innovation' and cluster governance/organisation may be more adequate in this case.

Keywords: Low-tech industries, Industrial competitiveness, Clusters, Fur industry

JEL – codes: R12, L70, O31, O13

1 Introduction

The term 'sunset industries' suggests that low-tech manufacturing industries are declining and perhaps even vanishing from Western, high-income countries and it is now widely believed that the growing and thriving industries of the future are primarily high-tech industries. Hence, the locations of these low-tech industries are gradually and inevitably moving into newly industrialised, low-cost countries as a result of the increasing globalisation of competition and production (Scott, 2006, Parrilli, 2009). The perception that sectors with low R&D intensities are less prosperous is reflected in the policy responses at the regional, national and super-national levels of aggregation. For example, following the Sapir Report, the policies of the EU have in the past decade aimed to 'change the balance of the industrial structure in favour of the research-intensive sectors' (European Commission, 2008, p. 16).

Contrary to this widespread view, others claim that low-tech industries still provide a substantial contribution to Western economies and that despite the attention received by high-tech clusters such as Silicon Valley and Cambridge bio-tech it is still relatively low-tech clusters that dominate. Hence, a growing number of studies are criticising the emphasis often placed by both policies and economic analyses on high-tech industries. These studies (e.g., von Tunzelmann and Acha, 2005, Hirsch-Kreinsen, 2008, Smith, 2003) argue that the economic relevance of high-tech industries remains small. Quantitatively, low- and medium-tech industries account for between 90% and 97% of the GDP in Western European countries (Hirsch-Kreinsen et al., 2003). Despite the debate regarding the widespread perception of the opposite, the relative shares of these industries have remained fairly stable. Some studies also argue that often the low-tech industries are innovative, even though they do not display large R&D intensities and that they increasingly use high-skilled human capital for their survival and competitiveness (Hansen and Winther, 2014). Finally, scholars claim that low-tech activities are often regionally clustered (Hirsch-Kreinsen et al., 2003), and that competitiveness and clusters are interrelated (Ketels, 2013). In a number of high-income countries, there are clusters of firms producing relatively low-tech products with large world market shares. Some of the most well-known low-tech clusters are from the northern industrial districts[1] of Italy, such as Montebelluna, which produces 80% of the world's motorcycle boots and 75% of the world's ski boots, and Belluno, which produces two-thirds of the world's eyeglasses (Asheim et al., 2006, p. 17, Belussi and Asheim, 2010). However, explanations with respect to the success of these regional low-tech clusters remain sparse.

This paper discusses how and why an apparently low-tech cluster may exist and thrive, even in a knowledge-based, high-tech, high-cost economy. The low-tech cluster used for this study is the Danish fur industry. This specific industry is considered a good case to study because it exhibits the following characteristics: large world market shares; low capital intensity; has clear clustering of production, also within Denmark; low start costs; easy to replicate; high labour intensity. Given these characteristics, it seems rather intuitive that the production should be located in low-cost areas, such as China. Paradoxically, Denmark is by far the largest producer in the world, and the majority of the customers who buy Danish fur are Chinese.

A number of explanations on low-tech regional competitiveness and clustering have been put forward (see a review in Hansen and Winther, 2014). Using insights from earlier literature on low-tech industries, clusters, and economic geography in general, we develop plausible explanations to this paradox, subsequently these are confronted with our case.

[1] There is a debate on the vocabulary regarding agglomerations, industrial districts, clusters. Some scholars regard industrial districts as a special form of clusters, others see the two concepts as closely interwoven (Lazzeretti et al., 2014). The distinction between agglomeration and clusters is perhaps more clear.

The study uses interviews with primary producers, industry associations and other key actors, and industry production experts. Additionally, secondary data from Statistics Denmark, Industry associations, and international organisations. It is found that the agglomerated (although relatively independent) small and low-tech companies, are dependent on local, sticky production factors, that are outside the boundaries of the industry. An important explanation for the global competitive position is related to the organisation of the industry rather than the innovativeness of the individual firms. Although innovation plays a role in the overall story, the single firm is not considered to be significantly innovative. This finding contradicts much of the established literature (e.g., Drayse (2011)). Furthermore, the primary firms in the industry do not directly collaborate to compensate for their smallness, as also suggested in the literature (e.g. Hewlett-Dundees, 2006). Therefore, the majority of these and other explanatory factors in the contemporary literature are rejected, and new avenues of explanations are suggested.

The paper begins by introducing industry context, the fur industry in Denmark. Secondly, based on the literature on economic geography, clusters, and industrial competitiveness, propositions are developed that may contribute to the explanations of global competitiveness and industry clustering. We then discuss the nature of the factors driving industrial competition and cluster formation with a special emphasis on the low-tech, region-specific clusters. Section 4 is a brief methodological outline. Section 5 analyses the explanations for the competition and clustering of the industry. These explanations are then discussed in light of the theoretical propositions. The last section concludes and considers future challenges, explains why several traditional industries are thriving in a knowledge-based society, discusses several policy issues, and provides possible avenues for further research.

2 The fur industry: economic evolution and regional agglomeration

2.1 Economic context: the market, production and prices

The upsurge of the industry in Denmark stems from the beginning of the 1930s, when a crisis occurred in the Danish agricultural sector. This crisis led producers to search for alternative sources of income and fur production was considered a promising option. The silver fox, which was first imported in 1928, was the dominant animal fur of choice in the beginning. However, during the 1940s, the mink replaced the silver fox as the preferred animal for fur.

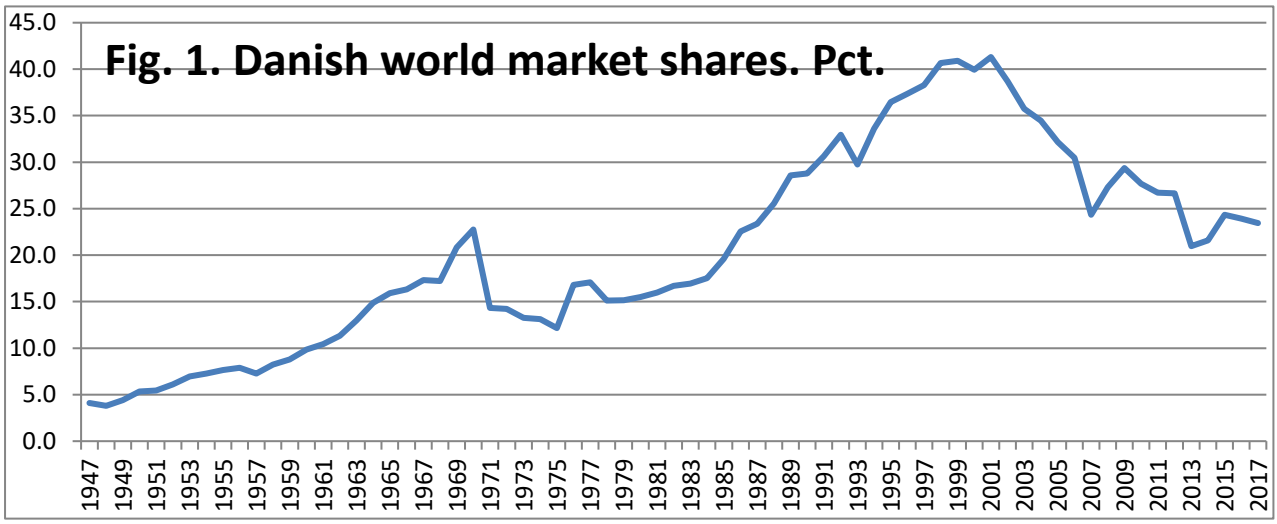
For many years, the Danish mink industry was by far the major producer of mink fur in the world. The industry had a world market share of approximately 40%, which it maintained for several years. Recently, however, the Danish industry's share of the world market with respect to mink fur has declined to approximately 22% in 2017[2]. Importantly, the market is segmented into four classes according to the quality of the fur. Danish fur dominates those classes that represent the highest quality of fur, as more than 90% of the world's production of high-quality fur comes from the Danish production. Furthermore, Danish dominance of the highest-quality classes has increased over time.

At approximately 17 million pelts, the Danish production is half of the total European production. In addition to China[3], other large producers include the Netherlands, Poland and the Baltic countries (including Russia). Each of these producers has approximately one-third of the Danish production.

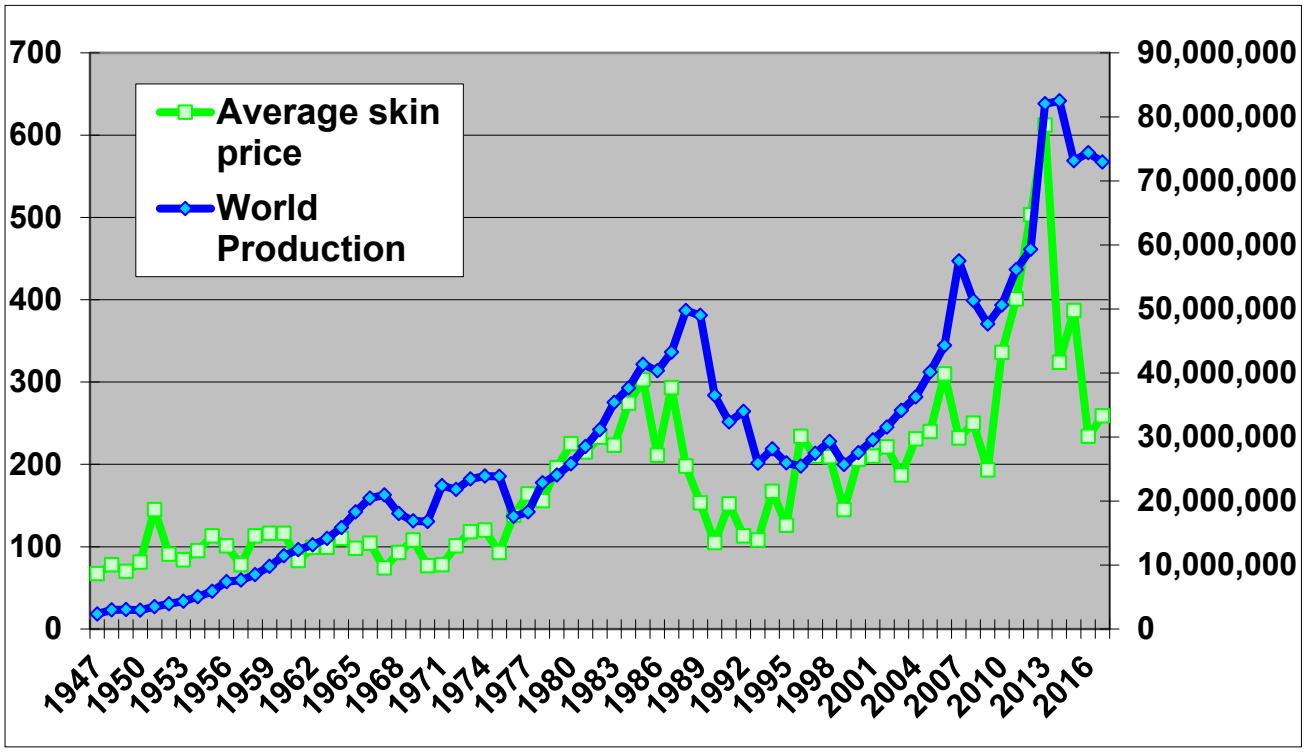
[2] The majority of the data referred to in this section are from Kopenhagen Fur and (in a few cases) the International Fur Breeders Association.

[3] When it comes to the Chinese figureres it must be noted that these statistics are not totally reliable. Although China produces a substantial amount of mink fur, the country often produces inferior-quality fur products and some of the production in China is sometimes not sold through official auction houses.

Other countries, including the US, Canada, Finland (in that order) and a few others, have even lower market shares.



The total market for mink fur has hovered approximately 73 million pelts in 2017. The market increased from 2009 to 2014, when it reached 82 million. However, a decrease was registered from 2007 to 2009, when production dropped from 57 million to 47 million pelts. Almost all of the decreases can be ascribed to the reduction in Chinese production, which decreased from 18 million pelts in 2007 to 13 million pelts in 2008 and then to 10 million pelts in 2009. These decreases may be due to the market's demand for high-quality fur, which the Chinese producers generally cannot deliver. Moreover, the Chinese producers are primarily small farms that have been reacting instantly to the fall in world market prices since the peak in 2006. Poland, the Netherlands and the Baltic states have observed a steady increase over the last decade. Poland has continued this trend with an annual increase of 15%, whereas production in the Netherlands has remained unchanged in the last part of the decade. Russian production has decreased substantially as a result of the economic crisis.



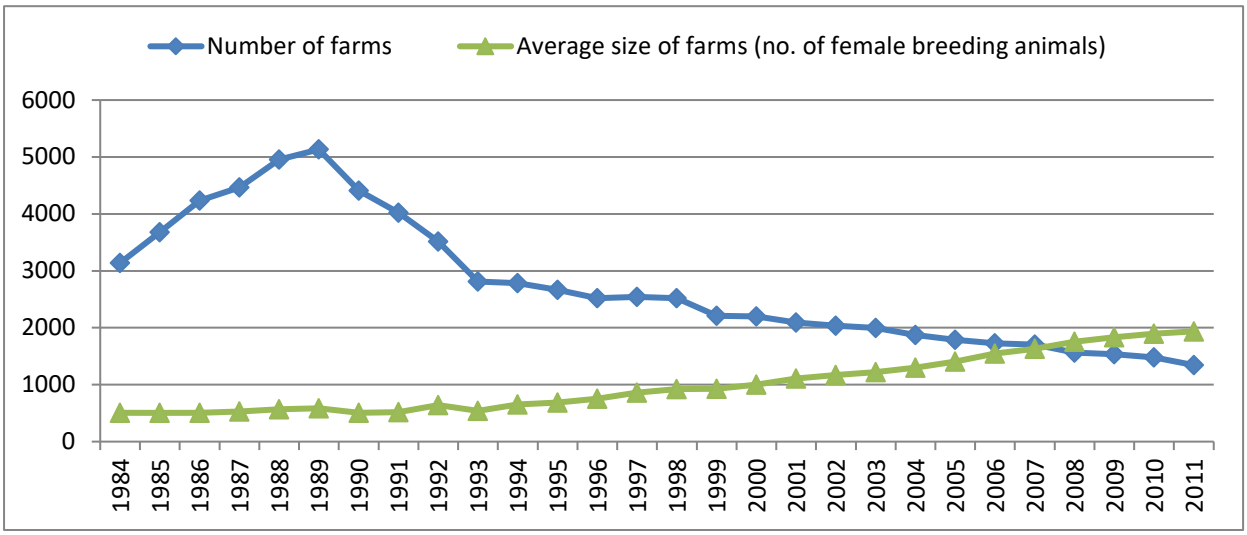
Although other types of fur, especially fox (a focus segment in Finland), rabbit, and chinchilla, are also produced, these other fur industries comprise a minor portion of the revenues, as more than 95% of the Danish production and approximately 90% of the world fur production is mink.

As indicated in figure 2, the price of fur fluctuates over time. These fluctuations indicate that the price is not only subject to changes according to business cycles, but also to exchange rate fluctuations, capacity/demand changes, and changes in weather conditions; in particular, prices are negatively affected by mild winters[4]. Furthermore, the prices may vary considerably over the course of a single year and are dependent on the quality classification, as the maximum price may easily exceed twice the average price at any given point in time. In 2013 prices reached 612 DKK but dropped in just one year to 324 DKK. In end-2018 the average price is down to 261 DKK, which is below the Danish production costs.

Annual Danish revenues from furs have ranged from 300 to 500 million Euro during the 2000-decade. Although, over the last decade, there has been a gradual trend of increasing production, the annual Danish production of furs remains at approximately 14 to 17 million pelts, making the mink industry the fourth largest agriculture sub-sector in Denmark. In fact, in December 2011, mink surpassed the export of cheese products to become the second largest Danish agricultural export product. One-third of all Danish exports to China are mink fur. Mink fur is the Danish export item with the highest world market share by far.

2.2 Industry structure

The number of Danish farms producing fur has increased steadily since the start of the industry and peaked in the latter part of the 1980s with over 5000 farms. As in the rest of the agricultural sector, the number of farms has decreased substantially since the 1980s, down to 1455 as of November 2018, and 1136 in November 2020, but the average size and productivity has increased. The average fur farm in 2011 has 1,937 female breeding animals, a number that has increased over time. The increase in the average size of the farm is evident from the upward trend in figure 3. The increase in productivity is also clear given that employment in the sector has remained stable for many years (Pedersen and Christensen, 2003, Hansen, 2017). The production methods are relatively standardised and low-tech with little variation between producers in productivity. The employment figures for this sector have remained steady at approximately 2500 to 3000 FTEs over the last decade.

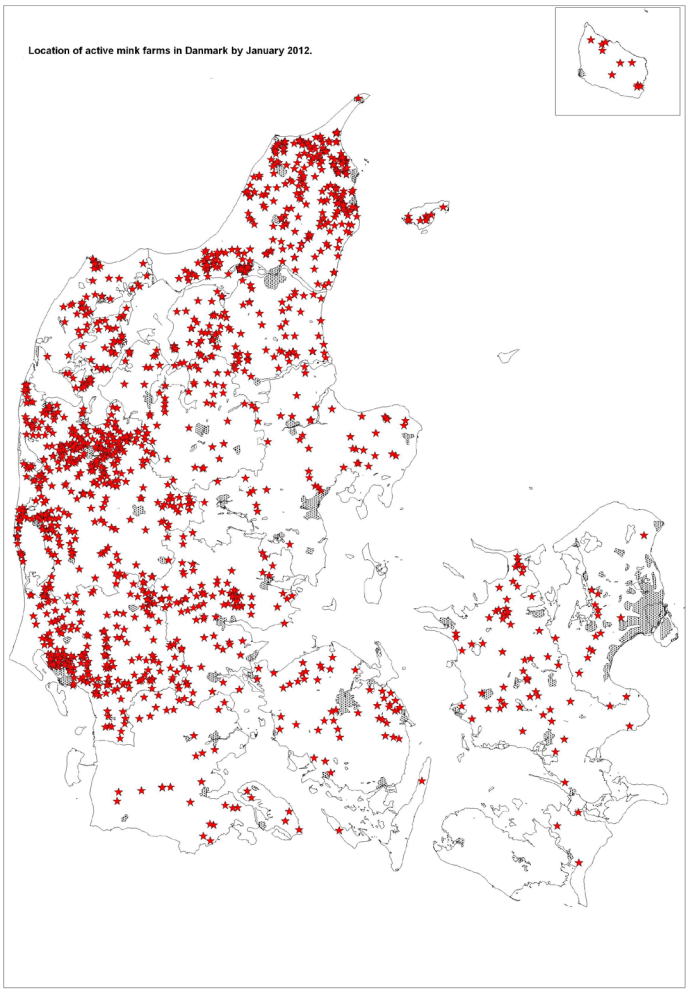


[4] Although mild winters benefit producers by increasing the availability of high-quality fur, the sales statistics clearly show that cold winters in the main markets (Russia and China) increases prices of fur (Kopenhagen Fur, 2009).

It is a relatively labour-intensive industry even when compared with other segments of agriculture. The primary producers represent only a portion of the total number of people employed in relation to the industry. The European Association of Fur Producers estimates that the fur sector creates approximately 60.000 FTEs in Europe alone and that the revenues amount to Euro 1.5 billion. These figures clearly indicate that employment in the fur industry is not confined to the primary producers. For example, a number of jobs are in the fodder industry, and an additional 400 people work in the auction house Kopenhagen Furs. Another example is the firm 'Minkpapir' (Mink paper) who produces special types of paper that separates fur skin. The Association of Danish Fur Producers and Kopenhagen Fur estimate that the total number of jobs in Denmark related to this industry totals 25.000.

2.3 Regional agglomeration

There is a strong regional concentration of mink producers located in Western and Northern Jutland, Denmark where around 80% of production is located. In the North Jutland region a third of all farms are located[5]. The two regions, North Jutland and Region Mid-Jutland had in 2017 73% of Danish farms.



Fur producers tend to geographically cluster in other countries as well, though not to the same extent and not for the same reasons. In Russia, this agglomeration dates back to the regime of the Soviet Union, when production was planned and established in a hierarchical, top-down style. In China, the

[5] The geographical production of other furs, such as fox and chinchilla, is even more concentrated, with the majority occurring in northern Jutland. However, compared with mink, these furs constitute a small fraction of the fur production.

production is concentrated in the provinces of Shandong, Hebei and Liaoning, in Spain in Galicia, whereas in Canada, garment and a well-established sales and distribution system are clustered in and around Montreal (Rantisi, 2014, Klein et al., 2007). In Finland almost all farms are located in the Ostrobothnia area (Hansen, 2017).

3 The competitiveness and clustering of local, low-tech industries and clusters

In this section we search for plausible explanations as to why the Danish mink industry is able to compete despite being in a high-cost country and why the firms in the industry tend to cluster despite not at first sight showing obvious features that speak for agglomeration.

Paradox 1 – competitiveness

Much of the literature on industrial competitiveness since Porter (1990) has discussed input factors with a special focus on knowledge as a critical factor. Scholars generally maintain that in the 21st century, knowledge is the most important input factor and that the firms that do not upgrade the sourcing, use and development of their knowledge will likely be short-lived. This emphasis on knowledge and innovation implies that there is a strong policy focus on promoting high-tech industries as the only competitive industries in the longer term.

Somewhat conversely, a growing literature has emphasised that low-tech industries still comprise the bulk of the manufacturing industrial sector and that these industries can exist even in Western, high-cost countries (Hirsh-Kreinsen and Jacobson (eds.) 2008, Hirsh-Kreinsen, 2008). The empirical literature includes several examples of niche and low-tech products from highly developed countries with large world market shares (Asheim et al., 2006, Belussi and Asheim, 2010)[6]. Thus, low- and medium-technology industries comprise more than 90 percent of the output even in the European Union, the USA and Japan (Robertson and von Tunzelmann, 2009). Additionally, low- and high-tech industries are interdependent. High-tech products depend on low- and medium-tech production, whereas many seemingly low-tech products incorporate high-tech products either in the product itself or in the production process. In fact, information and communication technologies and biotechnologies are often regarded as industries, though they would be better described as technologies that are used in a broad range of industries (ibid.). Hence, the literature demonstrates that innovations are not confined to the firms in high-tech industries also firms in low-tech industries innovate (von Tunzelmann and Acha, 2005, Hirsh-Kreinsen, 2008, Drayse, 2011).

Proposition 1.1:
Innovations in the Danish fur industry drive competitiveness.

Another possible explanation why the fur production can be located in Denmark could be if the industry is protected from competition to some extent. If the fur market is a typical niche market where entry barriers are high and the size of the market is too small to be attractive to competitors, this might explain high world market shares.

[6] However, counter examples can easily be identified by pointing to a number of resource-based, low-tech industries that have not survived in Western, high-income countries. For example, the UK economic landscape is filled with declining or extinct agglomerates of industries that were earlier based upon availability of energy or natural resources. Such examples include the textiles, pottery, and mining industries. However, some low-tech clusters are still faring well in high-income countries.

Related, protection of industries can perhaps explain competitiveness. In several cases, both declining low-tech industries and relatively prosperous industries or clusters have received extensive support in the form of government support that enable them to maintain their competitive positions. It could be hypothesised that the fur industry thrives on subsidies that allow it to compete. However, this hypothesis can be ruled out without further investigation. Although the Danish agriculture sector is heavily subsidised (as in the rest of Europe), there are no subsidies for the Danish fur industry from either the Danish government or from European Union funds (Hansen, 2017).

From this discussion, the following propositions are derived:

Proposition 1.2:
The fur industry can compete because of emphasis on niche production and high entry barriers.

Discussions in economic geography have addressed how firms in clusters often draw upon and source in knowledge from outside the cluster (Bathelt et al., 2004). There is growing recognition that most industries rely on knowledge generated in the periphery of the industry itself be it geographical or outside industry boundaries. In low-tech industries such as agriculture and food processing, the majority of innovations may be based on incremental, practise-driven progress within the internal processes of the industry itself. In some cases, however, substantial parts of their innovations may be based on knowledge from outside of the industry, including, in some cases, scientific knowledge (Christensen et al., 1996 on food, Smith, 2000 on fish farming, Christensen et al., 2011 on agriculture, Chamberlain and Doutriaux, 2010 on the forest industry, Robertson and Smith, 2008). Knowledge can be important for a low-tech industry, as education, consulting and research strengthen the use and diffusion of knowledge and best practices. The establishment of industry specific intermediaries for distribution of knowledge and other constructs to support such a knowledge dissemination process indicates that this is an important function (Watkins et al., 2015). This leads to the following proposition.

Proposition 1.3:
The competitive position of the Danish fur industry is explained by important extra-industry knowledge inputs.

Paradox 2 – clustering

The literature on the locations of industries proposes a number of factors to explain locations and agglomerations. Although some studies have discussed whether location has lost its relevance and become subordinate to other production factors because of decreased transportation costs, modularisation and other trends (Porter and Stern, 2001, Christensen and Drejer, 2006), location still matters for various reasons. It has, though, been suggested that agricultural clustering is limited because geographic suitability and characteristics of land determine location and agglomeration (Richards, 2018). However, fur production is more footloose than traditional crops agriculture. The cluster literature also suggests a number of reasons for why firms cluster in space and the literature on economic geography has pointed out that competitiveness of clusters is related to agglomeration effects (Porter, 1998, Storper and Venables, 2004, Malmberg and Maskell, 2002, Ketels, 2013). The Marshall-Arrow-Romer effects have been put forth as primary explanations. Generally, knowledge sharing is considered to be a relatively more valid explanation for clustering than traditional location explanations, such as access to input factors, raw materials and infrastructure. In fact, knowledge sharing is

considered an even more critical explanation than the traditional Marshallian industrial district explanations (Parrilli, 2009, Malmberg and Maskell, 2002, Maskell and Malmberg, 1999, Bathelt et al., 2004).

It was previously regarded as self-evident that an industry is located in close affiliation with its natural endowment bases. Although Marshall (1920) recognises the importance of factors such as knowledge and agglomeration effects, which are often cited in the cluster literature, he did not consider these factors to outweigh the importance of the relationship between the vicinity of the industry and its natural endowments:

"*Many various causes have led to the localization of industries, but the chief causes have been physical conditions, such as the character of the climate and the soil, the existence of mines and quarries in the neighbourhood, or within easy access by land or water. Thus, metallic industries have generally been either near mines or in places where fuel was cheap" (p. 223).*

Although Marshall is often cited in cluster papers for his notion that 'the mysteries of trade' are 'as it were in the air' (ibid., p. 225), he did emphasise that the localisation of industries is well grounded in the characteristics of the region. Additionally, he argued that the skills developed to efficiently produce a product are linked to the 'hereditary skills' (p. 225) accumulated among the residents in a region. Over time, these skills are passed on to future generations, and these working procedures become the established trajectories within which improvements are made.

With respect to the relative importance of these two perspectives, one may argue that the 'in the air' perspective has gained in importance in recent years. Clusters have been said to be instrumental in a knowledge-based setting, as they are known to have deeper specialisations, which, in turn, are considered a prerequisite for constructing comparative advantages (Parrilli and Sacchetti, 2008, Maskell and Malmberg, 1999, Porter, 2000).

Danish low-tech clusters in two other regions, Herning-Ikast-Brande (textiles) and Salling (furniture), are geographically close to the mink cluster and may therefore serve as relevant, parallel learning points. Consistent with several conceptual papers (e.g., Storper, 1997, Storper and Venables, 2002), these stories (Lorenzen, 1998, Maskell, 1998) show that a combination of intra-cluster trade, 'untraded inter-dependencies' and congruent goals contributes to the competitive capability of those clusters. The knowledge exchanged among the firms in the clusters is not easily accessible for outsiders because networks are closed to some extent and quite place-bound, in which case the knowledge becomes 'sticky' (Markusen, 1996) and confined to the industry context.

Some of the literature suggests that competition may play an essential role in the dynamism of a cluster (Rantisi, 2002, Porter, 1998, Malmberg and Maskell, 2002, Ketels, 2013). Rantisi (2002) contends that proximity not only directly facilitates innovation by easing the establishment of linkages among firms but also indirectly impacts innovation. Consistent with Malmberg and Maskell (2002), Rantisi's study on the production of women's garments in New York City shows that co-location allows firms to monitor their rivals and evaluate good practices. The variety in activities generated from the co-location of rival firms may stimulate both innovation and imitation.

The propositions derived from the above are the following:

Proposition 2.1.
Firms in the Danish fur industry cluster because they gain benefits from collaboration, intra-cluster trade and (informal) knowledge sharing.

Proposition 2.2.

Traditional, tangible location factors are no longer important for explaining agglomeration; rather, the exchange of knowledge and the membership in networks are important to explain the location of clusters.

Proposition 2.3.

Clusters display deeper specialisations, which, in turn, allow them to compete in the international markets and to develop industrial strongholds.

Proposition 2.4.

Firms in clusters are better able to upgrade their production processes by observing and benchmarking the best practices of clustered, competing firms.

4 Methodologies

The industry case study was based on complementary sources of information collected over a decade: 1) interviews were undertaken with the industry association, Kopenhagen Fur, which (as explained in detail later) is a key node in the organisation and evolution of the industry, 2) secondary literature and statistics was analysed. The data on the industry was provided by Kopenhagen Fur and Statistics Denmark, 3) Historical background information like annual reports from the industry association was studied to obtain an understanding of the dynamics and evolution of the industry, 4) Interviews and validation of draft findings were undertaken with researchers who are specialised in researching the production methods, veterinary standards etc. and who has extensive knowledge on the working procedures and development activities of the industry 5) 20 and 40 interviews with fur producers in respectively 2009 and 2019.

5 Explaining the clustering and market dominance of the Danish fur industry

5.1 Physical input factors and related industries

We begin the explanation with one of the input factors for the production, the fodder, which contribute to both explaining competitiveness and agglomeration. Concerning the location of industry, one of the reasons for the concentration of Danish fur production is related to the access to fodder. The narrow geographical location of the majority of the farms is the result of a historical trajectory. Specifically, because the farms used to be located close to major fishery harbours, they have had easy access to fish waste as raw material for fodder. Although this condition is not strictly necessary today, as fodder is transported both inside and outside the borders of the country, the original location has impacted the present geographical concentration and still represents an advantage.

Because the quality of the fodder is a critical factor in producing high-quality fur, fodder is an important input for a competitive mink production. The yearly production of fodder for the Danish mink industry alone is approximately half a million tonnes. The fodder, which consists of bi-products from the fishery industry (half the fodder content) and other slaughterhouses (e.g., poultry

slaughterhouses)[7] must be fresh and cooled down. In half of the year (summer), the fodder is delivered daily and kept cool, which eliminates the need for adding antibiotics. As access to these by-products is important in the mink production process, the high concentration of the industry and the short geographical distances are distinct advantages in this part of the production line. The production, sales and distribution of fodder is a vital part of the mink production process. The dominant, almost sole player in the market is Dansk Pelsdyrfoder a.m.b.a., which was established in 1978 and worked until 1993 as a division of the Association of Danish Fur Producers. This division was then transformed into a company partly (49%) owned by mink fodder producers and partly owned by The Association of Danish Fur Producers (51%). In 2005, this company was again transformed into a limited partnership with the fodder producers as the owners. Dansk Pelsdyrfoder buys the raw material for fodder production for the whole (99%) industry. The quality and delivery system related to the fodder, which is produced locally in 14 different locations, are of a much higher standard compared with the systems of other countries. Some Danish producers have tried to establish mink production in Poland and the Netherlands. However, the producers had problems achieving acceptable standards with respect to the quality and treatment of the fodder.

The clustering of the mink industry is strongly related to two other geographically concentrated industries. One is the fishery sector, which is a relatively large industry in Denmark, as it constitutes 20% of the Danish food exports and makes up 2 billion Euro of exports. Northern Jutland has the majority of the fish landings in Denmark. Specifically, Northern Jutland accounts for 64% of the total sales in the country, whereas the other mink-producing regions account for the bulk of the remaining part. One of the historical reasons for Northern Jutland's successful fishing industry is the fact that the region is surrounded by sea, and as a natural consequence, a number of relatively large (by Danish standards) firms in the area specialise in processing fish and fishery products. The waste product from this production is one of the primary reasons for the geographical concentration of mink producers in the region. In fact, in a further link of the chain, North Jutland's specialisation in machinery for the food industry (location quotient above 2.3) is partly explained by this concentration of fishery product processing firms. As a consequence, machinery for the mink industry draws upon this knowledge base.

Because the machinery for fodder, pelting and drying is developed specifically for this production, this machinery is expensive. Access to straw, which is easy to obtain because of the relatively large production of grain in the region, is another, albeit less important, factor. A third factor, which is again of less importance, is that the climate of North Jutland is marginally different from that of the rest of Denmark. Even in a small country, this marginal difference may affect the quality of the furs. Even if this is a marginally important factor in explaining agglomeration within Denmark it is a more important factor in explaining the Danish position as the world dominant producer.

In addition to the previously noted relationship between the mink industry and the fisheries industry, a relationship also exists among industries that share a similar structural character. Although mink production is a rather specialised industry, a number of producers combine mink production with growing different types of crops[8]. This combination may help the producers balancing the labour use, as the production peaks do not coincide, and the variations in income are levelled out. Moreover, synergies may relate to the supply of straw and the options to use manure and other types of waste in the fields. Still, the share of income stemming from mink remains by far the largest of the shares for these producers.

[7] On a European scale, one million tonnes of animal by-products from the fish and meat industries are used in fur production. Fish products are optimal, as the minks easily digest the proteins.
[8] In 2006 65% of mink farms had such additional production. This share has remained constant.

5.2. Knowledge inputs

The historical development regarding the transfer of skills throughout the industry is noteworthy, as this knowledge was tacit until relatively recently. There was until recently no formal education. Instead, one is trained on an existing farm and gradually learns by performing the different tasks and routines. This learning process may take a considerable amount of time. Because the education and training is primarily conducted through apprenticeships on existing farms, the existing geographical structure is thereby maintained, as people doing future start-ups who are taught in the region tend to stay in the region where they are originally trained.

A number of things may go wrong in the mink production process. For example, the timing of the various procedures is a critical factor. Similarly, the quality of the fodder and the garment as well as certain procedures (e.g., the drying of the fur) are crucial to the quality of the product. In turn, the quality significantly impacts the price. However, the knowledge involved in the production is not sophisticated or complex. To a large extent, this knowledge is generated through learning-by-doing and acquired through the transfer of practices. It is difficult for an 'outsider' to replicate the procedures from a manual. A publication from 1986, entitled 'Mink production' by Gunnar Jorgensen was the first to show in detail various aspects of the production process. This same author was the first editor of the scientific journal 'Scientifur', which has been in publication since 1976. Additionally, in a by-product of a Ph.D. dissertation, Møller (1997) showed what a typical production should look like. Specifically, a systematic online guide has been published (http://www.agrsci.dk/hpmink/sopintro.htm) as an introduction to the production system and as a basis for more systematic consultations and advice on the process. Although this information site does not guarantee an efficient production, the site has decreased the difficulty of achieving efficiency. Thus, although the several years of apprentice learning are no longer needed today, the basic message remains valid. The move towards greater codification of the knowledge involved is supported by the fact that four agricultural schools have opened a special mink breeding program as of September 2011. In addition, there is now a system with branch-specific consultants who visit breeders to give advice on optimizing production, similar to the systems used in the majority of the Danish agriculture sector.

Further upstream in the value chain research into the production process and the industry is conducted at the Danish Fur Breeders Association's laboratory, at the Faculty of Life Sciences at Copenhagen University and at the Faculty of Agricultural Sciences at Århus University. High veterinary standards are maintained by the sectoral institution, the Danish Fur Animal Laboratory. A huge and increasing number of blood samples from minks are analysed every year. In particular, the blood samples are screened for the disease plasmacytosis. In 2011, such analyses numbered 3.7 million (Kopenhagen Fur, 2011). Finally, considerable effort is put into the breeding process, which is important for optimising, for example, the colour and the length of the skin. The breeding efforts are facilitated by the information system provided by the auction house, Kopenhagen Fur. Through this information, the individual producer has detailed knowledge of his or her price rankings within different types of mink in comparison with the industry averages. Information on increasing prices of certain types of mink fur is immediately disseminated to the individual producer, who may then adjust his or her composition of the different mink accordingly.

5.3. Sales and distribution: Kopenhagen Fur and the Association of Danish Fur Producers as knowledge hub and industry organisers

The Association of Danish Fur Producers was established in 1930. In 1946, it acquired the central auction house in Copenhagen, Danish Fur Auctions, and moved in 1963 to a 75000 sqm premises in Copenhagen. As the largest fur auction house in the world, Danish Fur Auctions sells 60% of the world's furs and is increasing its position as the primary marketplace for furs. In april 2012, it had revenues from a 5-day period of 388 million Euro. Total sales for 2013 exceeded1.8 billion Euro.

The skins are sorted by length and colour. This sorting process is performed automatically by means of sophisticated machinery that sorts 3000 skins per hour and differentiates 2000 colours via optical scanners. New, more sophisticated machinery based on x-ray technology is under construction in Germany.

Kopenhagen Fur is now used as a term for the collective Association of fur producers and the auction house. Even further downstream in the value chain connected to Kopenhagen Fur is a so-called trend laboratory, Kopenhagen Studio, where new techniques and designs are developed together with designers and fashion houses. A branch of this laboratory is the Tsinghua Kopenhagen Studio, a year-long collaboration with the design education at the most prestigious Chinese university. The design part of the value chain has been an integral part of the efforts to sustain the competitive edge of the industry.

The Association of Danish Fur Producers also runs a consultancy entity and an insurance company. Thus, several links in the value chain and several supporting functions are covered in this structure, where the association plays a key coordinating role. The company 'Minkpapir' is an example of a part of the value chain, which has developed into a dominant producer of paper specially designed to separate fur skin. Moreover, there is an extensive division of labour at the industry level concerning various industrial tasks, such as the slaughtering of the animals, the sorting of furs and the selling of the products (Pedersen and Christensen, 2003). Saga Furs is a joint marketing and design collaboration in Denmark, Finland, Norway and Sweden.

In Denmark, an extensive tradition of knowledge sharing exists. In this particular industry, knowledge sharing may be even more dominant. However, self-organised collaboration at the firm level remains limited[9]. Interviews with 20 producers on their innovation activities, collaboration partners etc clearly indicates that firm-level innovation is of marginal importance (these interviews are not reported in detail in this version of the paper due to space constraints). Rather, the Association of Danish Fur Producers functions as a hub for information by both collecting and re-distributing information and knowledge. According to Kopenhagen Fur (2009), the cooperative organisation of the industry is responsible for the extensive tradition of knowledge sharing, which is structured, organised, and institutionalised. Although innovation and advanced technology and machinery are absent among the producers, the knowledge and process innovations in Kopenhagen Fur enable the producers to optimise their production. Hence, Kopenhagen Fur coordinates the dissemination of information by allowing each producer to adjust input factors. As each individual skin is marked with a bar code, Kopenhagen Fur registers the producer, the price obtained and the length, type and colour of the skin. Because such a large number of skins are processed through Kopenhagen Fur (approximately 28 million skins a year, 17 million of which are produced in Denmark), there is a system for breaking down this information into fine-grained segments of skin type and quality, which is in turn matched with the prices obtained. This system allows the individual producer to use this information to benchmark his or her production against the industry averages. Based on this information, the producer can adjust input factors such as fodder and breeding.

A number of other measures also stimulate knowledge transfer within the industry. For example, there is an established group of mink producers from all over Denmark who have demonstrated particularly good results. Organised by Kopenhagen Fur, the group meets to discuss how production processes and quality can be enhanced and how this knowledge can be disseminated to other producers.

As the industry exercises control of and benefits from not only the input part of the value chain but also from the sales, there is a common interest in sharing information to help increase production

[9] On this basis, it could be argued that we are not actually discussing a cluster. According to some definitions of clusters (e.g., the often-cited definition by Porter (1998, 2000)), interactions among the firms in the cluster constitute an important part of the definition.

volume. The more products processed and sold through Kopenhagen Furs, the more attractive Kopenhagen Furs becomes to its customers and purchasing managers. Through this process, better prices can be obtained.

In sum, the incentives for knowledge sharing are related to the organisation of the industry[10].

Although little direct collaboration or learning has occurred among the individual mink producers, close links exist between the primary mink producers and the sales part of the value chain, the supporting institutions, and the related manufacturing industries that are linked to food processing and processing machinery. These industries are also in close geographical proximity. The actors in the mink industry are not only related to other industries but also internally related in terms of spatial proximity, industry organisation and common institutions. Moreover, there is a common culture and identity among fur producers. Although other animal producers in the agricultural sector regard fur producers as not being 'a real peasant' they have their own pride and identity.

6 Propositions confronted with features of the industry

Plausible explanations to the research questions have in section 3 been derived from theories on industrial competitiveness and clusters. This section evaluates the degree to which these explanations hold for our case.

The idea of a niche market with a high barrier to entry (proposition 1.1) was presented as a possible explanation for the competitive position of the Danish fur industry. The market is, however, displaying growth and is substantial, and the market's open, international character, and the generally accessible information indicate that this market is not a typical niche market. With respect to the entry barriers, neither the establishment costs nor the minimum efficient scale of production for the single entity make up substantial entry barriers. The production facilities do not require much space and are relatively inexpensive. Previously tacit knowledge on production has over the past decade been more codified. The more substantial entry barriers include the nature of the knowledge involved and the requirements for setting up the system, consisting of substantial resources and access to knowledge on how the market reacts to the products of individual producers. Hence, Kopenhagen Fur, which dominates the global sales of fur even more than the producers dominate the production of fur, constitutes a competitive edge in itself, as does the organisation of the knowledge dissemination system. This is not easily replicable.

The Danish fur industry is characterised by a high degree of specialisation (proposition 2.3) on the high-quality segment of the market. Because demand has moved in the direction of high quality skins this has enhanced the competitive position of the Danish industry. However, this high-quality specialisation is valid throughout Denmark, and there are no differences in this dimension between

[10] The fish farming sector provides a parallel example with rather different conclusions. In many respects, this industry may be compared with mink farming, as the quality of the end-product is also dependent on the fodder, and the locations of the fish farms are restricted by physical and natural endowments, particularly access to clean freshwater (for in-land farms). Even if some highly advanced knowledge input (e.g., monitoring, nutrition, vaccines and automatic feeding systems) is used by the large, front-end organisations within the industry, the production in the broad spectrum of the industry is relatively low-tech and labour-intensive. As in the mink industry, the producers have ownership in the fodder-producing industry. However, the sales and marketing part of the value chain is remarkably different across the two industries. In contrast to the mink industry, the fish farming industry features no coordinating entities, common interests or congruent objectives. Given the fierce competition, the producers have limited negotiation power vis-à-vis the customers, and the knowledge sharing is limited.

the mink producers clustered in Northern Denmark and the mink producers in other regions of Denmark.

Concerning the role of competition, we hypothesized that firms benefit from clustering because clustering allow them to observe the best practices of their local competitors (proposition 2.4). The Danish mink case partly supports this explanation. On the one hand learning from best practices gradually became institutionalised through the benchmarking/information system described above centrally organised through the cooperative organisation of the industry. But it was only partly a benchmark and imitation process between the producers, the coordinating intermediation was decisive.

Regarding explanations on the regional agglomeration it has been suggested in the literature (e.g. Parrilli, 2009) that the model of 'marshallian industrial districts' now seems inadequate to explain competitive advantage and clustering of firms. For the present case, the 'outdated' Marshallian theory explains relatively well why the firms in this industry cluster. For example, this study indicates that, although knowledge sharing is important to the competitiveness of the industry, knowledge sharing is not related to the clustering of firms (as suggested by proposition 2.1). Rather, both the specific institutionalisation and the incentive structure for sharing knowledge are organised at the industry level. The knowledge involved in the specific production process is to some extent tacit and is therefore partly transferred through apprenticeship learning, but this form of knowledge transfer has decreased in importance over time. Although the extended knowledge base argument (proposition 1.3) has some merit in this case, it cannot explain the whole story.

The case study further shows that the concentration of firms in a small region of Denmark was related to the reproduction of the labour force and the firms' close relationships with related industries, particularly the industries related to production equipment and the delivery of fodder. The production inputs were shown to be traditional input factors, such as natural endowments (though they now play a diminishing role), rather than innovative factors, such as sophisticated knowledge. Thus, we reject the first part of proposition 2.2. on the irrelevance of traditional location factors. Regarding the second part of proposition 2.2, although innovation and technological progress play an important role, they are organised at the industry level. Advanced machinery for sorting and classifying pelts is incorporated and used at Kopenhagen Fur. Knowledge of breeding is also mediated and disseminated at an industry level and then implemented at the individual farm level. Conventional thinking about industrial competitiveness would imply that producers seek to develop distinct capabilities with respect to specialised production. On the contrary, in this case, the overall industry performance is maintained, despite the low degree of differentiation. If anything, it may be argued that industry organisation rather than firm-level innovation accounts for the difference. Innovation among the individual producers is not a decisive competition factor, as suggested by proposition 1.2. Therefore, although innovation plays a role in the overall story the proposition is only partly supported by the evidence.

Table 1 provides an overview of the propositions and indicates whether they are confirmed.

Proposition	**Holds 'V'; Rejected '%' Partly holds/rejected ( )**
1.1: Innovations drive competitiveness in the Danish fur industry.	**(%)**
1.2: It is possible for the fur industry to compete because of their emphasis on niche production and high entry barriers.	**%**
1.3: The competitive position of the fur industry is explained by important extra-industry knowledge inputs.	**(v)**
2.1: Firms in the Danish fur industry cluster because of benefits from collaboration, intra-cluster trade and (informal) knowledge sharing.	**%**

2.2: Traditional, tangible location factors are no longer important for explaining agglomeration; rather, the exchange of knowledge and membership in networks are important to clusters.	**% / (v)**
2.3: Clusters display deeper specialisations, which, in turn, allow them to compete in the international markets and develop industrial strongholds.	**(v)**
2.4: Firms in clusters are better suited to upgrading their production processes by observing and benchmarking the best practises of clustered, competing firms.	**(V)**

The innovation system literature would perhaps seem relevant as a framework for understanding the fur case, as this literature (Lundvall, 1992, Edquist, 1997, Cooke, 2001) incorporates different types of actors and institutions (formal and informal) and focuses on the links among the agents in the system. Thus, the literature encompasses a broader spectrum of the industry dynamics. However, in this literature, innovation, which is often defined in terms of new products, processes or organisation, lies at the centre of the analysis, and the primary carrier of innovation is the firm. This assumption does not fit our story well. In fact, rather than an 'innovation system', our case study points to a need for thinking about 'system innovation' i.e., *new ways of organising and facilitating industrial dynamics at a higher level of aggregation than the firm level*. The role of 'hubs' or professional associations in organising and facilitating learning in clusters has been addressed in the literature (Faulconbridge, 2007, Watkins et al., 2015) but the institutionalisation of learning and innovation from the industry governance and coordination is generally sparsely explored. The literature that comes close to this call for new understandings is a relatively sparse literature on governance of regional innovation systems (Cooke, et al., 2000).

7 Conclusions, discussion and further research

Section 6 concluded that the ex ante, plausible explanations generally do not hold. Instead of innovation, collaboration, specialisation, complex knowledge, and entry barriers, we found simple knowledge, relations to input suppliers and other input factors as well as vertical integration and industry organisation to be the primary explanations behind industry competitiveness and clustering.

We found that even if an industry is organised in a cooperative manner and encompasses a wide array of elements in the value chain, the industry's competitiveness and clustering is not purely the result of intra-industry dynamics; rather, there are substantial inputs and collaborations with related industries. The relationship was strong in several dimensions (e.g., among industries and geography). For example, the machinery industry was important, as there is high asset specificity in the (limited) machinery used for mink production. The fishery and other animal production processing industries have a symbiotic relationship with the fur industry, as the mink production helps to eliminate waste products from the former, whereas the former provides raw materials for high-quality fodder. Fodder distribution, in turn, plays a role with respect to geographical clustering.

Discussions and explanations of why mature, labour-intensive industries continue to not only survive but also thrive in Western, high-cost economies have often argued that the innovativeness of the firms in these industries provides a competitive edge (e.g., Drayse, 2011). A broad implication of the present study is to redirect the attention in innovation studies to this industry level. The literature on sectoral innovation systems (Malerba, 2002, 2004) encompasses and includes informal institutions

and the manner in which a range of different actors are interlinked. However, as the innovations studied in this literature include the innovation of firms, the interactions and links among actors are viewed as preconditions for this innovation activity. Our case suggests that innovation and the preconditions for industrial competitiveness may also be embedded in the linkages, connectivity and governance of the system itself. This systems innovation perspective (as opposed to an innovation systems perspective) obviously has implications for research, practice (i.e., the actors in the system) and policy. For researchers, the broadened scope suggests a change in focus from innovation systems to systems innovation. There is an extension of the innovation concept embedded in the latter approach. The actors and stakeholders in systems may recognise the need to work on and improve their connectivity, common values, and other issues, as noted in this paper. This finding suggests that industry organisations and other stakeholders should consider the overall health of the system.

The early success of the Danish dairy industry has been ascribed to the cooperative organisation of the industry as well. However, that industry has changed into a more traditional organisation. Although it has undergone minimal modernisation, the fur industry may well be the last of the cooperatively organised sub-industries in the Danish agricultural sector (Hansen, 2010). Despite being deemed an obsolete method of organising an industry, the cooperative method of organisation has, in this case, been an important explanatory factor in the 'humblebee' story of the industry, which is thriving despite disadvantages of having small scale of the firms and the firms' locations in a high-cost country.

Further research on the dynamics of the industry may examine how geographical concentration has developed over time. Research could also look into intra-regional clustering as there seems to be particular areas that are clearly having an over-representation of farms. It may also be interesting to identify the forces behind the evolution of the fur industry in other countries. However, the literature is extremely sparse with respect to this topic, especially from the industrial organisation perspective and the economic geography perspective[11].

Some of the most severe limitations to this study relates to the fact that it is based upon a single industry case in an atypical industry. Research may therefore also address the extent to which this case has general validity and what should be added to the theoretical knowledge if the contemporary literature provides such poor explanatory power?

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[11] To some extent, Furman et al. (2002) incorporates many of the aspects in play in this story: endogenous growth (cf. Romer (1990)), clustering and competitiveness (cf. Porter (1990, 2000)) and innovation system thinking (cf. Nelson (1993) and Lundvall (1992)). However, more research is required, as Furman et al. (2002) also tend to over-emphasise the role of innovation and technologies.

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