Received: 29 September 2017 | Revised: 23 April 2019 | Accepted: 1 June 2019 | Published on: 29 August 2019

DOI: 10.1002/smj.3080

SPECIAL ISSUE ARTICLE

STRATEGIC MANAGEMENT JOURNAL WILEY

The nanoeconomics of firm-level decision-making and industry evolution: Evidence from 200 years of paper and pulp making

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Abstract

Research Summary: We explore the qualitative differences in entries and exits over time. Using qualitative and quantitative data on 96 firms over 200 years, we study industry evolution from the perspective of individual decision-making situations. Our historical and statistical analyses reveal the vital role of technology investments in determining firm outcomes, and the technological, institutional and governance dynamics that lead firms to invest or to abstain. Our main theoretical and methodological contribution concerns the importance of the multiplicity of firm-level rationalities and decisions as fundamentals in theorizing on industry evolution.

Managerial Summary: What determines firm outcomes in terms of acquisition, dissolution, and survival? This article answers this crucial question of strategy and elaborates on the extent to which the outcome is under top management control. Our findings highlight the importance of technology investments and we identify factors that make such investments possible and profitable. Our results emphasize that firms weighing options must assess the economic meaningfulness of generational technology investments which result in narrowing profit margins and intensifying competition. Another insight concerns the management of political risks. Long-term fluctuations in

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regulation and foreign trade policy make it hazardous to optimize to the contemporary political regime. Skillful strategists invest in geographical and technological complexity, which in combination increase the chances of survival in rapidly changing political regimes.

KEYWORDS

exit mode, industry evolution, nanoeconomics, paper and pulp industry, technology investment

1 | INTRODUCTION

How industries evolve and why they evolve as they do is a shared research interest at the intersection of strategy, business history, and economics. Scholars in strategy and economics typically look for generalizable patterns and consistent empirical evidence. These efforts have resulted in important theoretical insights concerning the causal links between firm-level strategy and industry-level evolutionary patterns (e.g., Klepper, 1996; Malerba, Nelson, Orsenigo, & Winter, 2008). In general, business historians have been interested in location and time-specific processes and often-anomalistic effects of historical and institutional contexts on industry evolution (e.g., Butzbach, 2018; Cain & Haddock, 2005). Our aim is to build on and complement these research traditions by studying the nanoeconomics of the decisions made by entrepreneurs and managers (Braguinsky & Hounshell, 2016).

We follow earlier leads from the intersection of industry evolution research and theories on governance (e.g., N. S. Argyres & Liebeskind, 1999; Malerba & Orsenigo, 2015) and institutions (Bjørnskov & Foss, 2016; North, 1990) which emphasize the importance of institutional dynamics and history in the study of industry evolution and entrepreneurial decision-making. We study the evolution of a nationally important population of firms in the Finnish paper and pulp industry—a population that has produced several of the world's largest paper industry companies (currently numbering three in the global top 10) and has been a global technological forerunner since the 1970s (Nykänen, Paulapuro, Stewart, & Maylett, 2005).

In our analysis, we trace the firm-specific pathways to survival and exit for the whole population of firms. On the surface, the evolution of the industry seems predictable, given sufficient knowledge of industry life-cycle theory and an overall understanding of the sources of competitive advantage (see Figure 1). However, in the early phase of our research, we identified several anomalies, including a substantial percentage of exits having a nonmarket explanation and the inability of industry-specific physical resources to protect a firm against exit. These anomalies motivated us to seek causal mechanisms for the understanding of nano-level decision-making situations along evolutionary pathways and why and how these pathways in aggregate produce the inverted u-shaped, macro-level evolutionary cycle predicted by industry life-cycle theory. Our findings corroborate the crucial role of technology investments in determining the fate of firms (cf. Jovanovic & Macdonald, 1994), but we also find institutional and governance-related explanations for those investment decisions. Subsequently, our research question is as follows: How and why does the interplay of historical contexts and firm-level decision-making aggregate into industry-level structural changes?

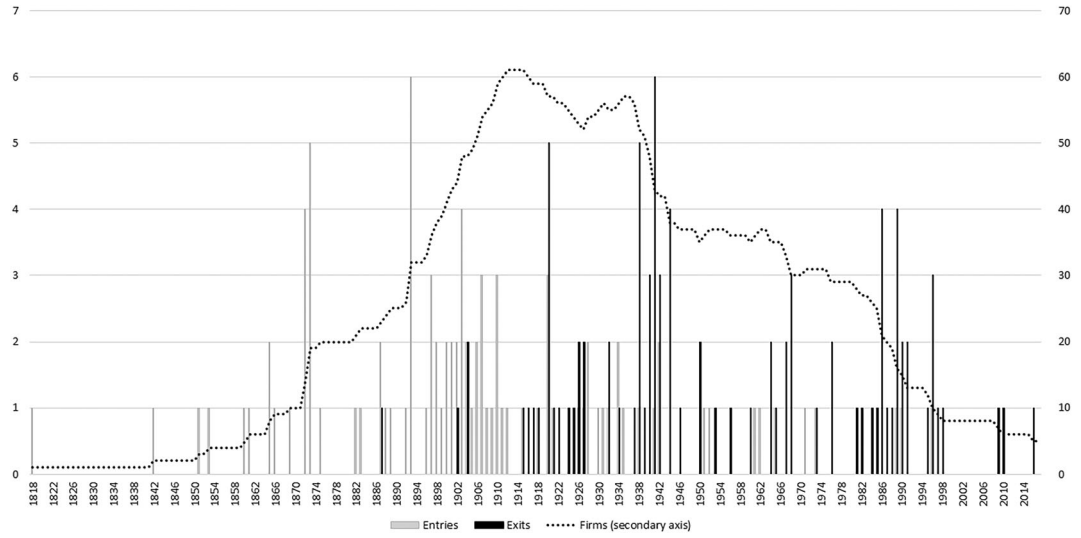

FIGURE 1 Entries, exits, and firms (firm numbers on the right-hand axis)

The main contributions of our research are as follows. First, our findings reveal that there are complex dynamics in play determining whether a firm makes investments or abstains. The division into investors and noninvestors is crisp, and plays a major role in determining firm outcomes. Second, we identify systematic differences in firms exiting via acquisition and dissolution: the physical and intellectual assets of acquired companies continue to contribute to the production capacity of the industry, whereas those of the dissolved companies truly exit the industry. Third, our findings contribute to the strategy literature by identifying growth in the diversity of the resource portfolio required to stay competitive. This adds a further facet of dynamism to the literature of dynamic capabilities: dynamic capabilities are not only used to build further resources but they may be used to facilitate the interchangeability of resources. Fourth, our findings emphasize the importance of the institutional and contractual environment as a mechanism that complements, and may even substitute, the effect of market competition in determining entries and exits. Decision-making rationalities and entrepreneurial opportunities dramatically vary in terms of both available options and risks depending on institutional dynamics. Fifth, we demonstrate the methodological value of combining historical research and quantitative nanoeconomic analysis. The reported research strategy can be seen as a model of how to avoid deductive determinism in industry evolution studies and instead start theorizing from firm-level rationalities to understand industry-level dynamics. Accordingly, we answer the call to qualitatively understand entries and exits throughout the industry life cycle (Peltoniemi, 2011) while simultaneously demonstrating the effects of history-specific institutional and governance dynamics in explaining individual decisions to invest or to abstain.

2 | ENTRIES, EXITS AND INVESTMENTS IN INDUSTRY EVOLUTION

Industry life-cycle theory explains the inverted u-shape curve of firm numbers with variation in the firms' ability and willingness to make technology investments and to increase production scale (Klepper, 1996; Klepper, 1997; Klepper, 2002). As the attractiveness of a new opportunity increases, firms with different characteristics enter, make different decisions on investments over time, and the

market tends to select the large, investing firms. Many empirical studies have confirmed the survival advantage of firms investing in technology and process innovation (e.g., Agarwal, 1996; Cefis & Marsili, 2006; Colombelli, Krafft, & Vivarelli, 2016). However, such studies do not offer explanations on the firms' different propensities to invest.

In addition, early entry and pre-entry experience have been widely confirmed to decrease the hazard of exit. The mechanisms explaining the prior finding include the ability of early entrants to preempt assets (Agarwal & Bayus, 2004) and to grow in a less crowded environment (Boschma & Wenting, 2007). Firms with experience in related industries, spin-offs and experienced entrepreneurs are consistently found to have a lower hazard rate (Agarwal, 1997; Agarwal & Bayus, 2004; Boschma & Wenting, 2007; B. Kim & Park, 2006; Klepper & Simons, 2000). Such experience has an effect on the technological choices (Sahaym, Howard, Basu, & Boeker, 2016) and strategic positioning (N. Argyres & Mostafa, 2016) of the entrants, allowing experienced firms and entrepreneurs to make better decisions at entry.[1]

Despite the important effects of firm characteristics on survival at different stages of industry evolution (Bayus & Agarwal, 2007; Chen, Williams, & Agarwal, 2012), research on what kinds of firms tend to enter at each stage remains scarce. There is evidence that early and late entrants tend to perform different kinds of innovations (Klingebiel & Joseph, 2016). This suggests that life-cycle stage may have an effect on the initial selection process of potential entrants. Even though the population of potential entrants is unobservable, conclusions may be drawn on the basis of differences in the characteristics of realized entries between life-cycle stages. By examining the differences in firm characteristics by entry cohort, we may gain insight into what kinds of firms have been able to enter at different stages of industry history.

Studies on exit usually treat all exits as equal. Some recent studies, however, have pointed out the difference between exit by dissolution and exit by acquisition. When firms exit by acquisition, their capabilities continue to play a role in industry evolution (Furr & Kapoor, 2018). The results obtained so far indicate that the selection into dissolutions and acquisitions is affected by investment in innovation: acquisition is more likely for investing firms (Boring, 2015; Cefis & Marsili, 2012; Furr & Kapoor, 2018). Such competing risks analyses indicate that the acquired firms differ from the dissolved ones, and therefore the survival–acquisition–dissolution selection process shapes the composition and population-level knowledge stock of the industry. However, these studies limit the analysis to the relationship of investment and exit mode, and exclude institutional and governance explanations of investment decisions.

In addition to the baseline explanation of entry and exit patterns via technological development and market dynamics, the effect of institutional changes is noted in many empirical and theoretical studies on industry evolution. Changing political regimes, for example, has been found to affect entry and exit patterns in established industries (Dobrev, 1999). More recently, attention has shifted to institutional barriers (Chang & Wu, 2014), as well as to buffering and enabling political ties (Zheng, Singh, & Mitchell, 2015), as factors dampening or modifying market selection forces in industry evolution.

While the fundamental role of institutions, or the "rules of the game" (North, 1990), is widely recognized across the social sciences and specifically in business history (e.g., Butzbach, 2018; Cain & Haddock, 2005; Malerba & Orsenigo, 2015), there is much less research in the field of strategy on how nano-level decision-making is motivated or constrained by institutions. Rare examples include

[1]In line with the resource-based view of the firm (Eisenhardt & Martin, 2000; Helfat & Peteraf, 2003), investments in technology and process innovation, pre-entry experience and early entry all contribute to the resource base of the firm which hence improve its chances of survival. As the industry evolves through stages, the required resources change (Dobrev, Kim, & Solari, 2004).

Murmann's (2003) findings on the different institutional settings of countries explaining the country-level variability in the growth and competitiveness of an industry population, and Braguinsky and Hounshell's (2016) work on the negative influence of government in the evolution of the Japanese cotton industry.

An element that is also relatively absent from industry evolution studies is institutional shocks: fast, unpredictable, larger-than-normal "windows of opportunities" (North, 1990) or threats that affect industry histories. Radical regulatory changes and exogenous shocks have been shown to affect industry structure in both emerging (Khanna & Palepu, 1999; Perez-Batres & Eden, 2008) and established industries (Corbo, Corrado, & Ferriani, 2016; Juravich & Mills, 2017). Accordingly, in the case of institutional shocks we may expect to see similar radical changes in firm behavior and, subsequently, entry and exit patterns. Building on these earlier theoretical premises and a few empirical studies, our aim is to study the effect of institutional shocks, positive and negative, on entries and exits, firm-level investment behavior and subsequent industry evolution.

Contracts and governance add a further layer of complexity to industry evolution. In Williamson's (2000) framework, the higher-order institutional mechanisms (e.g., norms, habits, laws, statutes, and policies) materialize through contractual arrangements between economic actors. Business groups, as an extreme form of contractual commitment between firms (Yiu, Lu, Bruton, & Hoskisson, 2007), have been found to affect management incentive practices (Banerjee & Homroy, 2018), cost of debt (Byun, Choi, Hwang, & Kim, 2013; He, Mao, Rui, & Zha, 2013), search behavior (Vissa, Greve, & Chen, 2010), and strategic adaptation (Campbell & Keys, 2002). Concerning our research, we assume that the role of business groups is crucial in contexts in which they have an institutionalized role, affecting entry and exit patterns in at least two ways. First, at the time of firm founding, business group membership may affect the first strategic decisions on market orientation and technology, and the availability of resources, which over time are imprinted (Sydow, Schreyogg, & Koch, 2009) as the firm's characteristics, explaining survival and exit patterns. Second, business group membership may filter market selection pressures differently, and affect the outcomes of group members and nonmembers.

2.1 | Research objectives

We explore the differences in characteristics of firms entering and exiting at different periods, and the role of investments and business group membership in determining exit mode. Thereafter, we quantitatively model the effects of investments, institutional shocks and business group membership on firm outcomes (dissolution, acquisition, survival). We also model the firm's propensity to invest. Finally, we reflect on our findings with the institutional changes embedded in the historical context.

3 | METHOD

The Finnish paper and pulp industry is suitable for the study of industry evolution for multiple reasons. First, the history and economics of the paper and pulp industry have been widely studied, which means that we had access to a vast amount of information on the evolution of the industry. Second, the industry has been well documented by contemporary sources, such as industry calendars and professional periodicals, making it possible to trace chains of events over extended periods. Third, the overall population of the paper and pulp industry firms is both small enough for detailed nano-level analysis and yet sufficiently heterogeneous to yield rich theoretical insights. Finally, due to the highly organized nature of archives and libraries in Finland, we have been able to collect

material covering all 96 firms in our database. Table A in the online appendix presents the use of these sources according to the analytical categories we employed in our research.

3.1 | Life histories

We began our analysis by identifying all the firms that have engaged in pulp and/or paper production in Finland, and by building a time series covering the industry evolution embedded in market contexts: entry and exit dates, technological progress, production figures and demand for different products. We wrote life histories for all 96 firms, focusing especially on the motivations for entry and exit. This information is typically not listed in industry calendars. Our work thus came to resemble that of detectives and historians, as we sought information from history books, stock ownership news, local histories, newspaper interviews, biographies of industrialists and company archives to obtain satisfactory knowledge of the entry and exit dynamics of the studied firms. The life histories are narratives of one to three pages. They include information on the motivations and pre-entry experience of the founders, the firms' characteristics at entry, the evolution of equity ownership, major strategic changes, links with commercial banks and other institutions, and chronologies and descriptions of exit processes.

In the next step, we sought information on major technology investments from the professional periodicals *Suomen paperi- ja puutavaralehti* and *Paperi ja Puu*. These two periodicals, published by the Association of Finnish Paper Engineers, include detailed information on new machines, technologies and investments. In addition, we triangulated this information with the database of paper machines in Finland (Lund, 1999) and from heterogeneous sources in the case of a few anomalies.

3.2 | Coding procedures

After we wrote the life histories and a complete series of technology investments, we began coding the variety of motivations for entries and exits. Each firm was coded with one or more entry incentive and exit explanation.[2] We proceeded with open coding, and created new categories of entry incentives and exit explanations as we went through the life histories. During the coding process, we noticed missing information for some firms. Therefore, we continued with an additional data collection round to ensure that the data were commensurate for all firms to the extent possible with historical research. In practice, there was more information available for large, long-lived firms than for small firms that exited in the 19th century. To control this bias, we performed specific fact-finding missions on the firms with less information. We then combined the categories to arrive at our aggregate entry incentives and exit explanations, as specified in Tables 2 and 3.

We identified two types of exit: exit by acquisition and exit by dissolution (cf. Fortune & Mitchell, 2012). With the former, we examined each merger to determine the acquirer and the acquired. In most cases, this was straightforward due to the continuity of firm names and because of the size differences between the firms. For the more difficult cases, we used continuity in the management team and the post-acquisition headquarters address as the determinants of the acquirer. The dissolutions took place either by filing for bankruptcy or by closing of operations. We combined the operational and ownership views of survival (cf. Josefy, Harrison, Sirmon, & Carnes, 2017). For the purposes of this study, survival consisted of continuing operations without a change in majority ownership.

[2]There were eight firms for which we did not find satisfactory information on exit explanation. Most of the eight were small firms, which made an early exit and left a minimal document trail for the use of historical research.

To evaluate the role of technology investments in subsequent exit behavior, we chose five technological advancements that have been of great importance in this industry: (a) the transition from sulfite to sulfate process in pulp production, (b) the kraft paper machine, (c) the supercalender for smoothing the surface of the paper, (d) the newsprint machine, and (e) magazine paper coating (see Online Appendix G for description of each). We chose these after a careful reading on each, discussions with industry practitioners, and ensuring that our data cover their introduction within the firms. All of them are technologies that mainstream companies would have needed to adopt to remain competitive. The first one became virtually mandatory by law during the 1960s and 1970s. The third was mandatory to continue producing paper that was acceptable for printing purposes. Investments 2, 4, and 5 relate to specific but common products with growing markets during the studied period. For each company, we traced which of these investments they made and when production based on the investment began. We used the production launch date because investment projects can have long durations and comprise many rounds of decision-making. Therefore, the start of production was the aspect for which we have the most reliable and commensurate information. In order to analyze noninvestment decisions as well, we went through the noninvesting exiting firms and coded their reasons for not investing.[3]

3.3 | Assessment of the historical approach

Our study follows the critical realist (Vaara & Lamberg, 2016) and analytical tradition in the historical study of strategy. To assess the quality of our analysis we followed earlier exemplary historical studies (e.g., Danneels, 2011; Golder & Tellis, 1993; Jacobides, 2007) and methodological guidelines for conducting historical studies (e.g., Carr, 1961; Gill, Gill, & Roulet, 2018; Gottschalk, 1969). Especially, we focused on the following attributes from the framework by Gill et al. (2018): credibility, confirmability, dependability, and transferability. First, to strengthen the credibility of our research we engaged in source criticism by analyzing and weighting sources and data points according to the context in which the sources were created and who or what organization had created the content. Second, to test the confirmability of our interpretations and observations, we openly cite earlier historical work and sources and use footnotes to reveal underlying assumptions and to "[…] ensure interpretations are grounded in evidence" (Gill et al., 2018: 195). Third, we developed the dependability of our research in multiple ways. Beyond triangulation (the expected norm in historical research, Kipping, Wadhwani, & Bucheli, 2014), we used different analytical techniques ranging from statistical models to micro-historical analysis of specific episodes (Vaara & Lamberg, 2016). Finally, we presented our results and data visualizations in multiple workshops and seminars in which experts of paper and pulp industry history gave comments and helped us to evaluate the strength of alternative explanations and frameworks. Fourth, we put extra emphasis on transferability of our research. Instead of simply presenting the results of our statistical research we embedded our findings on broader historical narrative of the industry and societal context and also, discussed other contexts with similar institutional and historical dynamics as in our study setting.

4 | HISTORY OF FINNISH PAPER AND PULP INDUSTRY

4.1 | Entries

Table 1 presents the factors that encouraged the firms to enter in different years. Based on the incentives to enter, we can summarize a proposition relating to the variation in characteristics between the

[3]There were two firms for which a satisfactory explanation of not investing was not found.

TABLE 1 Cross-tabulation of entry incentives per period

Period	Entries	% of total	Hydro		Experience		Synergy		Social capital		Tangible resources		Industrial policy		Internal funds	
Pre-Russian tariffs (−>1885)	22	23%	16	73%	6	27%	5	23%	5	23%	7	32%	0	0%	13	59%
Pre-WW1 (1886–1913)	43	45%	22	51%	11	26%	5	12%	9	21%	14	33%	1	2%	16	37%
Pre-WW2 (1914–1938)	17	18%	2	12%	2	12%	4	24%	4	24%	5	29%	2	12%	6	35%
Post-WW2 (1939–1972)	10	10%	1	10%	0	0%	3	30%	0	0%	4	40%	2	20%	3	30%
Post-EEC (1973 ->)	4	4%	0	0%	0	0%	2	50%	0	0%	1	25%	2	50%	0	0%
Total	96	100%	41	43%	19	20%	19	20%	18	19%	31	32%	7	7%	38	40%

entry cohorts. First, we observe that tangible resources and synergy were the only entry incentives that remained important throughout the history of the industry. Tangible resources include access to inputs including proximal woodlands, railways, and water channels. Synergy relates to the entrepreneur's decision to begin pulp production to use waste from a sawmill or to begin paper production to ensure inputs for a preexisting envelope factory, for example. Second, hydropower was a critical resource up to the Second World War until technological change rendered other sources of electricity viable.

Third, internal funds were a common entry incentive throughout the period, but with a decreasing trend. As the industry emerged, the initial investment required to begin operations was possible mostly only for entrepreneurs with inherited wealth, wealth through marriage, or wealth accumulated gradually through increasingly large entrepreneurial operations. This is a symptom of an underdeveloped financial market, where entrepreneurial ventures were financed mostly by the immediate family. It also means that entries were not subject to market selection, where the most promising operations would have been funded by the financial market. Funding was heavily tied to the individual and not necessarily dependent on the quality of the planned operation.

The fourth observation relates to pre-entry experience and social capital, both of which were common entry incentives until the Second World War. Pre-entry experience comprised of prior industrial operations such as sawmills, ironworks and preexisting domestic and international trade activities. Social capital, on the other hand, consisted of local political ties, collusion arrangements among entrepreneurs, relationships with paper machine manufacturers, and business relationships with trade houses in St. Petersburg. The importance of experience and social capital indicates the underdevelopment of both upstream and downstream markets. It was difficult to buy experience in the form of professionals.[4] Therefore, entry opportunities were to an extent limited to those with experience or links to a specialist job market, for example, in what was then the German Confederation and later the German Empire. The way in which society was arranged in terms of requiring permits from the Russian imperial establishment for beginning industrial operations further limited the population of entrepreneurs able to enter the industry. As society modernized in education opportunities and more democratic treatment of potential entrepreneurs, pre-entry experience and social capital took on smaller roles.

Finally, industrial policy became a factor in entry only in the 1930s. Therefore, the government did not play an active role in the creation of the industry and its technological basis. The few government-led operations all eventually exited due to the low profitability built into their locational and product-mix choices (cf. Braguinsky & Hounshell, 2016). This is not surprising, because the location choices of the government-led firms were mainly driven by regional differences in unemployment.

Proposition 1: *The entry advantage given by internal funds, pre-entry experience, social capital, and hydropower decrease over time due to institutional and technological changes while the importance of tangible resources and synergy transcend the institutional and technological changes.*

[4]The lack of professionals is explained by the underdevelopment of engineering education at the time. The first polytechnic in Finland, founded in the 1870s, focused on general engineering, geodetics and architecture. The Association of Paper Engineers was founded only in 1914 with 51 members. The first Finnish textbook on papermaking was published in 1933 by the Association. Moreover, due their remote locations, it was challenging for most Finnish firms to attract paper engineers from abroad and, if they were found, the risk of losing them to competitors was high.

4.2 | Exits

The explanations for exit are presented in Table 2. Based on these observations, we can summarize three propositions concerning the factors increasing the likelihood of exit. The inability to invest and family trouble remain nontrivial throughout the history of the industry. Certain investments were necessary to remain competitive over the years. These related to both product quality and the cost structure of production. Moreover, tightening environmental legislation in the 1960s and 1970s made the transition from sulfite to sulfate pulp processes practically mandatory. Companies that did not have access to funding, or if there was unwillingness to invest for some other reason, were either acquired or closed. Family trouble, such as the lack of a suitable successor or disagreements among the owning family, played a nontrivial role in exits throughout the period, being a factor in 10% of the exits.

Second, the resource-driven acquisitions were performed mainly in the period prior to the Second World War to gain access to woodlands and hydropower owned by the acquisition target. This means that firms were not necessarily acquired because of their milling capacity. This logic is confirmed by the fact that many acquired mills were closed shortly after acquisition (e.g., Strömsdals Bruk, acquired in 1915; Kissakoski Aktiebolag, in 1922; and Halla Aktiebolag, in 1932), and the available wood material was directed to the acquirer's other mills. The institutional explanation for the timing of such acquisitions was the legislation passed in 1915 banning the purchase of woodland by paper producers. In order to circumvent the new law, the firms acquired companies that owned woodlands. Moreover, some acquisitions were motivated by hydropower: the mill was closed, but the acquirer continued to operate hydropower and sell the electricity (e.g., Kaltimo Träsliperi).

In the later stages, the focus shifted to the buyer's motivation to respond to globalization. In order to face global competition, the firms had to take advantage of economies of scale. Building and operating an international network of sales offices on the margin earned from a single mill's output was not possible. Globalization also brought new legislation concerning cartels, which made it increasingly difficult for firms to collude in pricing from the 1980s onwards. This triggered acquisitions as cartel members organized into a single firm.

The fourth observation relates to portfolio optimizations taking place mostly between the First World War and the European Economic Community (EEC) agreement. Even though the financial markets had begun to function, funding decisions included a component of political control. In many cases, commercial banks made decisions on which mills could continue as independent firms. As legislation did not prevent banks from owning large shares of listed companies, the de facto power to sell, acquire and merge lay with financial institutions, including the Finnish government. This era of banks optimizing their portfolios ended as legislation limiting equity ownership by banks was gradually introduced. Finally, force majeure exits took place mainly during or after the two world wars, due to either the war closing export markets or facilities being damaged in the war. The few force majeure exits not related to the wars were due to fires or other accidents. It is noteworthy that 19% of the exits have such a nonmarket explanation.

Proposition 2a: *Inability to invest and family trouble transcend the technological and institutional changes taking place over time as explanations for exit.*

Proposition 2b: *Motives for acquisition shift from resource control to portfolio optimization to globalization over time, thereby reflecting changes in legislation and market competition.*

Proposition 2c: *Major external shocks, such as the world wars, played a large role in triggering exits.*

TABLE 2 Cross-tabulation of exit explanations per period

Period	Exits	% of total	Force majeure		Inability to invest		Family trouble		Control resources		Globalization		Portfolio optimization	
Pre-Russian tariffs (1885)	0													
Pre-WW1 (1886–1913)	4	4%	0	0%	1	25%	0	0%	0	0%	3	75%	0	0%
Pre-WW2 (1914–1938)	26	29%	8	31%	6	23%	1	4%	10	38%	7	27%	7	27%
Post-WW2 (1939–1972)	31	34%	8	26%	7	23%	5	16%	2	6%	9	29%	7	23%
Post-EEC (1973 ->)	30	33%	1	3%	8	27%	3	10%	2	7%	22	73%	1	3%
Total	91	100%	17	19%	22	24%	9	10%	14	15%	41	45%	15	16%

4.3 | Investments

The investment activity of the firms results in three observations. First, the investments cluster in certain firms. Of the 96 firms traced, only 42% made any of the five major investments. However, out of those who made the first additional investment, 50% also made a second, and out of those who made the second, 80% also made a third. The numbers for the fourth and fifth investments are 50% and 75%, respectively. This indicates that firms were more likely to continue further investment activity than they were to start it. Detailed data on the timing of the investments is presented in Table B in the online appendix.

Our second observation relates to exit modes (see Table 3). There are 25 firms that exited by dissolution. None of them made any of the five technology investments. There are 66 firms that exited via acquisition, and 55% of them made at least one further investment. It appears that keeping up with competitors in the adoption of new technology did not improve a company's chances of survival, but it helped a firm to remain a viable candidate for acquisition. Out of the 55 exiting firms that did not invest, 30 were acquired (55%). Out of the 36 exiting investing firms, 100% were acquired. Even though a significant number of noninvesting firms were acquired, technology investments raised the probability of acquisition to 100% of exits.

The third observation is about the surviving firms. There still are five firms in operation. Although Stora-Enso, UPM and M-Real have changed their names and merged several times, they all originate from firms that were large conglomerates already in the 1920s (Enso-Gutzeit and UPM/Kymi) or 1950s (Metsä-Serla). All the surviving firms have extensive histories of both technology investments and acquiring firms that made technology investments at a prior date. In other words, they have been in the position to choose plants that were technologically at an acceptable level while making heavy investments at the same time. It appears that acquiring firms after investments may have been a method of managing risk with inherently uncertain new technologies.

Proposition 3a: *Investments show friction, meaning that starting investments requires more favorable circumstances than continuing them.*

Proposition 3b: *Technology investments increase the likelihood of acquisition, and hence they play a major role in separating firms into acquisitions and dissolutions.*

Proposition 3c: *High level of activity concerning both investments and acquisitions attributes surviving firms.*

TABLE 3 Investments and exit modes

	Total	Dissolved		Acquired		Survived	
Firms	96	25	26%	66	69%	5	5%
No investments	56	25	45%	30	54%	1	2%
1 investment	20	0	0%	20	100%	0	0%
2 investments	4	0	0%	4	100%	0	0%
3 investments	8	0	0%	7	88%	1	13%
4 investments	2	0	0%	1	50%	1	50%
5 investments	6	0	0%	4	67%	2	33%

4.4 | Business groups

An analysis of the evolutionary pathways (see Online Appendix F) reveals that an important part of exits took place inside sub-populations controlled by the Finnish government and large commercial banks. In addition, as the majority of firms belonged to sales cartels from the early 1920s to the mid-1990s, their evolution was to a large degree determined by contractual commitments (e.g., who produced what and how much) that were beyond the control of smaller firms. Accordingly, the evolutionary mechanisms concerning a large share of firms were powerfully guided by contracts and interdependencies in sub-populations and cartel agreements. Online Appendix E illustrates the contractual constraints buffering firms from market competition and institutional shocks. Table 4 presents the cross-tabulation of member and nonmember dissolutions and acquisitions per period. Of the 29 group member exits, only 1 took place via dissolution whereas of the 62 nonmember exits 24 took place via dissolution.

It is important to note that although the business groups buffered and modified market competition, they simultaneously made evolution politically adjusted and beneficial, especially for the survival and growth of the flagship firms. For smaller firms inside the business groups, the situation was more complex. They were able to access financial resources and potentially professional ownership from the banks and other owners (cf. Byun et al., 2013; H. Kim, Hoskisson, Tihanyi, & Hong, 2004), but they also easily became pieces in the strategy game inside and between the business groups. For the relatively large number of firms outside the business groups, the evolutionary struggle was harsher. They typically had less access to financial resources to stay in the investment race, and they were vulnerable to institutional shocks and market dynamics.

Proposition 4a: *As a result of intra-group decision-making, business group members are more likely to exit by acquisition than are other firms.*

Proposition 4b: *Due to better availability of funding and professional decision-making skills, business group members are more likely to invest than are other firms.*

5 | QUANTITATIVE ANALYSES

To provide more precision for our historical observations, we performed hazard regressions on exit, exit modes, and investments. The population consists of 96 firms. The first entry is in 1818. Of the firms, 91 exited and five continue to operate at the end of 2017. There are two exit modes: 25 firms exited by dissolution and 66 exited by acquisition (63 were acquired by other firms in the studied population). The exiting firms survived for 50.3 years on average. We follow each firm from founding to exit—or, in the case of survival, up to 2017—and organize the observations into yearly spells.

5.1 | Measures

5.1.1 | Dependent variables

In the first group of models (1.1–1.6), the dependent variable is the exit. The surviving firms are right-censored at the end of 2017. In the second group of models (2.1–7.2), there are two possible

TABLE 4 Cross-tabulation of group member and nonmember exit modes per period

Period	Exits	Dissolutions	Member dissolutions	Nonmember dissolutions	Acquisitions	Member acquisitions	Nonmember acquisitions
Pre-Russian tariffs (-> 1885)	0	0	0	0	0	0	0
Pre-WW1 (1886–1913)	4	1	0	1	3	0	3
Pre-WW2 (1914–1938)	26	7	0	7	19	6	13
Post-WW2 (1939–1972)	31	14	1	13	17	7	10
Post-EEC (1973 ->)	30	3	0	3	27	15	12
Total	91	25	1	24	66	28	38

outcomes: dissolution and acquisition. In the third group of models (8.1–9.3), the dependent variable is investment. Our data include up to five investments per firm. Due to attrition bias, we limit the analysis to the first two investments per firm. We estimate the determinants of the first investment using the whole population, and the determinants of the second investment by analyzing the firms that made the first investment. This allows us to see whether the explanatory mechanisms for starting and continuing with investments differ.

5.1.2 | Covariates

Cohort 1 includes firms that entered before 1886. Cohort 2 includes entrants between 1886 and 1913, cohort 3 between 1914 and 1938 and cohort 4 from 1939 onwards.

PhysRes, KnowRes, and MonRes record firm resources at entry as binary variables. Physical resources are coded as 1 if the firm controls woodland and/or hydropower at the time of entry. Knowledge resources are coded as 1 if the entrepreneur has prior experience from related businesses or prior connections with machine makers or other relevant business partners. Thus, this is a measure of pre-entry experience. Monetary resources are coded as 1 if the entrepreneur has access to family wealth or has accumulated personal wealth through prior entrepreneurial endeavors. The resource variables are time-invariant.

InvCount is a count variable that accounts for the timing of five technological investments. It ticks up the year the new technology is used in production. It is possible to make more than one investment in a single year, and therefore InvCount can increase by more than one per year. The acquirer inherits the investments of the acquisition target.[5]

AcqCount is a count variable that records the number of acquisitions the firm has made. The count variable ticks up on the year of the transaction. Prior acquisitions of the acquired firm do not have an effect on this variable. Both InvCount and AcqCount are time-variant.

MemberGroup is a binary variable that is coded 1 if the firm is a member of a business group in that year. LargestGroup is a binary variable that is coded as 1 if the firm is the largest firm in its business group (i.e., flagship firm) in that year. Both MemberGroup and LargestGroup are time-variant, even though changes are rare.

GDPGrowth captures the growth in GDP in the UK and Germany. These countries were chosen because they were important export destinations for Finnish firms throughout the time frame of the study. The data are taken from the Maddison project database hosted by the University of Groningen

[5]If the acquisition target is making kraft paper and the acquirer is not, the acquirer's InvCount ticks up in the year of the acquisition. If the acquirer is already making kraft paper, then the acquisition of another kraft paper producer does not change the acquirer's InvCount.

(Maddison Project Database, 2018). To arrive at our variable, we sum the *RGDPNApc* variable for both countries each year and find the percentage growth, comparing the sum at *t* and at *t-5*. If the growth is 0.05524, the number used in the analysis is 5.524.

PosShock and NegShock are binary variables that are coded as 1 for the years of major institutional shocks, positive or negative, as detailed in Table C in the online Appendix. Major shocks are modeled to be in effect for 5 years and minor shocks for 3 years. GDPGrowth, PosShock, and NegShock are time-variant.

For the regressions on investment, we use a three-year time lag in relation to the environmental variables. The years when investments take place are determined based on when production with the new technology began. The decision for the investment has therefore taken place earlier. For an investment completed at time *t*, we use the values of *t-3* for GDPGrowth, PosShock, and NegShock. Descriptive statistics and correlations for all variables are shown in Table 5.

5.2 | Cox proportional hazards regression on exit

In order to study the determinants of exit, we use a Cox proportional hazards model (Cox, 1972). The hazard rate of exit at time *t*, $h(t)$ is as follows:

$$h(t) = h_0(t)\exp[\beta X(t)]$$

where $h_0(t)$ is a baseline function shared by the population and $X(t)$ is a vector of covariates that vary across firm-year observations. The results in Table 6 indicate that later entry cohorts are more likely to exit, and that monetary resources can protect a firm from exit. Moreover, both positive and negative shocks have a positive effect on exit even though they are not highly significant. However, we do not find that other resources, investments or acquisitions protect a firm from exit. We conjecture that this is because the effects are different for acquired and dissolved firms. To study this, we next use a competing risks model.

5.3 | Competing risks of dissolution and acquisition

In order to study the determinants of the exit mode, we use the proportional sub-hazards model presented by Fine and Gray (1999). The hazard of cause *i* at time *t* can be written as:

$$h_i(t) = h_{i,0}(t)\exp[\beta X(t)]$$

in which $h_{i,0}(t)$ is a baseline function that may vary across the competing risks (i.e., exit modes). This means that the cause-specific, cumulative incidence curves may cross over time. The Fine and Gray model takes into account the fact that the hazards of different exit modes are dependent: exiting by dissolution means that a given firm can no longer exit by acquisition.

The results in Table 7 are reported separately for the competing risks of dissolution and acquisition. Compared to the first group of models, we see stronger and more significant effects. First, investments have a strong, but opposite, effect on the propensities of the exit modes. Each investment doubles the likelihood of acquisition, and even just one investment renders the likelihood of dissolution minimal confirming Proposition 3b:. Moreover, physical and monetary resources each reduce the chances of dissolution to a third of those without such resources. This

TABLE 5 Descriptive statistics

Variable	Mean	Std. Dev.	Min	Max	1	2	3	4	5	6	7	8	9	10	11
1 Cohort	1.971864	.8597591	1	4	1.0000										
2 PhysRes	.5996989	.4899824	0	1	−0.2664	1.0000									
3 KnowRes	.2230168	.4162891	0	1	−0.1694	0.1623	1.0000								
4 MonRes	.4608074	.498485	0	1	−0.1373	0.1434	0.1206	1.0000							
5 InvCount	.5215018	1.012339	0	5	0.1867	0.0301	0.0083	0.1806	1.0000						
6 AcqCount	.3680248	1.150441	0	10	0.0977	0.0006	−0.0307	0.0960	0.7020	1.0000					
7 MemberGroup	.1305166	.3368868	0	1	0.1491	0.0811	0.0159	0.0111	0.3186	0.3476	1.0000				
8 LargestGroup	.0323704	.1769901	0	1	0.1631	0.0420	0.0170	−0.0496	0.4673	0.6717	0.4579	1.0000			
9 GDPGrowth	7.033055	12.84467	−54.66	24.84	0.0486	−0.0143	−0.0088	−0.0496	0.0440	0.0171	0.0127	0.0176	1.0000		
10 PosShock	.3085537	.4619182	0	1	0.0821	−0.0272	−0.0148	−0.0168	0.0616	0.0362	0.0164	0.0309	−0.0204	1.0000	
11 NegShock	.5550955	.4969786	0	1	0.0687	−0.0234	−0.0085	−0.0221	0.0512	0.0349	−0.0208	0.0011	−0.2972	0.0381	1.0000

TABLE 6 Results of Cox regression on exit

Variable	Model 1.1	Model 1.2	Model 1.3	Model 1.4	Model 1.5	Model 1.6
Cohort						
2	3.380326	3.366009	3.314703	3.331159	3.318699	3.258499
	(.000)	(.000)	(.000)	(.000)	(.000)	(.000)
3	3.639884	3.782541	4.254734	4.430268	4.479972	4.393421
	(.001)	(.002)	(.002)	(.002)	(.001)	(.002)
4	3.922451	4.06779	3.884017	4.606134	4.559187	3.984274
	(.001)	(.001)	(.002)	(.002)	(.001)	(.002)
PhysRes		1.148612	1.351903	1.315148	1.345428	1.235428
		(.555)	(.211)	(.246)	(.215)	(.406)
KnowRes		0.6732881	0.7162606	0.7364927	0.7139471	0.7206605
		(.159)	(.203)	(.239)	(.201)	(.210)
MonRes		0.7393376	0.6709902	0.6746862	0.7016024	0.6648648
		(.157)	(.064)	(.071)	(.100)	(.064)
InvCount		0.9273832	1.237194	1.001397	0.9858412	1.14721
		(0.497)	(0.165)	(0.996)	(0.944)	(0.428)
AcqCount			0.8673775	0.8490557	0.8261542	0.8699787
			(.477)	(.431)	(.362)	(.481)
MemberGroup			0.7558756	0.7681863	0.5699167	0.7584361
			(.316)	(.341)	(.092)	(.320)
LargestGroup			0.4368991	0.4840926	0.3614896	0.3869432
			(.432)	(.492)	(.313)	(.404)
InvCount ×				1.434948		
PosShock				(.117)		
InvCount ×				0.9545894		
NegShock				(.801)		
InvCount ×					1.460394	
MemberGroup					(.096)	
InvCount ×						1.151573
PhysRes						(.441)
GDPGrowth	1.016854	1.016915	1.017019	1.015941	1.017108	1.016683
	(.082)	(.082)	(.094)	(.114)	(.094)	(.093)
PosShock	1.280512	1.305038	1.302747	0.9250356	1.264664	1.295229
	(.281)	(.252)	(.257)	(.837)	(.333)	(.271)
NegShock	1.338302	1.338048	1.36108	1.417999	1.375299	1.372646
	(.196)	(.192)	(.180)	(.199)	(.162)	(.173)
Model X^2	28.24	33.34	41.37	47.50	51.83	40.60
	(.0001)	(.0002)	(.0001)	(.0000)	(.0000)	(.0002)
n	5,017	5,017	5,017	5,017	5,017	5,017

Note: The table gives hazard ratios (*p* values in parentheses), *n* gives the number of firm-year observations, Efron method for ties, robust standard errors.

TABLE 7 Results of competing risks regressions on dissolution and acquisition

Variable	Model 2.1 Dissolution	Model 2.2 Acquisition	Model 3.1 Dissolution	Model 3.2 Acquisition	Model 4.1 Dissolution	Model 4.2 Acquisition	Model 5.1 Dissolution	Model 5.2 Acquisition	Model 6.1 Dissolution	Model 6.2 Acquisition	Model 7.1 Dissolution	Model 7.2 Acquisition
Cohort												
2	4.421798	0.7550364	3.838115	1.231766	4.289434	1.029722	4.289434	1.002046	4.289434	1.046437	4.289434	1.06752
	(.044)	(.293)	(.071)	(.502)	(.054)	(.925)	(.054)	(.995)	(.054)	(.888)	(.054)	(.837)
3	4.720571	0.6258048	5.37495	0.7605325	5.967663	0.8505621	5.967663	0.8119646	5.967662	0.901326	5.967663	0.8130314
	(.049)	(.205)	(.048)	(.572)	(.036)	(.714)	(.036)	(.638)	(.036)	(.813)	(.036)	(.650)
4	0.9028971	1.391878	4.544516	0.9291526	4.937308	0.8214962	4.937307	0.8170033	4.937307	0.7533294	4.937308	0.8025713
	(.933)	(.351)	(.243)	(.879)	(.222)	(.679)	(.222)	(.677)	(.222)	(.538)	(.222)	(.641)
PhysRes			0.3280171	1.508375	0.3112689	1.510863	0.3112689	1.455966	0.3112689	1.579914	0.3112689	1.792557
			(.008)	(.162)	(.007)	(.173)	(.007)	(.220)	(.007)	(.140)	(.007)	(.120)
KnowRes			0.8423652	0.853845	0.9297485	0.8797282	0.9297485	0.8860467	0.9297485	0.8680001	0.9297485	0.8805463
			(.757)	(.605)	(.887)	(.667)	(.887)	(.681)	(.887)	(.642)	(.887)	(.663)
MonRes			0.3450189	1.486211	0.3008411	1.280999	0.3008411	1.315848	0.3008411	1.140238	0.3008411	1.293206
			(.031)	(.175)	(.024)	(.396)	(.024)	(.359)	(.024)	(.662)	(.024)	(.381)
InvCount			6.88e−08	1.569028	3.01e−08	2.121482	3.77e−08	2.001913	1.40e−08	2.736909	1.36e−08	2.346281
			(.000)	(.000)	(.000)	(.000)	(.000)	(.001)	(.000)	(.000)	(.000)	(.000)
AcqCount					3.048616	0.77988	3.048615	0.7648537	3.048616	0.8116909	3.048616	0.7888491
					(.231)	(.114)	(.231)	(.098)	(.231)	(.194)	(.231)	(.140)
MemberGroup					0.2555249	1.645844	0.2555249	1.705092	0.2555249	2.323017	0.2555249	1.650508
					(.228)	(.084)	(.228)	(.065)	(.228)	(.012)	(.228)	(.083)
LargestGroup					1.68e−07	0.2698413	1.66e−07	0.2971956	1.22e−07	0.3288722	1.53e−07	0.2674573
					(.000)	(.152)	(.000)	(.196)	(.000)	(.232)	(.000)	(.136)
InvCount ×							0.8708756	1.172				
PosShock							(.829)	(.345)				
InvCount ×							0.7139824	0.9222721				

TABLE 7 (Continued)

Variable	Model 2.1 Dissolution	Model 2.2 Acquisition	Model 3.1 Dissolution	Model 3.2 Acquisition	Model 4.1 Dissolution	Model 4.2 Acquisition	Model 5.1 Dissolution	Model 5.2 Acquisition	Model 6.1 Dissolution	Model 6.2 Acquisition	Model 7.1 Dissolution	Model 7.2 Acquisition
NegShock							(.604)	(.653)				
InvCount ×									25.21183	0.662341		
MemberGroup									(.021)	(.013)		
InvCount ×											6.66287	0.8391758
PhysRes											(.050)	(.287)
GDPGrowth	1.034113	1.021947	1.032562	1.019219	1.03412	1.017961	1.03412	1.017841	1.03412	1.017308	1.03412	1.018429
	(.311)	(.039)	(.295)	(.074)	(.293)	(.094)	(.293)	(.099)	(.293)	(.094)	(.293)	(.090)
PosShock	0.7667805	2.427434	0.7491326	2.224088	0.8279804	2.034304	0.8279805	1.720453	0.8279804	1.99332	0.8279803	2.034529
	(.627)	(.001)	(.596)	(.002)	(.739)	(.005)	(.739)	(.115)	(.739)	(.006)	(.739)	(.005)
NegShock	1.316195	1.978037	1.393277	1.909736	1.430629	1.976534	1.430629	2.211385	1.430629	1.899397	1.430629	1.919867
	(.525)	(.012)	(.453)	(.014)	(.421)	(.010)	(.421)	(.013)	(.421)	(.016)	(.421)	(.014)
Model X^2	12.22	29.82	2,420.12	74.50	2,319.63	130.30	2,386.38	133.46	3,086.41	116.73	2,853.93	128.61
	(.0572)	(.0000)	(.0000)	(.0000)	(.0000)	(.0000)	(.0000)	(.0000)	(.0000)	(.0000)	(.0000)	(.0000)
n	8,927	6,717	8,927	6,717	8,927	6,717	8,927	6,717	8,927	6,717	8,927	6,717

Note: The table gives sub-hazard ratios (*p* values in parentheses), *n* gives the number of firm-year observations (the different number of observations for the dissolution and acquisition models is due to how the Fine and Gray method handles censorings. The firms exiting by a competing event remain in the risk pool up to 2017), robust standard errors.

means that resource-owning firms tend to be acquired or to survive. Physical resources strengthen the protective effect of investments against dissolution and reduce their positive effect on acquisition. The latter signals that investments are not as critical for physical resource-owning firms to be acquired as they are for other firms. Business group members are about 70% more likely to be acquired, confirming Proposition 4a:. For group members, the protective effect of investments against dissolution is stronger than for other firms whereas the positive effect of investments leading to acquisition is weaker. The latter signals that investments are not as critical for group members to be acquired as they are for other firms. Both positive and negative shocks double the chances of acquisitions (both significant), whereas positive shocks have a negative effect on dissolution and a positive one on acquisition (neither significant). These provide support for Proposition 2c:. Based on these models, we conclude that investments have the strongest effect in determining exit mode. Next, we continue to examine what kinds of firms tend to make investments.

5.4 | Determinants of investment activity

In order to study the determinants of investment, we used a Cox proportional hazards model. Initially, we analyze the first additional investment. Observations end at the time of the first investment or, in the case of noninvesting firms, at exit. Next, we analyze the second investment. For this, we include only the firms that made the first investment. Observations begin at the time of the first investment, and they end at the time of the second investment or exit.

The results in Table 8 indicate that the determinants for the first and the second investment differ. Positive shocks almost double the likelihood of first investment, but have little effect on the second investment, thereby supporting Proposition 3a:. Negative shocks appear irrelevant in both cases. Monetary resources have a positive effect on the first investment, whereas physical resources and acquisitions have a positive effect on the second investment. Investments tend to increase the scale of production, and continuing with the investment path requires secure sources of raw material. The positive effect of acquisitions means that acquisitions and investments cluster into the same firms, which confirms Proposition 3c:. Group membership increases the likelihood of both investments, confirming Proposition 4b:. In terms of entry timing, the latest cohort is the most likely investor. This signals industry-level learning: later entrants are able to make more optimal choices at entry and therefore further investments are evaluated as being more profitable.

6 | FINDINGS EMBEDDED IN HISTORICAL CONTEXTS

The historical context of our study can be divided into three institutional regimes (cf. Malerba & Orsenigo, 2015). The *Russian regime* was in place as the industry emerged and ended with the aftermath of the First World War. As Finland gained its independence in 1917, the institutional environment shifted to the *Finnish regime*. During the 1970s, Finland began to take steps toward European integration and gradually entered the *European regime*. These regimes comprise different trends in trade policy, legislation and legitimate business practices. In the following section, we interpret our findings embedded in historical contexts and

TABLE 8 Results of Cox regressions on the first and second investment

	Model 8.1	Model 8.2	Model 8.3	Model 9.1	Model 9.2	Model 9.3
Variable	**First investment**			**Second investment**		
Cohort						
2	0.7039331	0.7306174	0.6251603	2.495393	3.14109	5.74873
	(.412)	(.502)	(.367)	(.151)	(.136)	(.040)
3	3.110326	2.627267	1.761952	1.794876	9.947057	2.641587
	(.032)	(.082)	(.313)	(.512)	(.011)	(.481)
4	11.21849	11.0331	4.361012	5.116727	47.0317	37.92245
	(.000)	(.000)	(.021)	(.064)	(.003)	(.020)
PhysRes		0.7268661	0.5819438		8.90361	2.4642
		(.384)	(.154)		(.004)	(.434)
KnowRes		0.9761605	1.11854		1.129038	1.411171
		(.964)	(.811)		(.855)	(.596)
MonRes		1.721333	1.751055		0.9837442	1.183434
		(.123)	(.104)		(.976)	(.804)
AcqCount			1.440338			2.457049
			(.309)			(.005)
MemberGroup			3.342417			4.392085
			(.008)			(.027)
LargestGroup			2.365744			0.4103007
			(.381)			(.585)
GDPGrowthLag3	0.9916294	0.9941847	0.9884203	0.9763259	0.9763507	0.9697119
	(.250)	(.377)	(.202)	(.157)	(.234)	(.181)
PosShockLag3	1.859268	1.910931	1.793329	1.040214	0.9282998	0.6139555
	(.044)	(.034)	(.068)	(.950)	(.915)	(.518)
NegShockLag3	1.08295	1.039434	0.7602004	1.006777	1.101633	1.131719
	(.832)	(.918)	(.518)	(.989)	(.875)	(.865)
Model X^2	54.83	57.37	139.03	6.17	31.02	29.39
	(.0000)	(.0000)	(.0000)	(.4042)	(.0003)	(.0034)
n	3,494	3,494	3,494	1,018	1,018	1,018

Note: The table gives hazard ratios (*p* values in parentheses), *n* gives the number of firm-year observations (the number of observations for the first and the second investment differ because the populations are different. Only the firms that have made the first investment are candidates for the second investment, whereas all firms are candidates for the first investment), Efron method for ties, robust standard errors.

influenced by institutional changes. In particular, we demonstrate how they influenced and interacted with industry evolution.[6]

The Russian regime contributed three important developments regarding early pulp and paper operations. First, economic policy was laissez-faire with minimal legislation concerning health and

[6]Rich historical accounts of the three historical regimes can be found, for example, in Jensen-Eriksen and Ojala (2015), Järvinen, Ojala, Melander, and Lamberg (2012), and Kuisma (2008).

safety, environmental protection, or IPRs, but the imperial bureaucracy required at the same time permits for industrial operations. Second, a formal established financial market was practically nonexistent. Third, the educational system did not yet offer courses in mechanical or chemical engineering vital for understanding pulping and papermaking technologies. This regime therefore offered great opportunities for entrepreneurs with internal funds to finance the operations, social capital to maneuver the imperial bureaucracy, and pre-entry experience and/or access to the foreign job market for paper engineers to understand and manage the technological challenges. Buying forestland and waterfalls suitable for power generation was essential for beginning operations, which created a race to preempt such assets. The majority of entries (68%) took place during this regime, but only 4% of the exits.

Fredrik Idestam (born in 1838), the founder of Nokia Corporation, is a representative example of the above.[7] Idestam had completed a degree in mining engineering at the Freiberg Mining Academy in Saxony and was connected to wealthy Finnish families able to finance his business operations. His technological prowess enabled what would be defined as corporate espionage by today's standards, namely, the copying of the design of a German pulp mill that he had visited. His social network was a necessary condition for the acquisition of Nokia rapids and the expansion of industrial production both in terms of scale and scope. His friend from college, Leo Mechelin, who was becoming an influential politician, helped Idestam acquire financing from his relatives and wealthy friends as well as obtain possession of lands along the Nokia River. Later, when the more developed financial market would have allowed further entries, the Nokia River and other optimal locations were taken. The story of Idestam also highlights the entry advantages important in the emerging industry, as summarized in Proposition 1:.

The majority of exits, 63%, took place during the Finnish regime, compared to only 28% of entries. This era was characterized by the increasingly active role of the government, which resulted in the emergence of industrial policy and state-owned operations, and legislation limiting the purchase of forestland. However, cartels and collusion were legal and legislators also allowed commercial banks to take an active role as equity owners and decision-makers. The Finnish regime saw the relative decline in the importance of internal funds, pre-entry experience, social capital and hydropower as incentives for entry. The slow emergence of a functioning financial market enabled funding outside of personal wealth, but at the same time business groups and cartels began to limit entry of independent entrepreneurs (see Jensen-Eriksen & Ojala, 2015). The financial market enabled investments and the majority (83%) of the first investments took place during this era. However, the business groups and the commercial banks funding them had a decisive role in such decisions: our quantitative results show that group members were three times as likely to invest as nonmembers were.

As the main wave of exits began, inability to invest and family trouble emerged as the reasons for entrepreneurs to give up. Major external shocks, such as the world wars, also triggered exits. On the other hand, the motivations for acquisitions shifted over time due to institutional changes. Legislation banning the purchase of woodlands by pulp and paper producers created a market for technologically backward firms in possession of such woodlands. Companies financed by large banks and/or the Finnish government aiming to secure material availability were able to circumvent the law by acquiring these technological laggards.

As the role of business groups and commercial banks became stronger, the rationale for acquisitions shifted from resource control to portfolio optimization. The banks were able to decide on

[7]The description of the early years of Nokia Corporation and especially Idestam's entrepreneurial activities are based on, for example, Bonsdorff (1965) and Toivola (2005). Full list of relevant literature in Online Appendix D.

mergers and acquisitions among the firms they were financing in order to achieve efficiency gains and channel resources to selected firms. Moreover, globalization became an important motive for acquisitions, especially for achieving economies of scale so as to be able to operate in the global markets for pulp and paper. Our quantitative results show that business group members were about 70% more likely to be acquired than nonmembers and that investments were not as critical for group members to be acquired as they were for other firms. This confirms the crucial role of business groups and their banks in shaping the composition of the industry.

As an example of the dynamics of the Finnish regime, Kymi made a series of acquisitions with various motivations.[8] The acquisitions of Kissakoski in 1922 and Halla in 1932 were motivated by the woodlands owned by these firms. The entrepreneurs at Kissakoski were willing to sell because a fire had destroyed the machinery in 1920, and they could not finance rebuilding. Halla had been founded by a group of Norwegian businessmen as a subsidiary of a Norwegian company. They grew worried that emerging protectionist legislation would make it increasingly difficult for foreigners to own and run industrial operations in Finland and were therefore eager to sell. The next acquisition was Högfors in 1940. The entrepreneurs wanted to focus on machine building and exited the industry by selling its pulp and paper operations to Kymi. Kymi's rationale for the acquisition was an increase in scale. Finally, Kymi acquired Läskelä in 1941. Läskelä had been making investments in the 1920s which had forced it into majority ownership by the commercial bank Suomen Yhdyspankki. When the Second World War disrupted operations, the bank reorganized the company to become a part of Kymi, the flagship among its holdings, in 1941. Kymi was also interested in the woodlands and railway connections owned by Läskelä. However, the operations and woodlands were located in the area handed over to the Soviet Union in the peace treaty, making this an unprofitable acquisition. Overall, we see the roles of changing legislation, exogenous shocks and the influence of the banks driving Kymi's acquisitions and concurrently molding the industry structure.

The European regime began when Finland joined the EEC in 1973. This was a part of the project of European integration, with the goal of eventually joining the European Union. In order to be eligible, the Finnish government had to begin harmonizing Finnish legislation, which meant laws banning cartels, collusion, and equity ownership and board membership by commercial banks, and requiring steps toward environmental protection. The latter forced pulp producers to invest in the sulfate process, thereby rendering the ability to invest important not just for competitiveness but also for being able to legally continue operations. During this period, 33% of exits took place but only 4% of entries.

The beginning of the European regime started a process in which expanding the scale and scope became a major strategic goal in each of the four business groups. The way these expansion processes were managed was primarily based on political will and the size of the flagship companies. In the early 1970s, Enso-Gutzeit was the flagship of the state-owned business group, yet it was chronically unprofitable and less efficient than industry average. Veitsiluoto was also owned by the state, and in terms of business performance, technological knowhow, and market reputation, it was a well-managed, modern corporation. Therefore, making Veitsiluoto the flagship would have made good business sense.[9]

The process, however, led to Enso-Gutzeit absorbing Veitsiluoto in 1996 in a merger organized by the Finnish government. Before that event, the government officials had merged Stockfors

[8]The account of Kymi Corporation's expansion is based especially on Ahvenainen (1972) and Alajoutsijärvi (1996). Full list of literature in Online Appendix D.

[9]On Enso-Gutzeit's evolution in the 1970s, 1980s, and 1990s, see especially Ahvenainen (1992) and Heikkinen (2000). Full list of literature in Online Appendix D.

TABLE 9 Cross-tabulation of explanations for not investing per exit period

Period	Noninvestor exits		Finance		Infrastructure constraints		Russia: Closed market or war		New strategy		Specialist producer		Environmental regulation		Death of founder	
Pre-WW1 (1886–1913)	4	7%	1	25%	0	0%	0	0%	3	75%	0	0%	0	0%	0	0%
Pre-WW2 (1914–1938)	20	36%	8	40%	3	15%	4	20%	9	45%	0	0%	0	0%	1	5%
Post-WW2 (1939–1972)	22	40%	5	23%	0	0%	5	23%	9	41%	0	0%	2	9%	2	9%
Post-EEC (1973 ->)	9	16%	1	11%	1	11%	0	0%	4	44%	3	33%	2	22%	0	0%
Total	55	100%	15	27%	4	7%	9	16%	25	45%	3	5%	4	7%	3	5%

(1984), Tervakoski (1986), Hackman (1991), and parts of Tampella (1991) into Enso-Gutzeit, making it larger and at the same time more resilient to market fluctuations. In 1973, Enso-Gutzeit did not look like a winner, but the mergers and acquisitions eventually made it larger and more independent from the national system, and finally made it possible to build its own marketing organization and to withdraw from national sales cartels in the mid-1980s. The process of Enso-Gutzeit gaining more size is illustrative considering the whole industry since the 1973 as the motives were partly commercial and operational, partly linked to changes in the regulative and institutional environment, and reflected the strategic visions of major shareholders of making the flagship firms larger and more competitive on the global scale. The consolidation process inside business group boundaries also reflects the theoretical assumption from Proposition 2b:: In the most recent decades, motives for acquisitions were predominantly driven by portfolio optimization and a perceived need to strengthen competitiveness in a globalizing business environment.

The existence of mixed motives and rationalities in decision-making is also prevalent when we focus on why managers and entrepreneurs chose *not* to invest. That group members and firms with particular resources at entry were significantly more likely to invest indicates that this was not simply a choice. In order to explore the decisions to not invest, we cross-tabulated the noninvesting exiting firms in Table 9.

Almost half of the noninvestments throughout history are explained by new strategy, that is, a decision to channel resources to other businesses. This is clearly a choice made by the entrepreneur. There are four cases where investments were not made because the required investments related to the changing environmental legislation. Investments usually have both an upside and a downside, but investments to comply with new legislation have only a downside. As a result, such investments were less attractive for entrepreneurs. The Russian explanation comprises further institutional shocks. Because the wars closed export markets and made machine purchases impossible, nine firms were unable to invest at times critical for their growth and survival.

The inability to finance the required investments is the second most common explanation after new strategy. This relates to the strong role of business groups in channeling resources, which made independent firms vulnerable. Moreover, infrastructure constraints rendered investment unattractive in four cases. Location choice made at entry rendered further investments impossible due to lack of space or limited hydropower capacity. Finally, there are individual cases where the death of the founder led unmotivated heirs to not invest. Overall, the reasons for not investing have a strong component of choice, but also governance structures, institutional shocks and bad luck play important roles, illustrating Proposition 2a:. Therefore, many of the firms could have reasonably changed their fate by investing but also many were in a position where investments were simply impossible or would not have been profitable.

7 | DISCUSSION

Our findings highlight how changes in institutional regimes and firm-level rationalities shaped entry opportunities, investments and selection pressures. These insights show that the macro-level curve of firm numbers hides a multiplicity of events and logics that aggregate into the familiar inverted-u shape. Certainly, many firms, according to the ILC explanation (Klepper, 1996), face the challenge of investing to increase scale. Yet the underlying concepts of capabilities (Klepper & Simons, 2000) and resources (B. Kim & Park, 2006) fail to capture the multiplicity of institutional and political boundary conditions, changing over decades, that shape the selection process as well as the units

over which selection operates. Theoretically and methodologically, our research makes five contributions to industry evolution and strategy research.

First, our findings add to the determinants of the survival stream in the industry life-cycle literature by shedding light on investment dynamics from the perspective of firms and entrepreneurs. We find that there is friction in investment decisions. This indicates a nontrivial separation into investors and noninvestors and that this separation plays a major role in determining firm outcomes. We also show that different resources become critical as firms continue on the investment path. Accordingly, there are different kinds of selection rounds, regarding whether a firm is able to invest and whether the potential investment is deemed profitable. This means that the effect of investments on firm outcomes is not only "more is better" (Agarwal, 1996) or "more is better up to a point" (Ugur, Trushin, & Solomon, 2016), but there are complex dynamics at play which determine whether a firm makes investments or abstains.

Second, our study contributes to the recent discussion on the multiplicity of exits (Fortune & Mitchell, 2012; Josefy et al., 2017). Acquisition is often a positive outcome for the entrepreneur and an explicit goal at firm founding. We show that there are systematic differences in firms exiting via acquisition and dissolution. Therefore, in addition to survival advantage, the literature on industry evolution is in need of the concept of acquisition advantage, which would summarize such differences. At the core of ILC theory is the reallocation of market shares to the more efficient firms. Exits via acquisition or dissolution have different roles in this process: the physical and intellectual assets of acquired companies continue to contribute to the production capacity of the industry, whereas those of the dissolved companies truly exit the industry. Consequently, the effects of the characteristics determining exit modes on the composition of an industry remain largely unknown.

Third, our findings contribute to strategy literature by showcasing the large variety of resources that have an effect on firm outcomes. Rather than resources becoming obsolete over time (e.g., Dobrev, Dobrev et al., 2004), we saw growth in the diversity of the resource portfolio required to stay competitive. The importance of physical resources in the early stages was later complemented by the crucial role of political skill in interacting within business groups and, finally tackling the challenge of operating in the global arena. In addition to the growth of the required resource portfolio, we observed that technological resources can be, to an extent, interchangeable with physical and institutional resources in making firms attractive acquisition candidates. This adds a further facet of dynamism to the literature of dynamic capabilities: dynamic capabilities are not only used to build further resources but they may be used to facilitate the interchangeability of resources.

Fourth, our findings are complementary with earlier research from the intersection of industry evolution and institutional theories (e.g., N. Argyres & Bigelow, 2007; Braguinsky & Hounshell, 2016; Malerba & Orsenigo, 2015), which has emphasized the importance of the institutional and contractual environment as a mechanism affecting how industries evolve over time. Institutional shocks, both positive and negative, had a large impact on firm outcomes and investment decisions. This was partly expected, but the complexity of causal mechanisms and their interactions highlights the need to see shocks as theoretically more important than simply as historical anomalies and accidents. We also identified a contractual environment that channeled evolutionary pressures to business groups instead of to the whole population. Such effects can be found from the finance literature on business groups (Byun et al., 2013; Campbell & Keys, 2002; Kang, Lee, & Na, 2010), yet to our knowledge this is the first study that has shown their role over time in industry evolution and individual investment decisions. These results join earlier research on decision-making criteria and institutional evolution (e.g., Bergquist & Soderholm, 2015; Braguinsky & Hounshell, 2016) by showing how and why

the decision-making rationalities and entrepreneurial opportunities vary both in terms of available options and risks.

Fifth, the above contributions highlight the methodological value of combining historical research and nanoeconomic analysis. Our results corroborate and expand on Braguinsky and Hounshell's (2016) vision of "[…] the nanoeconomic approach provid[ing] the means for scholars in strategy to understand the nature and consequences of strategic choice in industry evolution more fundamentally than is typical using microeconomic analysis on the one hand or purely historico-qualitative analysis on the other." Our results highlight that the predictive power of industry life-cycle theory is limited when the focus is on entrepreneurial choice and decisions. Although the macro-level outcome seems to derive from the interactions of market dynamics and technology evolution, the actions of individual firms and entrepreneurs witness different kinds of rationalities. Accordingly, our methodological choice to combine systematic nano-level analysis and historical interpretation created opportunities for new theoretical understanding while simultaneously being faithful to historical accuracy.

7.1 | Limitations and future research

Our theorizations build on data from a small country and from specific historical institutional settings, which could be seen as a liability. However, the selection of this country allowed us to trace all the firms to a level of detail that might not have been possible for larger countries.

Our analysis points at changing institutional regimes as an explanation of how the investment requirements change over time, meaning that firms face the need to invest at different ages. During the Russian regime, there were very few investments and competition operated more on preempting assets. As the investment race began with the Finnish regime, the role of investments as the main determinant of firm outcomes emerged. Future studies on larger populations with a sufficient number of exits and investments during each regime would enable detailed quantitative analysis of how the determinants of firm outcomes change as the institutional and historical context changes.

Industry life-cycle studies implicitly assume that firm outcomes are determined by technological and market dynamics, whereas organizational ecology assigns such a role to market dynamics and legitimacy-building in the eyes of stakeholders. Our findings challenge these logics as the decisions to invest or to sell the firm have a multitude of explanations, many of which are not affected by industry-level variables. Much like the birds who are unaware of the shape of the flock (Sawyer, 2001), entrepreneurs and executives operate on local and temporal knowledge unaware of the stage of the industry life cycle or the level of legitimacy of the operation. As paraphrased by Sawyer (2001: 555), "[…] higher-level regularities are often the result of quite simple rules and local interactions at the lower level", which implies radical changes in research strategies and practices when studying industry evolution.

Finally, our results also suggest that the concept of entrepreneurial volition introduced by Braguinsky and Hounshell (2016) may be a relevant factor in industry life-cycle studies. We observe that the level of volition varies between firms and over time. This relates to available resources: when resources are plentiful the entrepreneur is willing to invest and to further develop the firm. However, volition and resources are theoretically distinct: volition refers to the psychology of the decision-maker whereas resources represent the environment. The role of resources has been studied extensively and we suggest that this should be complemented with the dynamics of entrepreneurial volition. Entrepreneurship studies have covered volition as an in situ variable (see McMullen & Shepherd, 2006), but to date it has not been linked to industry evolution.

ACKNOWLEDGEMENTS

The authors would like to thank Ari Hyytinen, Mikko Ketokivi, Jyrki Kettunen, Juha Laurila, Jukka Luoma, Susanna Mansikkamäki, Satu Nurmi, Jari Ojala, Henrikki Tikkanen, Jouko Wacklin, Niklas von Weymarn, and the two anonymous reviewers for their constructive comments on earlier versions. The development of the paper also benefited from presentations at Industry Studies 2017, DRUID 2018 conferences and workshops at Universities of Jyväskylä and Turku in 2018. Moreover, research assistance by Nooa Nykänen, Jarmo Taskinen, Aleksi Rauhala, Esa Tiusanen, Petteri Impola, and Lauri Karvonen is gratefully acknowledged.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

How to cite this article: Lamberg J-A, Peltoniemi M. The nanoeconomics of firm-level decision-making and industry evolution: Evidence from 200 years of paper and pulp making. *Strat Mgmt J*. 2020;41:499–529. https://doi.org/10.1002/smj.3080