

This is a self-archived version of an original article. This version may differ from the original in pagination and typographic details.

Author(s): Ojala, Jari; Voutilainen, Miikka; Lamberg, Juha-Antti

Title: The Evolution of the Global Paper Industry: Concluding Remarks

Year: 2012

Version: Accepted version (Final draft)

Copyright: © Springer Science+Business Media Dordrecht 2012

Rights: In Copyright

Rights url: <http://rightsstatements.org/page/InC/1.0/?language=en>

Please cite the original version:

Ojala, J., Voutilainen, M., & Lamberg, J.-A. (2012). The Evolution of the Global Paper Industry: Concluding Remarks. In J.-A. Lamberg, J. Ojala, M. Peltoniemi, & T. Särkkä (Eds.), *The Evolution of Global Paper Industry 1800--2050* (pp. 345-363). Springer. World Forests, 17.
https://doi.org/10.1007/978-94-007-5431-7_13

The evolution of the global paper industry: concluding remarks

Jari Ojala, Miikka Voutilainen, Miguel Gutiérrez-Poch, and Juha-Antti Lamberg

The introduction to this volume posed a fundamental question as to how we can understand similarities and differences in industrial evolution in various regions and countries. Even though there is a conceptual agreement on the life cycles of industries, namely, on the stages of nascence, growth, maturity and decline, with certain metrics like number of active firms (Hannan & Freeman, 1989; Klepper, 1996, 2002; Murmann, 2003; Nelson & Winter, 1982), earlier studies usually concentrate on the issue only at the level of one country, analyzing either one or several branches of industry. The motivation of this volume is to present an analysis of industry dynamics concurrently in several countries over an extended period of time focusing specifically on one industry: pulp and paper.

As the individual chapters in this volume demonstrate, industrial papermaking during the past two hundred years offers an excellent opportunity to study industry evolution. First, the industry has gone through periods of growth, maturation and decline in different segments, technology and use of raw materials. Second, paper consumption, and consequently production, were already global in the nineteenth century – since then industry dominance has constantly varied among different countries and areas. Third, paper industry growth has evolved hand in hand with industrial and commercial development during the past two hundred years (Chandler, 1977, 1990). A general argument has been that until the 1990s there was a strong correlation between paper consumption and GDP per capita growth (Diesen, 1998; Järvinen, Lamberg, Nokelainen, & Tikkanen, 2012, in this volume). The importance of the this line of business can be seen, for example, in the development of paper consumption in different countries. In Europe, for example, the growth of the paper industry exceeded GDP growth during the last decades of the twentieth century, and grew three times faster than in manufacturing industries on average (Diesen, 1998; Rytönen, 2000). Fourth, the paper industry is an exceptionally important line of business for economic and societal development as a whole. One may argue that paper has been more important for global economic growth than the steam engine – although the latter has usually been emphasized in economic history (Kuisma, 2008).

The pulp and paper industry as a whole does indeed have systemic properties that partially explain the variation between countries. First and foremost, the development of the paper industry in each country has been relatively incremental and predictable since the late nineteenth century. Even though major innovations, such as the beginning of the mechanical

production of paper or the introduction of wood fiber as raw material, created revolutionary business opportunities, it took decades rather than years before these major innovations were implemented. Therefore, shifts in global industry dominance have been slow. The first industrializing countries, like Britain, France, and Germany dominated paper industries at the very beginning of mechanized production. During the latter half of the nineteenth century Northern hemisphere countries (North America, the Nordic Countries) acquired dominance for the following century, whereas the dominance shifted around the turn of the millennium to the Southern hemisphere and to the Far East. By and large the paper industry has followed the international trends of industrial globalization, though depending on specific raw materials and markets. Therefore, purely market factors such as demand and raw material supply explain a lot of the evolution of paper industries in the respective countries.

This concluding chapter summarizes the findings of the volume, and combines those findings with more general, comparative life-cycle analysis. In the following, we present a descriptive life-cycle analysis to demonstrate how paper industry companies have emerged and exited in different countries. To answer *why* these changes have occurred, we will refer to the historical explanations provided in the analysis chapters.

Referring to the original research questions we will in the following first analyze the industry structure and production volume by comparing certain case countries from an industry life cycle perspective. The aim is ascertain whether any international interdependencies in changes in industry structure can be found. Secondly, we will focus on the technology, raw materials, markets and products as factors explaining changes in industry structure and dominance. An object of major interest is whether international dominance in the paper industry has followed the technological leadership – or does market emergence create opportunities to gain technological leadership among higher sales and profits. Thirdly, we analyze the institutional environment, namely the governmental regulative policies – and informal institutional constraints such as cultural characteristics affecting paper consumption in each country. The institutional environment leads us to discuss to what extent the industry evolution is deterministic, that is, reliant upon the institutional structure. How individual companies have faced these technological, market, and institutional challenges is discussed in the country chapters and in our earlier volume in the World Forest series (Lamberg, Näsi, Ojala, & Sajasalo, 2006) which analyzed the strategies and organizational solutions of major pulp and paper companies.

Industry structure and dominance: life cycle approach

The pulp and paper industry has experienced dramatic changes during the past 200 years. In the U.S. alone, the total industry capacity increased 20 per cent between 1978 and 1992 (Pesendorfer, 2003). After the emergence of machine based paper production the companies typically evolved following a path from the organizational form of one factory per company to companies owning several factories, and more recently to multi-national corporations. The concentration within the paper and pulp industry occurred relatively late, and with accelerating speed after the 1960s. By analyzing how the number of firms and their relative sizes have evolved through time we can begin to understand the life cycles of the pulp and paper industry in different countries. The major question in international comparisons is to see how and why the timing of industry emergence, growth and shakeout evolved over time in different countries – and what it is that drives this particular development.

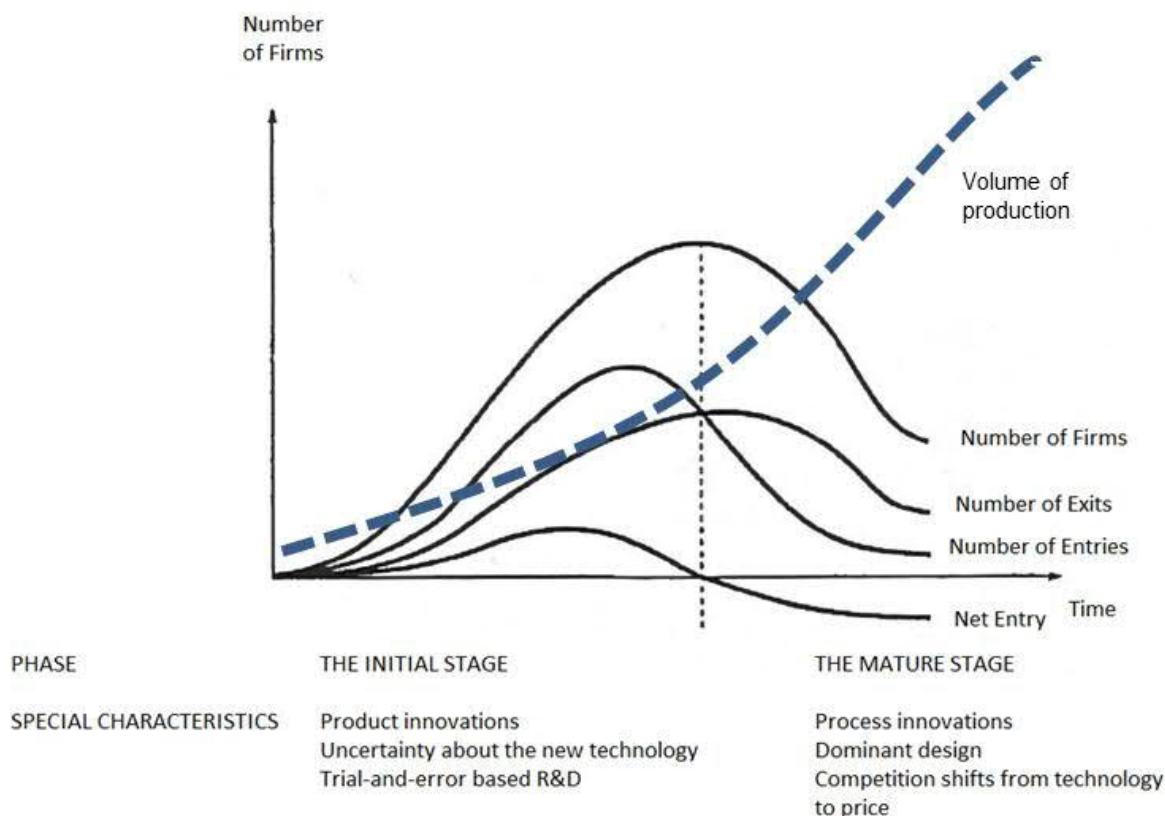
The analysis of industry life cycles over an extended period of time is a challenging task due to problems in identifying and correctly using historical sources. We analyze pulp and paper industry life-cycles on global scale by comparing the entries and exits of new companies in each country during certain cross cutting years. The data used was mainly compiled from specific industry directories (Phillips, 1910, 1950, 1971, 1974, 2000). These directories include, at least in theory, information on *all* paper industry companies in the world. Nevertheless, the data has its limitations. First, the data for these directories is based on questionnaires sent to the companies each year. Thus the reliability depends on how precisely the companies responded to the questionnaires. Second, the data is given in factory level format. Thus, to make a company level analysis we must first aggregate factories to company level, which may have given rise to mistakes in the course of the process. Third, the data from outside Western Europe and North America has shortcomings. For example, the data on the Chinese paper industry companies can hardly be regarded as reliable. Despite these shortcomings the data is to large extent comparable, especially after numerous iterations and comparisons to other data sources (Lamberg & Ojala, 2006).

The following analysis uses the data to understand the long-term development of the global pulp and paper industry and to scrutinize whether the industrial life-cycle hypothesis is adequate in describing its secular trends (Lamberg, Ojala, Peltoniemi, & Särkkä, 2012, in this volume). While the term life cycle has been used in several different contexts (Peltoniemi, 2011; Van de Ven & Poole, 1995, pp. 513-515), its meaning in industrial economics refers to a long-term path of organization population and a development shift from a high to a low

growth stage (Utterback & Abernathy, 1975, 1978). Although van de Ven and Poole (1995) claim that there is an inbuilt determinism within the life-cycle framework, Klepper (2002) has emphasized that differences in R&D expenditures can produce a pool of heterogeneous characteristics, from which the selection mechanism can ultimately produce an oligopolistic market structure.

Figure 11:1 presents a stylized model of the industrial life-cycle process: markets emerge, grow, shrink and ultimately die if a product is superseded by a successor (Fritsch, 1996, p. 237). Research analyzing industrial turbulence has suggested that different stages of the industrial life cycle are associated with different kinds of entry and exit behavior. Klepper and Graddy (Baptista & Karaöz, 2011; Klepper & Graddy, 1990, p. 251) demonstrated empirically and explained theoretically that change in the mean number of firms goes from positive to negative as an industry passes through its life cycle. Another distinctive feature of the life-cycle process is the changing nature of market turbulence, which is conventionally measured as a sum of firm entries and exits during a certain period divided by the number of firms in the population (Baptista & Karaöz, 2011; Beesley & Hamilton, 1984; Tervo & Niittykangas, 1994). According to several empirical studies (Agarwal & Gort, 1996; Baldwin & Gorecki, 1991), the levels of turbulence should be highest during the early phases of the life cycle, leveling off towards industrial maturity. It is also emphasized that the structure of the turbulence changes from entry dominated to exit dominated (Agarwal & Gort, 1996; Baldwin & Gorecki, 1991; Klepper & Graddy, 1990; Klepper & Miller, 1995), and that exits based on trial (and ultimate error) at entry should diminish towards maturity (Baptista & Karaöz, 2011, pp. 252–253).

Figure 11:1: Stylized paths in the number of entries, exits, and firms over the industry life cycle and characteristics of different development phases

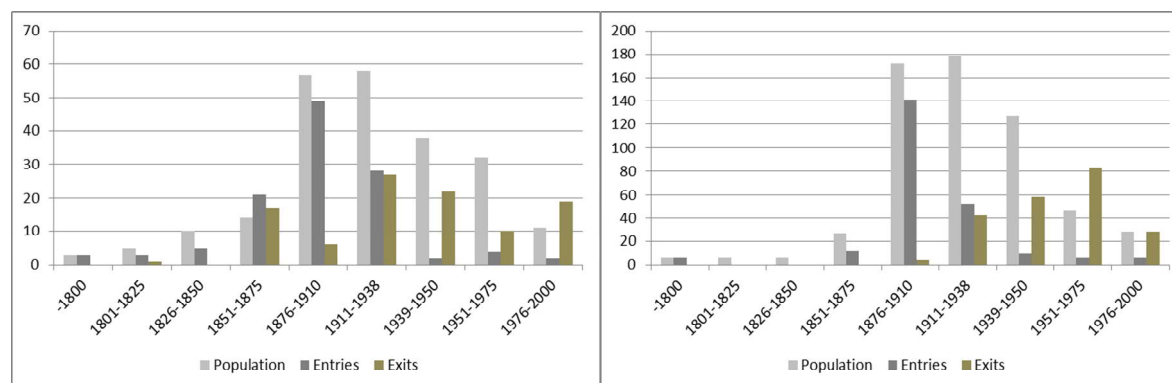


Source: (Fritsch, 1996, p. 237) (Klepper, 1997, pp. 148-150)

How well does the life cycle predict the historical development witnessed in the pulp and paper industry? Or, more interestingly, when the industry does not follow the path the theory assumes? Based his work on extensive analysis of several industries, Klepper (Klepper, 1997, pp. 168-174) proposes that the higher the degree of specialization possible, the higher the entry rate at later stages and the lesser the so-called first mover advantage. Caves (Caves, 1998, p. 1951) points out that corporate mobility (variation in sizes and market shares of the continuing firms) is largely independent of industry level change. An important feature of industrial turnover not captured by the vast majority of earlier research is the possible differences in the development process across institutional setups. The data analyzed here afford insights to this intriguing question. The data consisting of cross-sectional information on paper and pulp industries' population variables from 15 countries spans from the early nineteenth century to the year 2000.

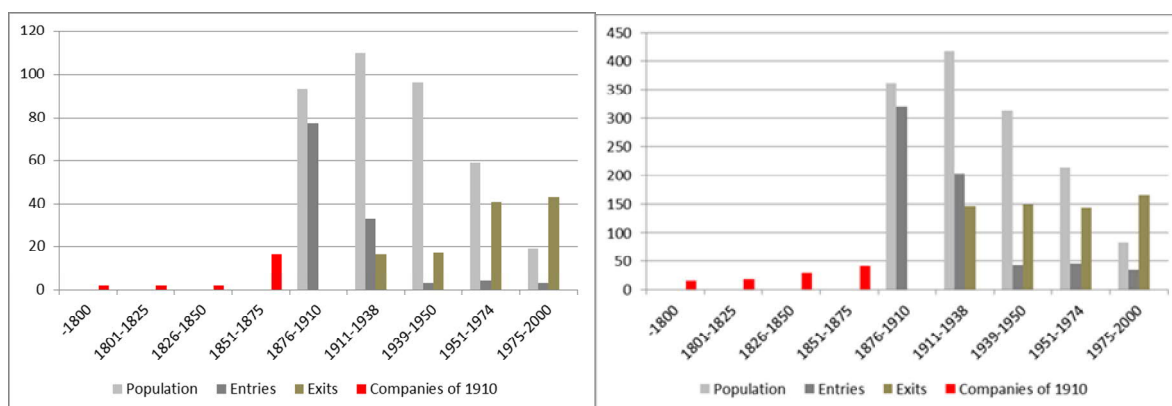
Figure 11:2 shows the country-level (1-15) data. The sample can be divided into two groups: pioneers and latecomers. The pioneer group consists of those countries which experienced the initial stages of high-turbulence prior to the First World War. Of the countries analyzed here, Finland and Sweden definitely belong to this group. According to the analysis by

Figure 11:2: Paper industry life cycles in selected countries



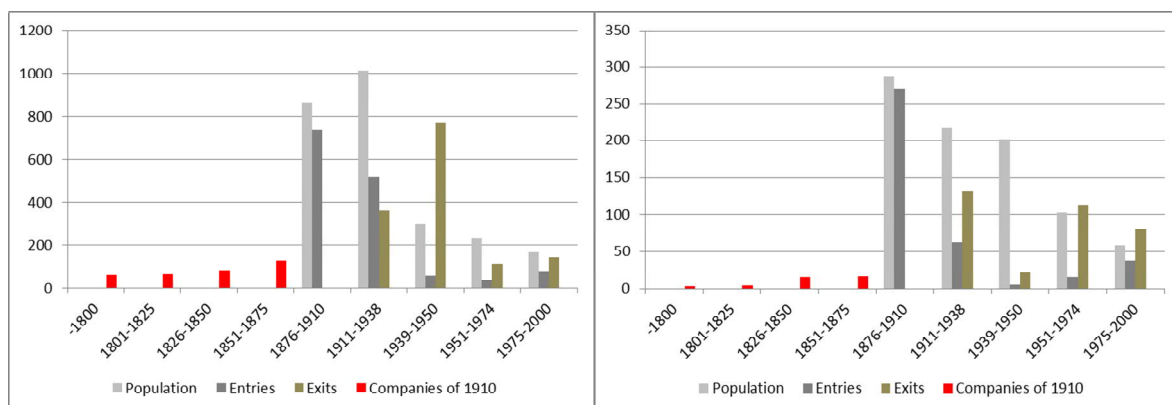
a. Finland

b. Sweden



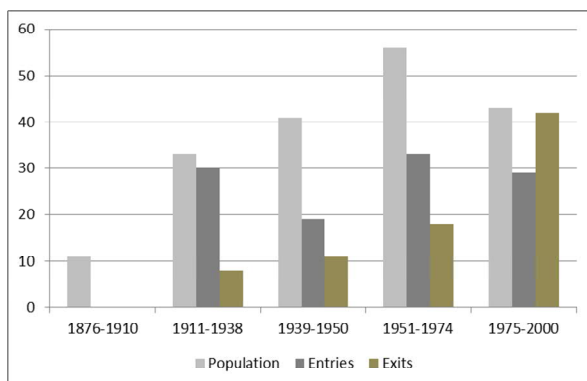
c. Norway

d. France

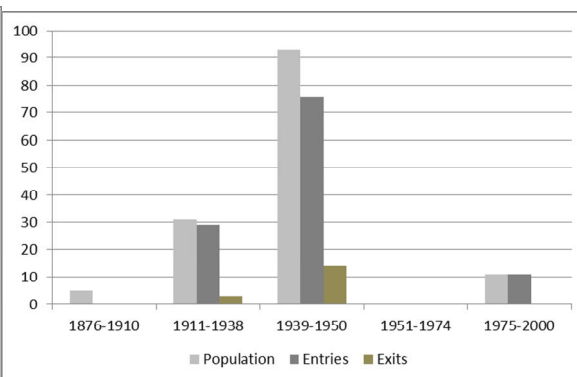


e. Germany

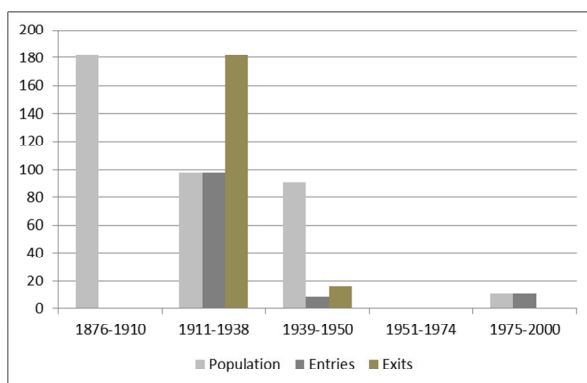
f. The Great Britain



g. Brazil



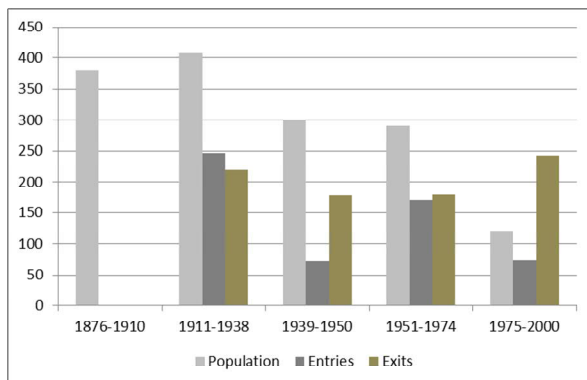
h. China



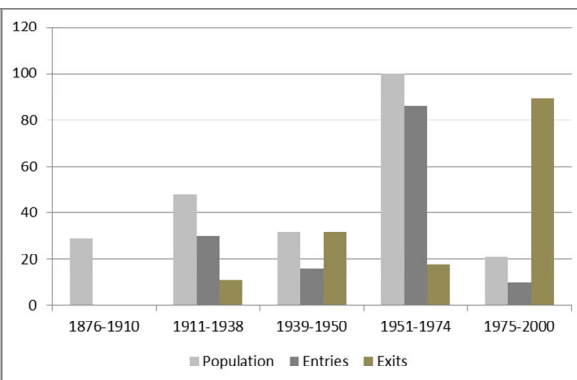
i. Russia



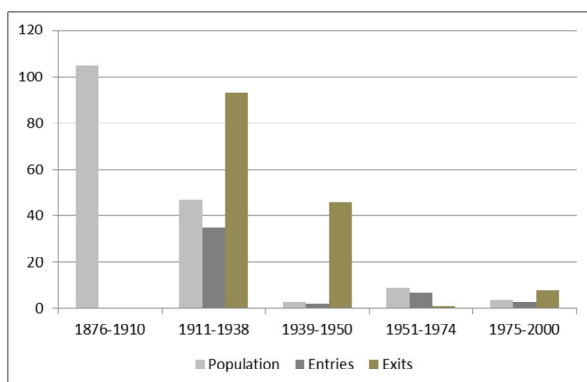
j. The Netherlands



k. Italy



l. Portugal



m. South Africa



n. Spain



o. Japan

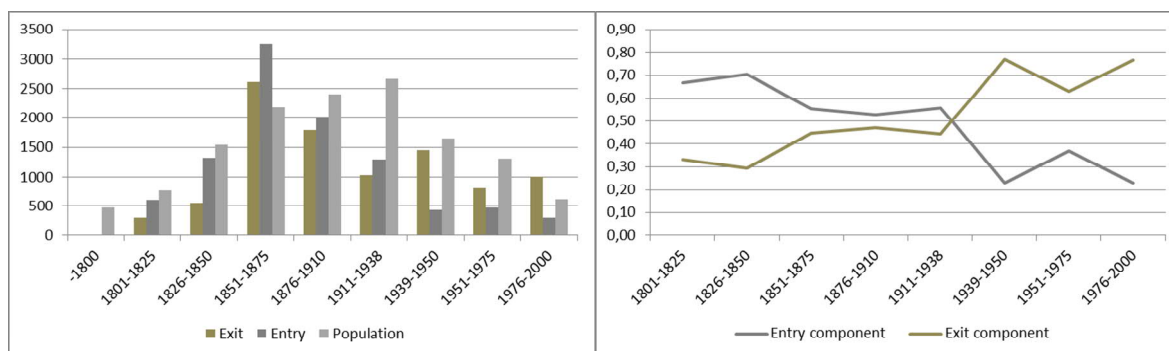
Source: DATASET

Klepper (1997, 2002), it can be claimed that the relatively few companies in Norway, France, and Great Britain surviving the period 1876-1910 should be assigned to the pioneer group – as is also witnessed in the country chapters in this volume. All these six countries experienced the entry driven growth phase in the last quarter of the nineteenth century and during the first decade of the twentieth century. Most likely the same applies to Russia and South Africa but the data is not exhaustive enough to verify this assumption. The largest paper company population in continental Europe (Germany) grew during the period from 1911 to 1938.(Turunen, 2012, in this volume)

The second group, the late-comers, are countries experiencing the peak-population phase after the First World War. Of these countries, Italy and The Netherlands reached the population high between the years 1911 and 1938, Japan and China during the first decade after the Second World War while for Brazil, Portugal, and Spain the maturity phases started after the 1970s. The similarities between Portugal and Spain are an interesting exception within the European framework, while the late surge in the Japanese paper and pulp population relates to the post-war reconstruction of the national economy.(Kurosawa & Hashino, 2012, in this volume)

Using the data, it is possible to estimate the life cycle of the European paper industry during the past 200 years, although the country specific variation is too wide to permit any reasonable estimate of the global paper industry. Figure 11:3 shows an estimated overall population development of ten European countries included based on interpolated relative shares.

Figure 11:3: Approximated paper and pulp industrial development in Europe 1800-2000 and its turbulence components



a Overall population dynamics

b Components of the industrial

turbulence

According to the estimate in Figure 11:3a, the population of the European paper and pulp industry grew until the start of the Second World War, although the highest rates of turbulence are measured during the period 1851-1875. As shown in Figure 11:3b, the entry proportion of the turbulence was considerably greater during the first half of the nineteenth century, followed by some 60 years of highly turbulent development, and the maturity stage settles in during the period 1939-1950. The rise of the exit component during the last period (1976 – 2000) can be explained by the mergers and acquisitions at the time (Ojala, Lamberg, Ahola, & Melander, 2006; Pesendorfer, 2003).

On the basis of visual inspection, it is apparent that the worldwide pulp and paper industry population can be comprehended using the life-cycle framework. The alteration in patterns of population dynamics may be due to institutional differences between countries, especially in terms of organizational “legitimacy”; the extent to which a certain branch of industry enjoys institutional support, reducing selection pressure from its “natural level” (Singh & Lumsden, 1990), pp. 184). According to Baptista and Karaöz (2011), the mechanism of selection differs in the early and later stages of the industrial life cycle. The data used here is too sparse and covers the early periods too superficially shed light on this hypothesis, but what it does show is that understanding these characteristics may require more in-depth knowledge concerning the nature of the industrial structure itself and the institutional and competitive framework driving the change. In the following, we return to reflect the findings of the book in the context of our original research topic.

Technology, raw materials, markets, and products

The life cycles of the paper industries described above are interrelated with the technology development, raw material acquisition, markets, and products produced at any given time and in any given country. In the Introduction (Lamberg et al., 2012, in this volume) we asked how the availability of technology and raw materials, on the one hand, and demand characteristics on the other, affect national technological advances. In an international context the relationships between technology transfer and leadership, raw material dependence and products varies globally. The crucial question is whether the international dominance in the pulp and paper industry is a function of technological leadership or if technological leadership is a co-product of rapid market growth. Furthermore, we aim to analyze the tension between raw material availability and distance to market in determining the competitive advantage of nations in this particular line of business.

Pulp and papermaking technology, like numerous other technologies, has evolved incrementally (Cohen, 1984; Magee, 1997a, 1997b, 1997c; Mokyr, 1990; Stier & Bengtson, 1992). The major technological change occurred in the early nineteenth century with the advent of machine based papermaking. However, it took almost one hundred years for machine based papermaking to supersede traditional manual papermaking (Munsell, 1980; Salzman, 1911; Spicer, 1907). The basic technology of making paper continuously has not changed dramatically in 200 years, although the size of the machines has increased. This, in turn, together with automation, has caused an enormous growth in productivity. The early twentieth century paper machine produced at best 200 meters of paper per minute, while a century later the speed exceeded 1800 meters per minute. At the same time the width of the machines grew from three to nine meters (Diesen, 1998; Lamberg & Ojala, 2006).

The opportunities offered by the new technologies encouraged new firms to enter the pulp and paper industries. The industry emerged during the nineteenth century as a consequence of new technologies and enlarging markets. Besides the paper machine itself, a number of other important innovations were also implemented during the nineteenth century, such as the use of wood fiber as a source of pulp, and sulfite and sulfate pulp technologies. One should also note the organizational and transport innovations followed by the general industrial development enabling large-scale industrial production, transportation, and distribution. The case of the United States paper industry (Toivanen, 2012, in this volume) is a prime example of processes of technological change. During the late nineteenth and early twentieth centuries the costs of new technologies were relatively low, encouraging new

companies to enter the markets. During the twentieth century, however, economies of scale made paper and pulp production more capital intensive, vertical and horizontal integration resulted in industrial conglomerates and mergers and acquisitions created the first multinational enterprises in the pulp and paper industry during the last decades of the twentieth century. Even though relatively small enterprises have succeeded in some niche products and local markets during the early third millennium, the bulk of the production is in the hands of multinational conglomerates (Berends & Romme, 2001; Diesen, 1998; Häggblom, 1999; Ojala, Melander, & Lamberg, 2009; Sajasalo, 2003; Siitonen, 2003).

Industry dominance has been closely linked to technology dominance in papermaking. The early technology development occurred in the Netherlands, France and Britain, then spread to Germany and later to the USA (Bouwens, 2004, 2012, in this volume; Toivanen, 2004, 2012, in this volume; Turunen, 2012, in this volume). After the Second World War the technological development has occurred especially in Nordic countries, most notably in Finland and in Germany (Järvinen, Ojala, Melander, & Lamberg, 2012, in this volume; Turunen, 2012, in this volume). Technological change can also lead to decline in paper industries, as was seen, for example, in the case of Norway (Järvinen, Ojala, et al., 2012, in this volume; Moen, 1994; Peterson, 1996, 2001; Toivanen, 2004). Research and development intensity, however, has been relatively low in the pulp and paper industries; process R&D is largely outsourced to machinery production firms while products are usually developed within the companies themselves (Alajoutsijärvi, 1996; Chandler, 1990; Hazley, 2000; Jokinen & Heinonen, 1987; Kettunen, 2002; Ojala et al., 2006).

The availability of raw materials is probably the single most important determinant for the geographical location and dominance of the paper and pulp industries. During the early phase of mechanical papermaking this line of business was dominated in the industrializing countries by Great Britain, Germany, and France. Besides technical capabilities and know how, these countries also had relatively large markets for paper – and the raw material used in the early nineteenth century, namely, rag (Särkkä, 2012, in this volume; Turunen, 2012, in this volume). The mid-nineteenth century experiments with esparto grass were not successful enough, while at the time Northern conifer wood proved to be both technically and economically the most suitable choice for large-scale papermaking. The use of wood as the raw material for industrial papermaking has for 150 years been the dominant solution in this area of business. The use of wood fiber changed the industry dominance for over one hundred years to the Northern countries with their larger forest resources, namely to USA, Canada, and the Nordic countries (Järvinen, Ojala, et al., 2012, in

this volume; Kuhlberg, 2012, in this volume; Toivanen, 2012, in this volume). With its vast forest resources Russia and the Soviet Union never succeeded in gaining such a dominant position in the global pulp and paper industry (Mashkina, 2012, in this volume). Markets also played a role and a lack of domestic raw materials could be compensated with pulp imports, as happened in Germany, Britain, and Japan (Kurosawa & Hashino, 2012, in this volume; Särkkä, 2012, in this volume; Turunen, 2012, in this volume). The lack of wood based raw material is among the most important reasons for the decline of the British paper industries (Särkkä, 2012, in this volume).

The change from sulfite to sulfate pulp changed the geographical orientation in the USA, as southern pine forests could be used for papermaking (Lamberg, 2005; Toivanen, 2012, in this volume). A more profound change in raw materials was yet to come: namely, the emergence of eucalyptus wood as a raw material for papermaking. Again, the technological change was a lengthy process starting with experimentation already during the early 20th century. Since the early 1990s the use of eucalyptus has moved the industry dominance to South America and Southern Europe (Gutiérrez-Poch, 2012, in this volume; Lima-Toivanen, 2012, in this volume).

Distance to market is an important determinant for global dominance in paper industries. For some of the countries analyzed in this volume these markets have mainly been domestic ones, as in the case of Germany, Russia, USA, Britain, and Japan (Kurosawa & Hashino, 2012, in this volume; Mashkina, 2012, in this volume; Särkkä, 2012, in this volume; Toivanen, 2012, in this volume; Turunen, 2012, in this volume). For the Nordic countries and Canada especially, the export markets have been in a dominant position (Järvinen, Ojala, et al., 2012, in this volume; Kuhlberg, 2012, in this volume). To a certain extent the lack or availability of raw materials can be compensated with distance and costs to market. Therefore, falling transport costs especially in overseas trade is a vital determinant for the creation of global paper markets and global production chains for paper products (Ojala & Kaukiainen, 2012; Stopford, 2009). Alongside global market changes China and east Asia as a whole have emerged as the major paper consumption area – and also the fastest growing area for papermaking. The large markets for paper can in turn also be a source for raw materials, as the evolution of the use of recycled fiber in central European countries demonstrates (Bouwens, 2012, in this volume).

The markets have determined the demand for different kinds of paper products. For the demand for paper products fairly simple variables are the most important ones: population growth, GDP per capita, consumption patterns, and literacy rate. Thus demographic

development does not alone explain paper consumption. Rise in income, witnessed in GDP per capita growth, led the way to modern consumerism that created various uses for paper products. Newsprint is usually taken as a primary example, but similar patterns can be seen, for example, in the rise of demand for packaging and hygiene paper products (Toivanen, 2012, in this volume). Bureaucratization and organizational changes during the twentieth century created markets for office papers, increased leisure and new consumer needs are seen, in turn, in the demand for high quality magazine papers. These basic factors seen in the historical development can also be harnessed for scenario building (Hetemäki & Obersteiner, 2001; Järvinen, Lamberg, et al., 2012, in this volume).

While newsprint was among the dominant products from the late nineteenth century until the late twentieth century, packaging materials and tissue papers have also grown in importance. In 1995 around 45 per cent of paper consumption was used for communication (newsprint, printing, and writing papers), 40 per cent for packaging, and 15 per cent for miscellaneous products (such as tissues). Substitute materials have challenged certain paper industry products: plastics in packaging and digitalization, especially newsprint and writing papers. Developments in office technology and advertising expenditures explain the demand for certain paper industry products. Finnish and Swedish paper industry companies, for example, have concentrated since the 1980s on office and high end coated magazine papers (Diesen, 1998; Lamberg & Ojala, 2006).

Regulation, government policy and cultural characteristics

The industry life cycle in different countries is also determined by the institutional development, including governmental policies and regulation (Baker, 2004; North, 1990, 2005; Porter, 1990). In turn, an unfavorable institutional environment may be an obstacle to the paper industry, as can be seen especially in the case of Germany (see Turunen in this volume). The institutional environment affecting the pulp and paper industries includes roughly four key elements. First, the economic policies of the respective countries affected industry prospects. In countries in which the paper industry was a dominant line of business, attention was paid to creating a favorable regulatory environment, as the companies had bargaining power in governmental policies. The Nordic countries Finland and Sweden, and partly also Norway, are prime examples of favorable formal institutional environments for paper industries and the powerful role played by the forest industry companies in domestic legislation (Hazley, 2000; Järvinen, Ojala, et al., 2012, in this volume; Kuisma, 2008;

Lamberg, 2005). This favorable environment includes legislation affecting different stages of production from raw material acquisition, energy regulation, production, labor regulation and investment regulation to transport and trade agreements with other countries. In Canada, in turn, the key role played by the provincial government in the control of timber and hydropower resources was crucial for the development of the pulp and paper industries (Kuhlberg, 2012, in this volume). Russia, and partly also Germany, are cases where the unstable institutional environment was detrimental to the further progress of the pulp and paper industry, although both countries have traditionally had fairly strong paper industries operating mainly in domestic markets (Mashkina, 2012, in this volume; Turunen, 2012, in this volume).

Second, the environmental legislation affecting the opportunities to exploit raw materials has grown in importance globally during the last decades of the second millennium. Nevertheless, forest regulation has been widely debated issue since the late nineteenth century, especially in countries with vast forest resources and consequently important forestry industries (Lehtinen, Donner-Amnell, & Saether, 2004; Palo & Lehto, 2012; Sonnenfeld, 2002). In emerging pulp and paper industry countries, most notably in South America, a lot of attention has been paid to environmental regulation (Lima-Toivanen, 2012, in this volume) which is a new and different phenomenon than any faced by the first entrants in the nineteenth century.

Third, the end-use of forest products is also under specific regulation. This can be seen especially in the freedom of the press, which has affected the demand for newsprint production. Furthermore, the lowering of taxes affecting newspaper industries has also had an impact on paper production (Guthrie, 1941). The freedom of the press and press taxation regulation explains, at least partly, the rise of paper industries first in Britain and certain other European countries, together with the development in North America (Kuhlberg, 2012, in this volume; Särkkä, 2012, in this volume; Toivanen, 2012, in this volume). As a curiosity, the rapid growth of Finnish paper industries during the turn of the 20th century can mainly be explained by the rising demand for newsprint in Russia, where liberal policies gave rise to newspaper industries (Heikkinen, 2000; Järvinen, Ojala, et al., 2012, in this volume; Kuisma, 1993; Mashkina, 2012, in this volume). Domestic regulation, however, does not alone explain the evolution of paper industries in different countries. Regulation in the main market areas has also been important for major paper exporting countries such as the Nordic countries and Canada (Järvinen, Ojala, et al., 2012, in this volume; Kuhlberg, 2012, in this volume).

Fourth, informal institutional structure has also affected markets for paper. Religion and culture as a whole may have a significant impact on paper consumption. This is particularly apparent in the case of Japan, where for centuries the traditional hand-made paper has retained its importance. (Kurosawa & Hashino, 2012, in this volume).

Conclusion: lessons learned from the evolution of the global paper industry

What can we learn from the evolution of the global pulp and paper industry relative to industry evolution across industries? The Introduction to this volume (Lamberg et al., 2012, in this volume) noted that we still lack an understanding of two key issues in industry evolution: (a) To what extent are evolutionary explanations geographically and temporally universal causing similar patterns in different types of countries? and (b) What kinds of causal relationships are there between industrial decline in one geographic region and rise in another? The case of the pulp and paper industry enables us, at least partly, to answer these fundamental questions.

The evolutionary reasons for the rise and fall of pulp and paper industries in the countries analyzed in this volume are summarized in Table 11:1 below. The universality of evolutionary explanations over time and geographic region can be summarized in the factors described above; namely, raw materials, markets, technological capabilities, and institutional factors. However, decline in one region does not necessarily lead to a rise of that industry elsewhere unless several or all these factors are involved in this transfer of industry.

Table 11:1 Country specific example of evolutionary explanations for paper industry life cycles

Country	Industry structure and dominance	Technology, raw materials, markets	Regulation and government policy
Nordic countries	Emergence from the late 19th century, regional dominance and international presence during the late 20th century	Pioneering with modern technology, technology leadership late 20th century pine and spruce resources export orientation	Favorable institutional environment for forest industries, cartelization
USA	Emergence in the turn of the 19th and 20th century, regional dominance and international presence throughout the 20th century	Technology lead throughout the 20th century changes in raw material base domestic markets	Non-regulated markets, specific regulative changes affecting forest industries
Germany	Long tradition in paper making, early emergence of	Technology lead from the early 19th century,	Institutional shakeouts and external shocks, cartelization

	factory scale production and dominance	challenging raw material situation domestic markets	
Canada	Emergence during the turn of the 20th century, dominance until the late 20th century	Technology follower favorable raw material situation export markets	Regional institutional constraints, regulation in major export area (USA)
Japan	Emergence from the early 20th century, regional dominance on domestic markets	From technology follower to leader during the latter part of the 20th century imported raw materials domestic markets	Favorable institutional environment
Britain	Pioneering country with early emergence and industrial dominance	Technology leadership throughout the 19th century dependence on imported raw materials large domestic markets	Non-regulated markets, changes in trade policy affecting paper industry
Netherlands	Long tradition and early dominance	Early technology leadership (late 18th century) imported raw materials and recycled fibers mainly domestic markets	...
Southern Europe	Traditional paper making dominant for long time, late emergence, acquiring dominance	Technology follower long search for suitable raw material base mainly domestic markets	Favorable institutional environment
South America	Late comer advantage, acquiring dominance	Active innovation policies to acquire technology leadership vast raw material sources global markets	Favorable institutional environment
Russia	Slow and fluctuating evolution	Technology follower vast raw material resources domestic markets	Institutional shakeouts

When comparing pulp and paper industry development in the analyzed countries with an historical perspective we may observe two major issues that add value to our understanding of industry evolution and competitive advantage. These two issues are (1) the fundamental effect of market growth on all other aspects in industry evolution; and (2) the ways globalization has changed the mechanisms and processes causing changes in industry dominance.

First, having a time perspective of almost two hundred years allows us to witness several changes in industry dominance defined as the agglomeration of production capacity, technological knowledge, and management and marketing capabilities (cf. (Chandler, 1990; Murmann, 2003)). According research in this volume and related projects we identify the major changes in industry dominance as follows:

From U.K. to U.S.	(Beginning of the 20th century)
From U.K. to Germany	(Beginning of the 20th century)
From U.S. and Germany to Canada and Japan	(Mid 20 th century)
From U.S. and Germany (and Canada) to Nordic countries	(The 1980s and 1990s)
From Nordic countries to China	(Early 2000)
From Nordic countries to South America	(Early 2000)

When focusing on similarities between the transitions two issues emerge as necessary causes. First, dominance has always shifted to the region with the highest market potential in terms of population size and speed of economic growth. The markets may be domestic or export oriented, as has been the case with the Nordic countries and Canada (Järvinen, Ojala, et al., 2012, in this volume; Kuhlberg, 2012, in this volume). Second, industrial growth and the accumulation of technological knowledge require a certain maturity of political systems, regulation, and organization of research and development. Likewise, similarities between regions that lose their competitive advantage are characterized by saturation of demand, thereby weakening incentives to invest in production capacity, which is subsequently detrimental to the whole value network. In a recent network analysis (Järvinen, Lamberg, & Pietinalho, 2012), for example, the relative decline of the pulp and paper clusters in U.S. and Japan is characterized by ever rarer network connections, meaning fewer business deals from the perspective of supporting industries such as machinery and chemical industries.

Transitions are also different in one important dimension: the major resource on which firms may build their strategic position. Germany, Japan, China and the U.S. ? are examples of countries with huge market potential in terms of proximity of potential customers. Likewise, the Nordic countries, Canada, and to some extent South America represent settings in which the main competitive advantage is the availability of forests suitable for harvesting and use in industrial production. This difference affects many aspects in industrial evolution: focus of research and engineering knowledge, organization of market activities, and structure of industrial populations. For example, the fact that Nordic firm populations have been small and characterized by the large size of major companies signals the need to have advanced marketing and organizations capabilities that have allowed expansion to potentially hostile markets in Germany and U.K. (Jarvinen, Lamberg, Murmann, & Ojala, 2009). Also, as can be seen from Table 11:1, industry dominance and technology leadership are closely interlinked (Alajoutsijärvi, 1996; Murmann, 2003)

Transitions of competitive advantage from one region to other regions used to be comprehensive: as a result of changing market dynamics new firms emerged in regions,

local producers catalyzed new types of technological inventions, and so the dominance shifted regularly and predictably. In a metaphorical sense, economic regions were like isolated islands each witnessing the evolution of pulp and paper industry clusters as predicted in the life-cycle literature. In this sense, dominance shifts were primarily the function of industry evolution occurring at different times in different places. Globalization has radically changed this dynamic. First, although economic activity and the demand for pulp and paper products may decline, this no longer means that firms fade away as was the case, for example, in the U.K. paper machine industry in the early twentieth century. Due to globalization and increasing demand somewhere especially technology firms always have markets although their 'domestic' customers may be in trouble. Second, the evolution of regional firm populations takes a different shape than it has historically, as we have increasing number of multinational corporations that may expand to any emerging market thus bypassing the nascent domestic firms. The same has also happened in mature markets, as the Dutch case witnesses (Bouwens, 2012, in this volume). As a consequence, the total sum of global firms does not grow. In the distant future, we may witness the dominance of a few multinational pulp and paper firms, saturation of technological progress, and ultimately the emergence of a totally different type of industry.

References

- Agarwal, R., & Gort, M. (1996). The evolution of markets and entry, exit and survival of firms. *The Review of Economics and Statistics*, 78(3), 489-498.
- Alajoutsijärvi, K. (1996). Rautainen pari. Kymmenen ja Valmetin suhde, lähiverkosto ja makrovoimat 1948-90 (Vol. 31). Jyväskylä: Jyväskylän yliopisto.
- Baker, A. (2004). Governments, Firms, and National Wealth: A New Pulp and Paper Industry in Postwar New Zealand. *Enterprise & Society: The International Journal of Business History*, 5(4), 669-690.
- Baldwin, J. R., & Gorecki, P. K. (1991). Firm entry and exit in the Canadian manufacturing sector, 1970-1982. *The Canadian Journal of Economics*, 26(2), 300-323.
- Baptista, R., & Karaöz, M. (2011). Turbulence in growing and declining industries. *Small Business Economics*, 36(3), 249-270.
- Beesley, M. E., & Hamilton, R. T. (1984). Small firms' seedbed role and the concept of turbulence. *The Journal of Industrial Economics*, 33(2), 217-231.
- Berends, P. A. J., & Romme, A. G. L. (2001). Cyclicity of capital-intensive industries: a system dynamics simulation study of the paper industry. *Omega (Oxford)*, 29(6), 543-553.

- Bouwens, B. (2004). *Op papier gesteld. De geschiedenis van de Nederlandse papier- en kartonindustrie in de twintigste eeuw* (forthcoming).
- Bouwens, B. (2012, in this volume). The paper and board industry in the Netherlands, 1800–2000. In J.-A. Lamberg, J. Ojala, M. Peltoniemi & T. Särkkä (Eds.), *The Evolution of Global Paper Industry 1800 - 2050. A Comparative Analysis*. Dordrecht: Springer.
- Caves, R. E. (1998). Industrial organization and new findings on the turnover and mobility of firms. *Journal of Economic Literature*, 36(4), 1947-1982.
- Chandler, A. D. J. (1977). *The Visible Hand. The Managerial Revolution in American Business*. Cambridge, Mass.: Harvard University Press.
- Chandler, A. D. J. (1990). *Scale and Scope. The dynamics of industrial capitalism*. Cambridge, Mass.: The Belknap Press of Harvard University Press.
- Cohen, A. J. (1984). Technological Change as Historical Process: The Case of the U.S. Pulp and Paper Industry, 1915 - 1940. *Journal of Economic History*, 44(3), 775-799.
- Diesen, M. (1998). *Economics of Pulp and Paper Industry. Paper Making Science & Technology*. Helsinki: Fapet.
- Fritsch, M. (1996). Turbulence and growth in West Germany: A comparison of evidence by regions and industries. *Review of Industrial Organization*, 11(2), 231-251.
- Guthrie, J. A. (1941). *The Newsprint Paper Industry, and Economic Analysis*. Cambridge: Harvard University Press.
- Gutiérrez-Poch, M. (2012, in this volume). Is there a Southern European model? Development of pulp and paper industry in Italy, Spain and Portugal (1800–2010). In J.-A. Lamberg, J. Ojala, M. Peltoniemi & T. Särkkä (Eds.), *The Evolution of Global Paper Industry 1800 - 2050. A Comparative Analysis* Dordrecht: Springer.
- Hannan, M. T., & Freeman, J. (1989). *Organizational Ecology*. Cambridge, MA: Harvard University Press.
- Hazley, C. (2000). *Forest-based and related industries of the European Union: industrial districts, clusters and agglomerations*. Helsinki: Taloustieto.
- Heikkinen, S. (2000). *Paper for the World. The Finnish Paper Mills' Association - Finnpap 1918 - 1996*. Helsinki: Otava Publishing Company Ltd.
- Hetemäki, L., & Obersteiner, M. (2001). *US Newsprint Demand Forecasts to 2020*. IAASA, Interim Report.
- Hägglom, R. (1999). The forest cluster is becoming global and more compact. In A. Reunala, I. Tikkanen & E. Åsvik (Eds.), *The Green Kingdom. Finland's Forest Cluster*. (pp. 296-301). Helsinki: Otava Publishing Ltd - Metsämiesten Säätiö Foundation.
- Jarvinen, J., Lamberg, J. A., Murmann, J. P., & Ojala, J. (2009). Alternative Paths to Competitive Advantage: A Fuzzy-Set Analysis of the Origins of Large Firms. *Industry and Innovation*, 16(6), 545-574. doi: 10.1080/13662710903371066
- Jokinen, A., & Heinonen, J. (1987). *Tutkimus ja tuotekehitys yritysjohdon työvälineenä paperiteollisuudessa*. (Vol. 17). Helsinki: Tekes.
- Järvinen, J., Lamberg, J.-A., Nokelainen, T., & Tikkanen, H. (2012, in this volume). The Evolution of the Paper Industry: 2006 - 2050. In J.-A. Lamberg, J. Ojala, M. Peltoniemi & T. Särkkä (Eds.), *The Evolution of Global Paper Industry 1800 - 2050. A Comparative Analysis*. Dordrecht: Springer.
- Järvinen, J., Lamberg, J.-A., & Pietinalho, L. (2012). The Fall and the Fragmentation of National Clusters: Cluster Evolution in Paper and Pulp Industry. *Scandinavian Journal of Forest Economics*, 18(3).
- Järvinen, J., Ojala, J., Melander, A., & Lamberg, J.-A. (2012, in this volume). Evolution of pulp and paper industries in Finland, Norway, and Sweden. In J.-A. Lamberg, J. Ojala, M. Peltoniemi & T. Särkkä (Eds.), *The Evolution of Global Paper Industry 1800 - 2050. A Comparative Analysis*. Dordrecht: Springer.

- Kettunen, J. (2002). Kuuseen kurkottajat. Teknologian kehitys Metsäliiton piirissä 1950-luvulta vuosituuhannen vaihteeseen. Helsinki: Metsäliitto-yhtymä.
- Klepper, S. (1996). Entry, Exit, Growth, and Innovation over the Product Life Cycle. *The American Economic Review*, 86(3), 562-583.
- Klepper, S. (1997). Industry life cycles. *Industrial and Corporate Change*, 6(1), 145-181.
- Klepper, S. (2002). Firm survival and the evolution of oligopoly. *RAND Journal of Economics*, 33(1), 37 - 61.
- Klepper, S., & Graddy, E. (1990). The evolution of new industries and the determinants of market structure. *The Rand Journal of Economics*, 21(1), 27-44.
- Klepper, S., & Miller, J. H. (1995). Entry, exit, and shakeouts in the United States in new manufactured products. *International Journal of Industrial Organization*, 13(4), 567-591.
- Kuhlberg, M. (2012, in this volume). An Accomplished History, An Uncertain Future: Canada's Pulp and Paper Industry Since the Early 1800s. In J.-A. Lamberg, J. Ojala, M. Peltoniemi & T. Särkkä (Eds.), *The Evolution of Global Paper Industry 1800 - 2050. A Comparative Analysis*. Dordrecht: Springer.
- Kuisma, M. (1993). Metsäteollisuuden maa. Suomi, metsät ja kansainvälinen järjestelmä 1620–1920. Helsinki: SKS.
- Kuisma, M. (Ed.). (2008). Kriisi ja kumous. Metsäteollisuus ja maailmantalouden murros 1973 - 2008. *Metsäteollisuuden maa 5*: SKS.
- Kurosawa, T., & Hashino, T. (2012, in this volume). From non-European Tradition to a Variation on the Japanese Competitiveness Model: The Modern Japanese Paper Industry since the 1870s. In J.-A. Lamberg, J. Ojala, M. Peltoniemi & T. Särkkä (Eds.), *The Evolution of Global Paper Industry 1800 - 2050. A Comparative Analysis*. Dordrecht: Springer.
- Lamberg, J.-A. (2005). Evolution of Strategic Action. Path Dependence in a Global Industry. Helsinki.
- Lamberg, J.-A., Näsi, J., Ojala, J., & Sajasalo, P. (Eds.). (2006). *The Evolution of Competitive Strategies in Global Forestry Industries. Comparative Perspectives*. Dordrecht: Springer.
- Lamberg, J.-A., & Ojala, J. (2006). Evolution of Competitive Strategies in Global Forestry Industries: Introduction. In J.-A. Lamberg, J. Näsi, J. Ojala & P. Sajasalo (Eds.), *The Evolution of Competitive Strategies in Global Forestry Industries: Comparative perspective* (pp. 1-29). Dordrecht: Springer.
- Lamberg, J.-A., Ojala, J., Peltoniemi, M., & Särkkä, T. (2012, in this volume). Research on Evolution and Global History of Paper and Pulp Industry: An Introduction. In J.-A. Lamberg, J. Ojala, M. Peltoniemi & T. Särkkä (Eds.), *The Evolution of Global Paper Industry 1800 - 2050. A Comparative Analysis*. Dordrecht: Springer.
- Lehtinen, A. A., Donner-Amnell, J., & Saether, B. (Eds.). (2004). *Politics of Forests. Northern Forest-Industrial Regimes in the Age of Globalization*. Aldershot: Ashgate.
- Lima-Toivanen, M. B. (2012, in this volume). The South American Pulp and Paper Industry: Cases Brazil, Chile and Uruguay. In J.-A. Lamberg, J. Ojala, M. Peltoniemi & T. Särkkä (Eds.), *The Evolution of Global Paper Industry 1800 - 2050. A Comparative Analysis*. Dordrecht: Springer.
- Magee, G. B. (1997a). Competence of Omniscience? Assessing Entrepreneurship in the Victorian and Edwardian British Paper Industry. *Business History Review*, 71(2), 230-259.
- Magee, G. B. (1997b). *Productivity and Performance in the Paper Industry: Labour, Capital, and Technology in Britain and America, 1860 - 1914*. Cambridge, Mass.: Cambridge University Press.
- Magee, G. B. (1997c). Technological Divergence in a Continuous Flow Production Industry: American and British Paper Making in the late Victorian and Edwardian Era. *Business History*, 39(1), 21-46.
- Mashkina, O. (2012, in this volume). The Pulp and Paper Industry Evolution in Russia. A Road of Many Transitions. In J.-A. Lamberg, J. Ojala, M. Peltoniemi & T. Särkkä (Eds.), *The Evolution of Global Paper Industry 1800 - 2050. A Comparative Analysis*. Dordrecht: Springer.

- Moen, E. (1994). Technological Change and the Decline of the Traditional Pulp and Paper Industry in Norway, 1950 - 1980. *Scandinavian Economic History Review*, 42(3), 257-278.
- Mokyr, J. (1990). *The Lever of Riches. Technological Creativity and Economic Progress*. New York: Oxford University Press.
- Munsell, J. (1980). *Chronology of the Origin and Progress of Paper and Paper-Making*. New York - London: Garland Publishing.
- Murmann, J. P. (2003). *Knowledge and Competitive Advantage: The Coevolution of Firms, Technology, and National Institutions*. Cambridge (Mass.): Cambridge University Press.
- Nelson, R., & Winter, S. (1982). *An evolutionary theory of economic change*. Cambridge, MA: Harvard University Press.
- North, D. C. (1990). *Institutions, Institutional Change and Economic Performance*. Cambridge-New York: Cambridge University Press.
- North, D. C. (2005). *Understanding the process of economic change*. Princeton, N.J.: Princeton University Press.
- Ojala, J., & Kaukiainen, Y. (2012). Finnish Shipping – A Nordic Exception? . In S. Tenold, M. J. Iversen & E. Lange (Eds.), *Global Shipping in Small Nations. Nordic Experiences after 1960* (pp. 129-155). Basingtoke: Palgrave Macmillan.
- Ojala, J., Lamberg, J.-A., Ahola, A., & Melander, A. (2006). The Ephemera of Success: Strategy, Structure and Performance in the Forestry Industries. In J.-A. Lamberg, J. Näsi, J. Ojala & P. Sajasalo (Eds.), *The Evolution of Competitive Strategies in Global Forestry Industries: Comparative perspectives* (pp. 257-286). Dordrecht: Springer.
- Ojala, J., Melander, A., & Lamberg, J.-A. (2009). Competitive behaviour and business innovations in the forest industry: Family firms and listed firms in comparison In P. Fernandez-Peres & M. B. Rose (Eds.), *Innovation and Networks in Entrepreneurship in Europe* (pp. 118 - 137). New York: Routledge.
- Palo, M., & Lehto, E. (2012). *Private or Socialistic Forestry? Forest Transition in Finland vs. Deforestation in the Tropics (Vol. X)*. Dordrecht: Springer.
- Peltoniemi, M. (2011). Reviewing Industry Life-cycle Theory: Avenues for Future Research. *International Journal of Management Review*, 13(4), 349-375.
- Pesendorfer, M. (2003). Horizontal Mergers in the Paper Industry. *The Rand Journal of Economics*, 34(3), 495-515.
- Peterson, C. (1996). *Finsk ingerjörskonst och svenskt imperiebyggande: En jämförande studie av finsk och svensk skogsindustri*. Stockholm: SNS.
- Peterson, C. (2001). The Development Paths of Two Nordic Forest Nations, 1950-1992. *Scandinavian Economic History Review*, 49(1).
- Phillips. (1910). *Phillips Paper Trade Directory of The World 1909-1910*. London: S.C Phillips & Co.
- Phillips. (1950). *Phillips' Paper Trade Directory of The World 1950*. London: S.C. Phillips & Co.
- Phillips. (1971). *Phillips' Paper Trade Directory of the World 1971*. London: S.C. Phillips & Co.
- Phillips. (1974). *Phillips Paper Trade Directory Europe/Mills of the World 1974*. London: Benn Brothers Limited.
- Phillips. (2000). *International Phillips 2000 Paper Directory*. Kent: Miller Freeman UK Ltd.
- Porter, M. (1990). *The competitive advantage of nations*. New York: Free Press.
- Rytkönen, A. (2000). Mestäklusterin toimintaympäristö. In R. Seppälä (Ed.), *Suomen mestäklusteri tienhaarassa* (pp. 27 - 30). Helsinki: Wood Wisdom.
- Sajasalo, P. (2003). *Strategies in Transition. The Internationalization of Finnish Forest Industry Companies*. Jyväskylä: University of Jyväskylä.
- Salzman, F. (1911). *Die Papierindustrie. Ihre wirtschaftliche Entwicklung und heutige Lage*. Berlin: Franz Siemenroth.
- Siitonen, S. (2003). *Impact of Globalisation and Regionalisation Strategies on the Performance of the World's Pulp and Paper Companies*. Helsinki: Helsinki School of Economics.

- Singh, J. V., & Lumsden, C. J. (1990). Theory and research in organizational ecology. *Annual Review of Sociology*, 16, 161-195.
- Sonnenfeld, D. A. (2002). Social Movements and Ecological Modernization: The Transformation of Pulp and Paper Manufacturing. *Development and Change*, 33(1), 1-27.
- Spicer, A. D. (1907). *The Paper Trade. A Descriptive and Historical Survey of the Paper Trade from the Commencement of the Nineteenth Century*. London: Methuen & Co.
- Stier, J., & Bengston, D. (1992). Technical change in the North American Forestry Sector: A review. *Forest Science*, 38(1), 134-159.
- Stopford, M. (2009). *Maritime Economics* (third edition). Abingdon: Routledge.
- Särkkä, T. (2012, in this volume). The British Paper Industry, 1800–2000. In J.-A. Lamberg, J. Ojala, M. Peltoniemi & T. Särkkä (Eds.), *The Evolution of Global Paper Industry 1800 - 2050. A Comparative Analysis*. Dordrecht: Springer.
- Tervo, H., & Niittykangas, H. (1994). Developments in the growth, location and turbulence of business services in Finland. *Papers in Regional Science*, 73(1), 73-95.
- Toivanen, H. (2004). *Learning and Corporate Strategy: The Dynamic Evolution of the North American Pulp and Paper Industry, 1860 - 1960*. Georgia: Georgia Institute of Technology (unpublished dissertation).
- Toivanen, H. (2012, in this volume). Waves of Technological Innovation: The Evolution of the U.S. Pulp and Paper Industry, 1860-2000. In J.-A. Lamberg, J. Ojala, M. Peltoniemi & T. Särkkä (Eds.), *The Evolution of Global Paper Industry 1800 - 2050. A Comparative Analysis*. Dordrecht: Springer.
- Turunen, O. (2012, in this volume). The Paper Industry in Germany, 1800–2000. In J.-A. Lamberg, J. Ojala, M. Peltoniemi & T. Särkkä (Eds.), *The Evolution of Global Paper Industry 1800 - 2050. A Comparative Analysis*. Dordrecht: Springer.
- Utterback, J. M., & Abernathy, W. J. (1975). A dynamic model of process and product innovation. *Omega*, 3(6), 639-656.
- Utterback, J. M., & Abernathy, W. J. (1978). Patterns of industrial innovation. *Technology Review*, 80(7), 40-47.
- Van de Ven, A., & Poole, M. S. (1995). Explaining development and change in organizations. *Academy of Management Review*, 20(3), 510-549.