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REGULAR ARTICLE

Knowledge combinations and the survival of financial services ventures

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Abstract The paper investigates the role of knowledge in the evolution of new financial services ventures in Sweden between 1990 and 2002. Drawing upon economic theories of human capital and spin-out entrepreneurship, we investigate whether knowledge from prior employment in the financial and technological industries facilitates the survival of new entrepreneurial firms. Based on a database tracking the evolution of 1,077 financial services ventures, we find that firms with more extensive knowledge from the financial services and high-tech sectors have higher chances of survival than firms with more narrow knowledge bases. Our findings offer contributions to the emerging literature on spin-out entrepreneurship and to research on entrepreneurship in services.

Keywords Entrepreneurship · Spin-out · Spin-off · Knowledge · Financial services · Survival analysis

JEL Classification L11 · L26 · M13 · L84

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1 Introduction. Knowledge combinations and the survival of financial services ventures

Services are an increasingly important component of overall economic activity (Miles 1993). Service firms represent a majority and a growing proportion of new entrepreneurial firms (Armington and Acs 2004). Deregulation and increasing market instability have generated business opportunities for the emergence of many new service firms throughout Europe (Lindmark 2005). In this paper, we investigate the development of new ventures in the financial services industry. Since this industry is dominated by very large incumbent firms, we seek to unravel the question: what specific types of *knowledge* and *resources* do new firms use to gain a foothold and to survive in the financial services industries?

To study this topic, we draw upon economic theories of human capital and spin-out entrepreneurship, where experienced individuals bring business and technological know-how from their former organizations to organize a new venture. These theories are used to derive hypotheses of how firm founders' professional backgrounds contribute to the knowledge base of new financial services ventures. We predict that firms whose founders bring knowledge from both the financial and technological industries are more able to combine such knowledge into new, innovative capabilities, and that these firms will have higher chances of survival than firms with more narrow knowledge bases. The hypotheses are tested on a 13-year panel tracking the evolution of all new Swedish financial services ventures between 1990 and 2002 using matched employee–employer databases.

We find that ventures whose founding team has prior employment with a firm in the finance sector have a higher likelihood of survival. Also, ventures whose founders have prior employment in the information technology sector have somewhat higher survival chances. In particular, firms whose founders have experience from *both* sectors have a clearly higher chance of survival, beyond the effect of employment experience from a single sector. Our findings offer empirical and theoretical contributions to the emerging literature on spin-out entrepreneurship and to research on entrepreneurship in services.

2 Entrepreneurship in the financial services industry

Financial services refer broadly to organizations that deal with money management. Firms such as banks, insurance companies and stock brokerages all belong to the financial services industry, which in terms of earnings is the largest industry in the world. The industry's development has of late been characterized by a growing rate of new entrants spawned by institutional changes and increasing rate of innovation. In regulated industries, it is common that new types of innovations tend to come from the periphery of an industry, such as from new entrants (Audretsch 1995).

To establish an intellectual base for theorizing about the role of innovations and new firms in the financial services industries, we conducted a broad literature review of prior studies of financial services in various strands of the literature, such as economics, entrepreneurship and strategic management. To facilitate interpretations of our findings from the empirical investigation (Swann 2006), we also interviewed the owner–managers of six different financial services ventures in Sweden which, over the last 5 years, had successfully established themselves on the market. These interviews indicated that firm founders' personal experiences of the financial industry and its *modus operandi* were crucial—but so were their abilities to break with some of these practices by introducing new technologies. To date, there is still little substantive evidence in the empirical literature to authenticate such arguments. The current study provides an initial test of the way in which knowledge facilitates the development and survival of new firms, highlighting the role of different types—or *combinations*—of knowledge. One co-founder and director of marketing in a financial services venture explained their uniqueness in offering online payment solutions:

> This technology is widely available in other industries, see, but none of the existing players seem keen on introducing these services. Maybe they are hesitant about the credit risk. But we know consumers want to be billed rather than using (credit) cards! After ten months of operations we are still the only ones offering these types of producer-to-consumer payment solutions.

As this quotation illustrates, information technology is often perceived as a great enabler of innovation in service industries. Van der Aa and Elfring (2002) characterize technological innovations as development and implementation of technology, as well as related reconfigurations of concepts and processes related to the services' product offerings. However, a complicating factor is that the quality of professional services is subjective and to some extent depends on the buyer's actual decision to purchase (Gummesson 1978). In the financial services sector, services that are perceived as high-quality have often been of the type that allow customers to interact more easily with service providers, for example through the Internet, by phone, or through electronic transfer via mobile phone systems. Examples are systems that partly routinize the marketing or sales of savings and insurance services. One firm we interviewed was based on exactly this type of organizational innovation:

> Our system works by automatically downloading address data where we order and rank potential customers based on a set of criteria. It is really an easy algorithm. After getting (a customer) the system is used to track and measure profitability in different segments. In this way we use it both for getting and maintaining customers. But still, you need the personal contact, see? People want to feel confident we can manage their money. So you need the personal (phone) calls and the occasional meetings, but everything in between, you need to get rid of, really.

Thus, innovation in financial services can be a way for new entrepreneurial firms to gain a foothold in an industry otherwise dominated by large banks and insurance firms (Cooper et al. 1995). Prior research indicates that firm founders' knowledge and their general resource base are important for the firms' ability to build a viable business platform. We are therefore interested in the types of knowledge and resources that new firms in the financial services industry use to increase their chances of establishing a position and survive in a highly competitive market. In the following sections, we draw upon economic theories of spin-out entrepreneurship and human capital to present hypotheses of how firm founders' knowledge enhances the survival of new financial services firms. We test the hypotheses on the survival of 1,077 financial services ventures in Sweden between 1990 and 2002. Sweden offers a particularly good testing ground for these theories: it is a country with highly developed financial institutions where new technologies are swiftly adopted. More than half of the population relies primarily on online banking to conduct personal finances, and more than 40% declares taxes via mobile phones or the Internet. During the latest decade, there has been a proliferation of new ventures in the financial services industry, several of which have grown to become quite successful firms (Lindmark 2005).

3 Theory and hypotheses

Spin-outs, or spin-offs, refer to new firm entrants founded by employees of firms in the same industry (Klepper and Sleeper 2005). In his characterization of different types of industrial entrants, Klepper (2001) describes spin-off firms as firms founded by experienced employees of incumbent firms in the same industry. This theoretical perspective draws relevance from research in industrial organizational economics, arguing that experience from markets where a firm is currently active shapes the knowledge resources of the firm and in particular the departments and sub-units of which it consists. Therefore, individual employees choosing to leave such a unit to start a new organization often benefit from their experiences with their prior employer, or 'parent' organization (Klepper and Sleeper 2005). Since resources and organizational routines are believed to be transferred from old to new organizations through personnel migration (Nelson and Winter 1982: 115–121), an individual firm founder's experiences can have strong influences on the new firm's performance. In other words, the previous experiences of founders of spin-out firms influence not only the formation and product development of new firms, but also the firms' ability to establish a position of competitive advantage and achieve organizational longevity (Agarwal et al. 2004).

In the research context of this paper, there is a teleological problem in defining a new independent firm started by former employees of a firm as a 'spin-off', in that the term indicates that some type of agency or formal relationship should exist between the firm that used to employ the new entrepreneur(s) and the spin-off firm started by the entrepreneur(s). This is

often not the case. For example, frustration or conflict with one's employer is often a major reason why skilled employees choose to leave employment in order to start up a new firm (Garvin 1983). Helfat and Lieberman (2002) distinguish between 'parent spin-offs' that are at least partly owned by the parent firm, and 'entrepreneurial spin-offs' that are founded by individuals previously employed by an established firm, but have other owners. To discriminate between different types of new firms, this study therefore follows the terminology of Agarwal et al. (2004), who defined entrepreneurial ventures of ex-employees as 'spin-outs'.

Spin-out firms are associated with their parent organization through the inheritance of knowledge in the form of rules and procedures for conducting business in a specific industry, where knowledge may be thought of as the industrial counterpart to genes (cf. Nelson and Winter 1982: 14–16). The experiences gained through previous employment in parent firms allow founders of spin-outs to bring specific knowledge regarding a wide range of issues to their new firm, e.g. knowledge of customer demand, products, technology, suppliers and competitors (Helfat and Lieberman 2002). Also, industry experience gained through working in an established organization allows these individuals access to detailed information which can help them to identify valuable business opportunities (Romanelli 1989). For example, through employment in an existing organization individuals can, via interaction with customers, gain knowledge regarding their customers' needs for new and/or modified service offerings (Von Hippel 1986). They might exploit this knowledge by trying to commercialize their ideas, either within the parent organization, or by leaving the firm and starting their own (spin-out) firms. Further, by developing, marketing, and/or selling financial services in an existing organization, individuals can build up the personal confidence necessary to engage in building a new venture (Audia and Rider 2006).

Empirical studies have provided support for several of the theoretical mechanisms proposed by the literature on spin-out entrepreneurship: Agarwal et al. (2004) studied 46 spin-out firms in the U.S. disk drive industry and found that these firms had higher chances of survival than de novo firms without prior industry experience. Klepper and Sleeper (2005) followed the evolution of 79 spin-outs in the U.S. laser industry, together with the evolution of their parent firms. They found that the long-lived parents produced more spin-outs, especially parents who had been in existence between 11 and 15 years. Spin-outs were also more likely to produce the same type of lasers that their parent did, and seemed to move from initially targeting niche markets overlapping with their parents' markets towards targeting related markets not catered to by their parents. Chatterji (2006) studied 69 spin-outs in the U.S. medical device industry, and suggested that the success of spin-outs was driven by non-technological rather than technological knowledge inherited from the parent firm. In Europe, Koster (2005) surveyed 289 Dutch firms and concluded that prior employment experience provided firm founders with more relevant knowledge, especially in regard to product-related knowledge. Finally, Dahl and Reichstein (2007) followed 323 spin-outs in the Danish

manufacturing sector from 1980 to 2000 and ascertained that the vitality of the parent company, combined with industry-specific experience of the spin-out founder, positively affected the new firm's likelihood of survival.

These past studies indicate that the transfer of organizationally embedded knowledge from employees to new spin-out firms can facilitate the creation and development of new firms. However, there is still little evidence in regard to how the experiences of individuals' employment in a parent organization impact the development of new spin-out firms. Some prior evidence indicates that the knowledge accumulated by the founders of spin-out firms has a positive impact on the competitive advantage of these new firms: Agarwal et al. (2004) observed in their study of the rigid disk drive industry that the technological know-how of spin-out firms had a positive effect on their subsequent survival. However, marketing know-how had a negative but insignificant effect. In contrast, the current study concerns the financial services industry, which is market-driven to a much higher extent than the technology-driven disk drive industry studied by Agarwal et al. It is therefore likely that marketing know-how should have at least as positive an effect on the new firms' development as technological know-how (cf. Chatterji 2006). Earlier studies of the financial services industry, such as Cooper et al. (1995), indicate that market know-how and prior experience within the industry can be a vital source of knowledge for these new firms. As an example, the marketing manager of one small firm that we interviewed said:

> We had this new (customer call-back) system that Sven had built at his former job in the telecom business. The whole idea was to construct a similar system that we could use. I knew from heading the manual desks (at a large insurance firm) that sales personnel were usually just making cold calls based on some address list. It was my idea, actually, taking his system and using it to track and register new potential customers. In the end, it proved great at selling, and even better at measuring profitability in different segments.

In the literature to date, there is little existing evidence that different *types* of knowledge are important, despite the theoretical arguments that experience from employment in the industry allows founders to bring *specific* knowledge on products, technologies, suppliers and competitors. Helfat and Lieberman (2002) reviewed the extant literature on capabilities and resources in organizations and industries at the time of new firms' market entry. They suggested that similarity between pre-entry resources and required resources in an industry should affect the likelihood of entry as well as the likelihood of firm survival, indicating an endogenous pattern of prior knowledge and resources for the choice to enter and the subsequent performance of spin-out firms. Other studies indicate that individuals from firms with a longer history of doing business are more likely to start a spin-out (Klepper and Sleeper 2005) and also more likely to attain a larger share of the market (Lane 1988). These studies have not been able to follow specific individuals, but have approximated their knowledge through the industry tenure of their parent

companies. Thus, disaggregating the effects of post-entry firm capabilities into, on the one hand, intangible resources brought into the firm by individual founders, and on the other hand tangible initial stockpiles of capital and equipment, represents an important contribution of this study. Although the knowledge of individual founders and the characteristics and resources of their parent firm are likely to be positively related, we believe that the precise mechanisms by which industry knowledge enhances the survival of new firms work through the influence of individual firm founders, rather than through the characteristics of their parent companies. This leads us to formulate a first hypothesis:

Hypothesis 1. Firms whose founders have *more extensive experience from a parent firm* in the financial or the technological industries will have a higher chance of survival.

A fundamental reason for why new firms are able to thrive, despite their relative deficiencies in resources and experience, is that they bring something new and valuable to the market. We draw upon three theoretical works to derive explanations of how new firms are able to break with past industry habits by introducing new types of services. First, Schumpeter argued that innovations are new combinations of existing knowledge and incremental learning (Schumpeter 1934: 65–66). From this perspective, innovations need not be 'disruptive' but are often quite mundane in nature, corresponding to the conditions of the financial services industries. Both mundane and disruptive (radical) innovations necessitate that individual entrepreneurs' knowledge is drawn upon, in order to discover how inputs or procedures can be recombined into new products or services or new ways to produce or market these.

Second, the theory of industry evolution by Nelson and Winter (1982) also highlights the importance of individuals' accumulated knowledge for the introduction of new innovations. The theory is based on the notion that organizations are dependent on different sets of routines in producing and marketing goods and services. To explain how new innovations are introduced, Nelson and Winter suggested that it is the departure of employees with idiosyncratic knowledge from a plant that causes the 'mutation' of an existing routine, both in an old plant and in the new organization (Nelson and Winter 1982: 119–121). Also from this perspective, new innovations are closely associated with a new firm's prior stock of knowledge in the form of organizational routines, which "provides the best scope for new combination" (Nelson and Winter 1982: 131).

Third, Kogut and Zander (1992) outlined a theory of innovation and product development in large established firms based on firms' capability to combine unexploited technological opportunities, using prior knowledge accumulated within the firm. We think that Kogut and Zander's notion of *combinative capabilities* can also be employed to explain the potential for *new* firms to exploit their existing knowledge together with the unexplored potential of new technologies. For new firms in the financial services industry, we cannot readily theorize about an existing knowledge base, since the firm itself has no prior history of doing business and has not yet accumulated a

body of knowledge distinctive to the firm. Rather, the new firm's knowledge is to a large extent the aggregate of firm founders' personal industry experience and business acumen.

A separate strand of studies focusing on individual entrepreneurs has investigated the effects of firm founders' industry experience for firm survival. This line of research has argued that the largely positive effects of industry experience provide founders with *specific human capital*, such as knowledge of how business is conducted and how products can be sold within that specific industry (Iyigun and Owen 1998; Neal 1995). The theory of human capital uses economic logic to study, among other things, individual productivity and career choices. General human capital is made up of skills that are useful in a variety of work settings. Specific human capital is made up of skills that are more specialized and valuable for a particular type of purpose or in a specific industry, but less valuable in the general labor market.

The effect of such specific human capital as individual firm founders' industry experience has been shown in several studies. Gimeno et al. (1997) investigated the survival of 1,547 individual firms belonging to the National Federation of Independent Businesses in the United States. They noticed that experience from contacts with customers, suppliers, products and services in the same industry raised the likelihood of firm survival. Brüderl et al. (1992) investigated 1,849 individual firm founders in the greater Munich area in Germany, and determined that entrepreneurs with prior industry experience were almost twice as likely to survive in business compared to entrepreneurs without such experience. Pennings et al. (1998) investigated the survival of 1,851 Dutch accounting firms during the period 1880–1990, and concluded that the founding team's industry experience had a non-monotonic effect on firm survival, where some industry experience facilitated firm survival but very high levels of experience decreased firm survival because founders with extensive experience tended to be quite old and thus prone to dissolve or sell their firm. Delmar and Shane (2006) also suggested that the founding team's industry experience might impact firm survival and financial performance in non-linear ways, and furthermore might change over time. However, their study of 223 randomly sampled firms in Sweden revealed that industry experience positively enhanced firm turnover but had no effect on firm survival during the first 2 years of existence. These studies indicate the importance of controlling for performance measures in studies of new firm survival, and vice versa. Further, the positive effects of founders' experience in service-based studies such as Pennings et al. (1998) should not be automatically extended to more general samples of new firms (Delmar and Shane 2006).

None of the aforementioned studies investigated the potential of experience from different sectors, although popular lore and practically oriented literature on entrepreneurship highlight the importance of 'having a well rounded team' (Leonard and Sensiper 1998). This absence of studies investigating different types of experience among new firms suggests a potential for theoretical extension, between strategic theories of knowledge development in large firms and the evolution of new entrepreneurial firms (Mosakowski 2001). It is for

this purpose that we draw upon the theory of combinative capabilities, in which firms build upon their existing knowledge to leverage the unexplored potential of new technologies (Kogut and Zander 1992). For new firms in the financial services industry, such new knowledge can be conceptualized as the aggregate of firm founders' joint industry experience, i.e. their combined human capital. This individual-level theory of human capital and the firm-level theory of combinative capabilities therefore lead us to formulate a second hypothesis:

Hypothesis 2. Firms whose founders have experience *from parent firms in both* financial services and technological industries will have a higher chance of survival.

4 Method

4.1 Data sources

The data source in this project is a combination of two longitudinal databases maintained by Statistics Sweden: RAMS, which provides yearly data on all firms registered in Sweden, and LOUISE, which provides yearly data on all Swedish inhabitants. To the best of our knowledge, we are the first to explore a link between these two databases. We sampled all financial services ventures started from 1990 through 2002 and followed these until their termination or until 2002. In total, 1,237 firms were started during the period. We linked data on the ventures to data on their founders' career histories prior to venturing, work experience, education, and various other variables. Firm-level data include performance measures as well as exit codes that allow us to distinguish between firms that merge or are acquired by other firms from firms that are terminated.

Since there is little previous work on how new ventures in the financial services industries manage to survive and build competitive advantage, we also interviewed managers from six different financial services ventures that over the last 5 years had successfully established themselves on the market. These ventures were sampled from a list of financial services firms started between 2002 and 2006 that had registered with the Swedish Financial Supervisory Authority, a requirement for conducting any type of finance-related business in Sweden. We contacted a random sample of twenty firms meeting these criteria. Eleven of these agreed to participate, but after an initial telephone interview it was clear that only six firms were really 'new' in the sense of having been set up, organized and launched some type of service during the past 5 years. The CEO or one person in the founding team in each of the six firms was interviewed at the company's premises for one to three hours using a semi-structured interview format. All interviews were taped and transcribed in full. The transcriptions were posted to the respondents who commented further upon these. The qualitative data allowed us to gain better familiarity with the conditions of financial services ventures, and especially helped guide

our theorizing as to how or why knowledge among the founding team could facilitate the firms' development.

4.2 Variables

Dependent variable The dependent variable used in this study is firm survival. A firm can exit either by termination or by acquisition by another firm. However, acquisition and mergers need not be a sign of organizational failure. On the contrary, divesting of their equity can instead be seen as the pinnacle of success for many firm founders. We therefore determined that discontinued and acquired/merging firms should not be pooled in our survival analysis. Two statistical tests based on a discrete choice model of the multinomial logit type were used to examine the validity of this belief: We used a log-likelihood ratio test to compare the vectors of coefficients of the discontinued and the sold firms (relative to surviving firms). The test revealed a statistically significant difference between the vectors of coefficients ($\chi^2 = 38.02$, $df = 12$. $p < 0.01$), indicating that the two alternatives should not be pooled. A Hausman test of the Independence of Irrelevant Alternatives (IIA) showed that the coefficients for surviving and non-surviving firms were not affected by excluding firms that were merged from our analysis ($\chi^2 = 11.65$, $df = 12$. $p < 0.46$). We therefore eliminated the 160 sold firms from our dataset, leaving us with a final 1,077 firms.

Independent variables Our two main independent variables are denoted *finance* and *hightech*, indicating the number of years of prior employment at a firm active in the finance or high-tech industries. A third variable in dummy form, *combinative*, is used to denote firms whose firm founders have experience from both the finance and high-tech industries. All independent variables are time-invariant, since the founding team's past experience cannot change after a founding event.

Control variables In order to test the impact of knowledge accumulated before the founding of new firms on subsequent survival, we need, to the highest extent possible, to control for other conditions which are known to impact the likelihood of survival for new firms. For example, firm founders bring with them to the new firm not only knowledge imparted to them from previous employment and training, but also financial resources and valuable contacts within their social network. Such resources and contacts should be relatively more valuable in new firms founded not by a single entrepreneur but by several persons who bring with them resources that are mutually advantageous (cf. Nelson and Winter 1982: 120). With other founding factors held constant, we expect spin-out firms with larger founding teams to be more able to build a market position that allows them to survive (Klepper 2001). We therefore include the ordinal scaled variable *team size*, measuring the total

number of firm founders. We also introduce control variables for firm size and resources in the form of number of *employees* (in addition to the founding team), number of *plants*, and yearly *turnover* (revenues). We use dummy variables to control for the firms' legal form (incorporation, partnership, or sole proprietorship) where the simplest form, sole proprietorship, is the base category.

Finally, we try to control for two important sources of heterogeneity in a firm founder's background that might obscure the effects of experience through prior employment: those of social networks and entrepreneurial capabilities. Through job experience in a parent firm, individuals not only acquire knowledge but also accumulate social network ties within that firm. While this network might facilitate career advancement and thus inhibit transition to entrepreneurship (Zenger and Lawrence 1989), some authors argue that social networks might help entrepreneurial firms overcome the first uncertain period and thus facilitate their long-run survival (Davidsson and Honig 2003). To control for the effects of social networks to the best extent possible, we include the variable *region tenure* which measures how long a firm founder had lived at one single location since 1989. Since living long in a region is likely to be correlated with an extensive social network, this variable approximates, albeit in a coarse manner, for the possibility that a new venture's survival is positively enhanced by its firm founders' social capital.

To control for entrepreneurial capabilities, we tracked all firm founders' experience from 1989 onwards in the LOUISE database, noting each year in which they were working as independent entrepreneurs rather than employees, to create an ordinal scaled variable *past entrepreneurship*. For example, if a firm was founded in 1995, we searched the records of all firm founders between 1989 and 1994 for their prior experiences in entrepreneurship. While this is an imperfect measure for individuals with extensive labor market experience—for older persons with extensive labor market experience, we do not know their activities during the 1970s or early 1980s—the inclusion of this additional variable does capture most of the heterogeneity in founding teams' experience, especially more recent experiences which are likely to be more important than very old entrepreneurial experiences. All control variables except team size, past entrepreneurship and region tenure are time-dependent and updated yearly. In addition, we control for cohort effects by introducing dummy variables for all yearly cohorts.

4.3 Statistical analysis

We use event history analysis to assess firm survival. Similar to prior studies of firm exit, where time is measured in discrete intervals (e.g. Anderson and Tushman 2001), we estimated a piecewise exponential hazard model without the need to make specific assumptions in regard to duration dependence of new ventures' survival. The model below denotes the hazard at time t of a firm with a vector of characteristics $\mathbf{x}$ as $h(t|\mathbf{x})$, where t goes from 1993 to

2002. To allow the hazard to vary between years, the model is divided into yearly intervals with variable coefficients that are updated yearly (Blossfeld and Rohwer 1995). Letting L denote the time periods, α the coefficients, and β a vector of coefficients, the hazard model is specified as:

$$h(t|x) = \exp\left(\alpha_{1993} L_{1993} + \alpha_{1994} L_{1994} + \cdots + \alpha_{2002} L_{2002} + \beta' x\right)$$

This model allows the hazard to vary over yearly intervals but constrains the coefficients to shift the hazard by the same proportion each year.

5 Results

Investigation of the variables and their correlations provided no indication of multicolinearity among the predictor variables. The variables and their mean values are described in Table 1, together with the correlation matrix.

Figure 1 presents Kaplan–Meier survival graphs describing the exit patterns of the 1,077 financial services firms started in Sweden between 1990 and 2002. Three lines denote the survival rates of firms with no prior knowledge (bold line), firms whose founders bring industry knowledge from either the financial services or the high-tech sector (dark grey line), and firms whose founders combine industry knowledge from both the financial services and high-tech sectors (bright grey line). The survival rates for all ventures in the sample are comparatively low. Fifty per cent of the firms survived no more than 4 years, and after 7 years, only about one-third of the sample remained in business. The three lines clearly indicate higher survival rates among the firms with some prior knowledge, and in particular those firms with combinative knowledge. Bivariate tests of the survival function verified the impression that firms with prior knowledge have higher probability of survival (Wilcoxon χ^2: 11.02 $df = 2$, $p < 0.01$).

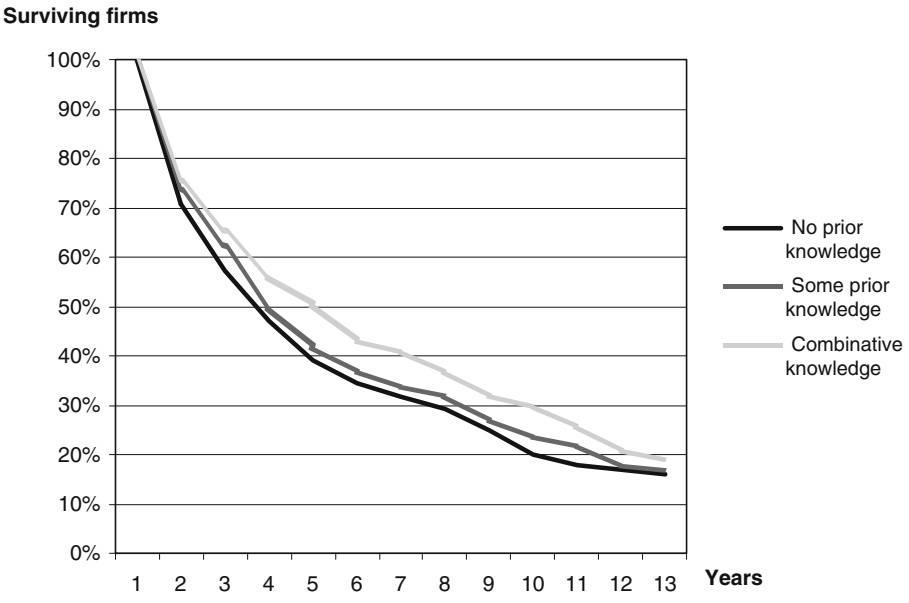
In Table 2, we introduce the event history analysis of firm survival, which allows us to control for factors that might invalidate the bivariate tests presented in Fig. 1. We present three models: first a base model with only the control variables, followed by a second model introducing the two variables for firm knowledge derived from founders' employment experience at firms in the high-tech and financial services sectors, respectively. The third model introduces the final variable with an indicator for firms whose founders have prior employment in both of these industries.

The coefficients in Table 2 are presented as hazard ratios, where coefficients above 1.00 indicate a lower likelihood of survival (higher hazard rate) and coefficients below 1.00 indicate a higher likelihood of survival (lower hazard). Looking first at the control variables, we find that firms which are incorporated, have more plants, higher turnover and a larger founding team, and hire more employees display a higher likelihood of survival. One additional member in the founding team increases the probability of survival by 15%, and each

Table 1 Variables and correlation matrix

Variable		Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11
1	Exit	0.10	0.21											
2	Incorporation	0.39	0.29	−0.07										
3	Partnership	0.06	0.07	−0.01	−0.02									
4	Plants	1.73	11.80	−0.10	0.09	0.02								
5	Turnover (log)	2.33	5.28	−0.10	0.28	0.06	0.03							
6	Employees	3.29	23.94	−0.07	0.34	0.03	0.32	0.27						
7	Region tenure	4.43	4.50	−0.02	0.01	0.02	−0.02	−0.02	−0.04					
8	Past Entrepreneurship	0.70	3.42	−0.13	−0.02	−0.03	0.03	0.02	0.01	0.01				
9	Team size	3.33	6.31	−0.08	0.03	−0.01	0.42	−0.04	0.31	0.01	0.01			
10	Finance	6.47	4.50	−0.02	−0.03	−0.01	0.02	−0.02	0.01	0.29	−0.02	0.06		
11	Hi-tech	5.38	3.49	−0.01	−0.03	−0.02	−0.02	0.01	−0.03	0.32	−0.02	−0.05	−0.26	
12	Combinative	0.15	0.36	−0.03	0.04	−0.01	0.08	−0.02	0.10	0.24	−0.01	0.23	0.37	0.39

Note: All correlations above ±0.03 significant at the 5% level. Legal form and combinative variables are in dummy form and thus represent total frequencies.



Note: 1,077 firms, founded at any time during 1990-2002

Fig. 1 The impact of single and combinative knowledge on firm survival. *Note*: 1,077 firms, founded at any time during 1990–2002

individual hired after the first year of existence increases the firms' probability of survival by 14%. Also, the founding team's prior entrepreneurial experiences have a seemingly positive effect on firm survival, but this effect disappears after the introduction of the variables denoting experience from prior employment in models 2 and 3. This is consistent with the findings of the study of Gimeno et al. (1997) of independent start-ups in the U.S., and the study of Dahl and Reichstein (2007) of Danish spin-outs, but not with the studies by Brüderl et al. (1992) or Delmar and Shane (2006). A plausible explanation is that both the studies of Gimeno et al. and Dahl and Reichstein followed the same procedure as this study by excluding acquired firms from their sample, whereas Brüderl et al. pooled firms that exited by closure and acquisition, and Delmar and Shane only followed firms during their first 2 years of existence.

Looking at model 2, we can see that the two variables *finance* and *hi-tech* are both associated with a higher likelihood of survival, significant at or above the 1% level. This leads us to confirm hypothesis 1—firm knowledge gained from founders' experience in the finance and high-tech industries clearly improves the probability of firm survival. The effect is markedly stronger for finance experience: the final model indicates that for each additional year of experience from the financial services industry within the founding team, the firm increases its probability of survival by 6%. One additional year of

Table 2 Piecewise exponential models on new firm survival

	Model 1	Model 3	Model 4
Incorporation	0.38***	0.40***	0.41***
	(0.05)	(0.05)	(0.05)
Partnership	1.12*	1.11*	1.11*
	(0.09)	(0.09)	(0.09)
Plants	0.80*	0.80*	0.79*
	(0.05)	(0.05)	(0.05)
Turnover (log)	0.99***	0.99***	0.99***
	(0.01)	(0.01)	(0.01)
Employees	0.85*	0.86*	0.86*
	(0.10)	(0.11)	(0.11)
Region tenure	0.99	0.99	0.99
	(0.13)	(0.14)	(0.14)
Past entrepreneurship	0.98*	0.99	0.99
	(0.10)	(0.13)	(0.13)
Team size	0.83***	0.85***	0.85***
	(0.02)	(0.06)	(0.06)
Finance		0.94***	0.94***
		(0.02)	(0.02)
Hi-tech		0.98**	0.99*
		(0.04)	(0.04)
Combinative			0.88**
			(0.05)
Log likelihood:	−3, 672.34	−3, 658.32	−3, 648.11
LR test vs. previous model:	35.40	28.04**	20.42*

Note: $*p < 0.05$, $**p < 0.01$, $***p < 0.001$. Coefficients in hazard rate form, standard errors in parentheses. All models include cohort dummies and are based on 2,668 firm-year observations and 1,077 unique firms.

experience from the high-tech industry increases the probability of survival by 1%. These findings are in opposition to the study of the technology-intensive disk drive industry of Agarwal et al. (2004), where technological know-how but not marketing know-how contributed to the survival of spin-outs.

Model 3 introduces the indicator variable for firms whose founders have prior employment experience in both industries. The coefficient is significant at the 1% level in the expected direction. We therefore confirm also hypothesis 2—firms that are able to draw upon firm founders' experience from both the financial services and high-tech industries have a 12% higher chance of survival, above that contributed by the length of experience in the two industries, respectively.

6 Conclusions and discussion

In this paper, we used economic theories of human capital and spin-out entrepreneurship to present hypotheses of how firm founders' knowledge should impact the development of spin-out firms. We used matched employee–employer databases to follow the full population of financial services ventures

founded in Sweden between 1990 and 2002, illustrated by interviews with six successful ventures.

We learned that larger founding teams with more extensive knowledge gained from employment in the financial services or high-tech industries had higher chances of survival. In addition, firms whose founding teams combined knowledge from both the financial services and high-tech industries had markedly higher chances of survival. The high hazard rates and the strong effects of initial size and resources can be explained by entry barriers in the recently deregulated financial services industry. With relatively low barriers to entry, entrepreneurs will be attracted to the industry despite initially high failure rates as long as there are some perceived chances for success (Audretsch and Mahmood 1994).

Our findings add to the emerging empirical literature on employee spin-outs as transfers of knowledge and business procedures between firms and between different industrial sectors. By drawing upon their knowledge resources from prior employment experiences to create new services that challenge the predominant market conditions—'the carrying out of novel combinations'—spin-out firms fulfil the role of Schumpeterian entrepreneurs in the financial services sector, a sector where such research has been little investigated. Given the increasing importance of the service sector in modern economies, spin-out firms in services constitute an important part of the industrial dynamics important for job creation and economic growth (Armington and Acs 2004), or in the words of Eliasson (2000: 49), "the benefits of financial innovations like junk bonds are to reduce barriers to competitive entry to make both successes and failures possible".

Whereas earlier research on individual entrepreneurs has verified the importance of pre-firm knowledge in the form of firm founders' prior employment experiences (Delmar and Shane 2006; Gimeno et al. 1997; Pennings et al. 1998), this study is the first to demonstrate the importance of different types of knowledge. Our results suggest that it is the *combination* of different types of knowledge that is particularly important for new service ventures. Several of the examples provided by the firms studied simultaneously introduced several different components of innovation, such as a new service, a new method of production, and a new market focus (Schumpeter 1934: 65–70). We believe the role of knowledge for new firm survival in the service sector, in particular different *sources* of knowledge, to be an important area where more research is needed.

As an initial attempt to investigate the role of spin-out firms in services, this study necessarily has several limitations. First, it is difficult to discuss innovation in any detailed sense without more detailed data on product or service development and commercialization. While being a strong indicator of success and economic resilience, organizational survival *per se* does not prove that spin-out firms are able to combine knowledge better than other types of start-up firms. Future research should therefore focus on the role of knowledge inherited from parent firms for innovation and product/service development in spin-outs. Second, it is possible that there are other factors,

besides the ones investigated here, more strongly associated with the successful development of financial service ventures. This could obscure the results presented in the current study. Specifically, future research should consider how factors associated with the 'spillover' of knowledge, such as locating in an industrial cluster (Baptista and Swann 1999; Dahl et al. 2003), might affect the role of combinative knowledge drawn from firm founders' prior experiences. Third, the findings of this study in the financial services industry might not be generalizable to other service sectors. More detailed investigations of other sectors are therefore also warranted. These limitations offer opportunities for future research on the role of new firms in general, and the role of spin-out firms in particular, regarding innovation and economic change in the service industries.

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