The Eect of Previous Co-Worker Experience on the Survival of Knowledge Intensive Start-Ups

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Abstract

The aim of the paper is to investigate the effect of previous co-worker experience on the survival of knowledge intensive start-ups. For the empirical analysis I use the Danish Integrated Database of Labor Market Research (IDA). This longitudinal employer-employee database allows me to identify co-worker experience among all members of the firm. In addition, I will make a distinction between ordinary start-ups and entrepreneurial spin-offs. The results show that previous co-worker experience has a positive effect on new firm survival. This effect appears to be valid predominantly for ordinary start-ups than for entrepreneurial spin-offs.

1 Introduction

In the last two decades there has been an increasing interest in entrepreneurial and venture founding teams (Kamm et al., 1990; Gartner et al., 1994). Up to this point, the entrepreneur was mainly treated as: "the lone hero, battling against the storms of economic, government, social, and other environmental forces before anchoring in the harbour of success" (Cooney, 2005, p. 226), despite the fact that entrepreneurship in many aspects is a social activity (Ruef et al., 2003). This collective approach also play a central role in the emergence of knowledge intensive entrepreneurship as the nature of work in these start-ups is dependent on the knowledge input of multiple individuals (Chowdhury, 2005). In addition, empirical work on knowledge intensive entrepreneurship have the tendency to selects those activities that are run by teams. However, only a few empirical studies can be found that test how the composition of these start-ups affect their performance. This is surprising given that both skills and the intra-organizational relationships play an important role in overcoming a their liability of newness/adolescence (Stinchcombe, 1965; Eisenhardt and Schoonhoven, 1990).

In this study, I will test the impact of involving former colleagues, which is a logical addition to a team within this type of start-up, and how their presence affects their likelihood of survival. I argue that recruiting a former co-worker solves, as suggested by Campbell (2005), the liability of newness /adolescence (Stinchcombe, 1965; Brüderl and Schüssler, 1990) because (i) they bring in share narratives and a shared language that is necessary to build the required internal social structure and (ii) it is easier to assess whether these previous co-workers possess the skills that are required in the new business. However, former co-workers have similar experiences that leads to a high degree of lock-in in the routines of the previous firm and does not create the diversity in skills. For this reason, I hypothesize that previous co-worker experience has a positive effect on the survival of new rm but high degrees of shared co-worker experience is negative.

I investigate this issue on a sample of knowledge intensive start-ups founded in the period 1995-2004. This sample is selected from the Danish Integrated Database for Labor Market Research (IDA). IDA is a longitudinal and universal linked employer-employee dataset constructed from government registers and maintained by Statistics Denmark (DST). The database contains detailed information on al l individuals and al l establishments in Denmark from 1980 onwards. The knowledge intensive start-ups are not selected on the grounds that they are active in so-called high tech and knowledge intensive industries; instead, I will adopt a person-centric perspective toward knowledge intensity, i.e. the share of high skilled workers employed in the start-up, which is a normal approach in studies on knowledge intensive firms (e.g., Alvesson, 1993, 2001, 2004; von Nordenflycht, 2009) There are three reasons for adopting this perspective: First, knowledge intensive industries are knowledge intensive based on the industry aggregate. It is, however, not very likely that all firms, including start-ups, in this industry class are knowledge intensive; in addition, knowledge intensive start-ups are also present in traditional low-tech non-knowledge intensive industries. This person-centric perspective takes both considerations into account. Second, such a person centric perspective towards knowledge intensity is often used in identifying knowledge intensive rms. Third, IDA is a database strong on these person centric variables. In addition, I will only select those knowledge intensive start-ups that are active in (low-tech and high-tech) manufacturing and services.

The results of the logistics regression analyses show, after correcting for the usual predictors of rm survival, a significant and positive effect of previous co-worker experience on rm survival. However, when making a distinction between entrepreneurial spin-offs, i.e. the start-up where the founder of the start-up has experience in the same industry, and other start-ups this effect changes. Previous co-worker experience in other knowledge intensive start-ups has a signicant positive impact on the likelihood of survival while for entrepreneurial start-ups this effect disappears. In addition, the analysis shows that there are some signs of curvilinear effects, indicating that too much previous co-worker experience is detrimental for rm survival.

After this introduction, I will continue with the theoretical framework. This theoretical framework will focus on the link between previous co-worker experience and firm survival thereby building some testable hypotheses. In the method section, I will describe the database, sample selection, and the construction of the various variables used in the regression analyses. Afterwards, I will present the descriptive statistics and the results of the regression analysis. Lastly, the paper will summarize the findings and outline some concluding remarks.

2 Theory and Hypothesis

2.1 The of Social Networks in Human Resource Formation

Previous studies on human resource dynamics in start-ups focus, as mentioned in the introduction, on entrepreneurial or venture founding teams. This focus is one way to incorporate a broader human resource perspective. Nevertheless, this approach might still be too narrow because "the focus on the founder or founding team as the only source of human capital fails to recognize the important role that other employees in the new venture may play" (Cardon and Stevens, 2004, p. 296). New recruits are, due to their flexibility and creativity, one of the most critical resources for an organization (Aldrich and Ruef, 2006). Moreover, the acquisition of skilled human resources, being regarded as an important repository for knowledge (Argote and Ingram, 2000), is crucial for the existence of the activities undertaken in knowledge intensive start-ups (Sarasvathy, 2001). Ruef et al. (2003) already stated that: "Many entrepreneurs begin entirely on their own, although they may turn to others for help with various aspects of the founding process. Others begin with a team, making the enterprise a collective effort" (p. 195-196). Before investigating how previous co-worker experience affects to the survival of these knowledge intensive start-ups, it is important to recognize in what way these human resources are mobilized to become part of this start-up. In describing this human resource formation process, I will make a distinction between the formation of the entrepreneurial team and the recruitment of employees, despite the fact that the motivations behind these different types of human resource formation are similar.

2.1.1 Formation of Entrepreneurial Teams

Entrepreneurial teams are social entities and their existence depend on the possibility and wish to be formed Ruef et al. (2003). This formation mostly occurs prior to the venture formation processes and either before or after the business opportunity is recognized (Cooney, 2005). The large majority of the entrepreneurial teams that come into existence are formed based on social connections that existed prior to the start of the entrepreneurial process, e.g. friends family and/or associates (Vyakarman et al., 1999). This network dimension is one of the crucial mechanisms in entrepreneurial team formation (Ruef et al., 2003). In addition, Ruef et al. (2003) discusses four others mechanisms by which entrepreneurial teams are created, i.e. homophily, functionality, status expectations, and ecology.

Based on the theoretical considerations on the formation of groups, Ruef et al. (2003) expected to find: (i) homogeneity in the mechanisms homophily, which are the ascribed characteristics like gender and ethnicity that create greater levels of interpersonal attraction, trust, and understanding leading up to a better cultural fit; (ii) a heterogeneity based on functionality, i.e. occupational backgrounds, due to the anticipated advantages that can be obtained from being diverse on these grounds; and (iii) homogeneity in status expectations because high status individuals will have a strong preference for other high status individuals. These member addition mechanisms are in line with the one described by Forbes et al. (2006). They identified that teams are formed based on the manifestation of interpersonal attraction, often explained by similarity/attraction theory, that is driven by tangible *and* intangible but identifiable characteristics. Such a manifestation leads to a rather homogeneous composition. On the other hand there is the resource seeking behavior where members are add intangible assets, e.g. human and social capital, that are lacking and which are essential for the "success" of the start-up. On this grounds the teams would be regarded as heterogenous.

Despite the strong argument put forward by Ruef et al. (2003) on the expected effects of the difference in the composition of entrepreneurial team, their analyses showed a natural tendency to form entrepreneurial teams that are homogeneous on all these characteristics. This might be explained by the remaining two mechanism, i.e. network and ecological constraints. As already mentioned by Vyakarman et al. (1999), teams are formed of individuals that are part of each others network. These networks are driven by large degree of homogeneity on all the dimensions described and creates a barrier of being diverse, also on functionality. This homogeneity in functionality can be ascribed to the identifiable nature of a person's occupational background which can lead to a selection based on the manifestation of interpersonal attraction rather than resource seeking behavior.The ecological constraints relate to the diversity of potential partners that are present within a certain geographical space. Group formation is driven by geographical proximity and prior studies have shown that individuals in a certain region based on the achieved and status characteristics tend to be similar (Ruef et al., 2003). The importance of these network and ecological constraints are supported by the work of respectively Dahl and Sorenson (2008, 2009), who studied the geographical location of start-ups based on the presence of their social network and linked it to a their success; and Sørensen (2004), who added a ecological perspective on the start-up of firms based on the availability of labor in a specific region. Although their studies also apply on the recruitment of employees and not only on the formation of entrepreneurial teams.

2.1.2 Recruitment of Employees

The second component of human resource formation is the recruitment of other human resources in order to strengthen the activities of the start-up. The recruitment efforts of these start-ups are often "unplanned, informal and (...) 'unimaginative' " (Barrett and Mayson, 2008, p. 120) with only very few that have established methods for recruitment (Aldrich and Ruef, 2006; Barrett and Mayson, 2008). The responsibility of this activity often falls on the founders and trusted employees that are already present in the new venture. Nevertheless, the early recruitment decisions have lasting consequences for the new organization (Baron et al., 1999); especially given that most firms do not grow in size (Aldrich and Ruef, 2006) and the observation that the first to obtain a certain position in the firm creates a profile for those that will fill the position in the future (Burton and Beckman, 2007).

The motivation for hiring a certain individual can be divided in three overarching criteria (Baron et al., 1999; Aldrich and Ruef, 2006): (i) recruitment based on technical skills and experience needed to accomplish the tasks; (ii)recruitment based on cultural fit with the new organization; and (iii) recruitment based on long-term potential. The human resource formation process is thus based on the similar mechanisms as described in Forbes et al. (2006). Where most start-ups, due to the lack of individuals competent in dealing with human resource issues, fall back on the second criteria, i.e. cultural fit, thereby relying on socio-demographic factors (Aldrich and Ruef, 2006). Such a process will, like it was the case for entrepreneurial teams, predominantly lead to recruitment of workers that are similar to the already existing staff of the firm.

There are three types of recruitment channels available for new start-ups, i.e. informal recruitment, formal recruitment and brokering (Williamson and Robinson, 2008). Most entrepreneurs use a mix of the above-mentioned recruitment processes (Aldrich and Langton, 1998; Aldrich and Ruef, 2006), but it is the informal process that is the primary source for attracting new employees (Williamson and Robinson, 2008). This can be explained by the rather inexpensive

method and speed in which a person can be attracted. This is an advantage given the lack of financial and material resources that are available for this recruitment process. The process is distinct because the channels by which recruitment takes place where originally not intended for job market purposes (Marsden and Gorman, 2001) and dominantly relies on the social network of the founder and trusted others, i.e. strong and weak ties (Granovetter, 1973). Such an approach allows firms to increase their application horizon because they are able to move more people into applying for the available position (Williamson and Robinson, 2008). In addition, the quality of applicants might be higher because the person that suggest has knowledge on the potential fit of the potential applicant. In addition, the reputation of the person in the social network is dependent on the quality of the person they refer Aldrich and Ruef (2006); Williamson and Robinson (2008). Due to the reliance on social networks it can be expected that there is a high degree of similarity between the new recruit and the human resources already present in the organization. However, this might be desired when new start-ups want to recruit with the intention to improve cultural fit.

The formal recruitment process is to be preferred whenever a start-up is seeking to acquire a unique set of qualifications and skills; although the desire to recruit for cultural fit might as well lead that person are recruited which are similar. However, this process is more expensive —estimations have claimed that the costs are 67 percent higher than informal recruitment (Fernandez et al., 2000; Williamson and Robinson, 2008)— and time consuming because they recruit individuals that are not part of their social network. A challenge new start-ups face is their lack of organizational awareness (Williamson et al., 2002). As a result, additional efforts, e.g. placing job advertisements, web-based recruitment, and recruitment brochures, are required to make job seekers aware of the job position (Aldrich and Ruef, 2006). In addition, there is a high degree of uncertainty at both side of the employment relationship creating higher transaction costs for both parties (Lin, 2001; Aldrich and Ruef, 2006). Potentially benefits arise since these recruits are not bounded by the social network of the entrepreneur, which expands the number and the diversity of potential candidates. Nevertheless, most senior position will be filled by entrepreneurial team members and through informal recruitment; positions offered through formal recruitment methods are mostly junior positions, based on a well defined and concretely set of skills, making the task of formal recruitment easier (Aldrich and Ruef, 2006).

Brokering means that the entrepreneur approaches a third party to take part in the recruitment process, e.g. schools, training, institutes, or employment agencies. Such a process allows the start-up to leverage the social ties of others and enhance the breadth and depth of information on the job market (Williamson and Robinson, 2008). In practice this process can be regarded as the middle ground between formal and informal recruitment. Although the information that brokers will provide is less intimate they still have a reputation to uphold. As a result they will still provide information that might not be revealed through other screening processes. It is, however, required that there is a level of trust between the broker and the start-up and the broker should be the appropriate partner for the start-up — some brokering firms might be specialized in a certain domain (Williamson and Robinson, 2008).

Thus, the motives for forming an entrepreneurial team and recruiting new employees are similar and both processes rely heavily on existing social networks. The individuals who can be mobilized from a social network are different in the pre-founding relationship (e.g family, friends, colleagues, and other acquaintances). Although one might assume that in start-ups with a knowledge intensive dimension the recruitment of family and friends is subordinate to recruiting other

more skilled-based motives. The benefits that can be expected from these individuals might differ because the environment in which the social tie is developed is put into a new context; e.g. a former colleague changes organizational context. Therefore, it is important to distinguish between the different pre-founding relationships, rather than making only a distinction between the benefits of recruiting a strong or a weak tie. It can be expected that recruiting friends will have a different impact compared to recruiting former co-workers, because the latter relationship is already embedded in a work context. In the following sections, the role of adding a former co-worker to the start-up is discussed more in depth.

2.2 Overcoming the Liabilities of Youngness

A widely accepted belief on why new firms suffer from high mortality rates is their exposure to what has been termed "liabilities of newness" (Stinchcombe, 1965) or "liabilities of adolescence" (Brüderl and Schüssler, 1990). The liabilities of newness hypothesis was formulated because of Stinchcombe's observation that new organizations have a higher mortality rate. This hypothesis was tested and confirmed in a vast array of industry studies, including in industries that can be identified as knowledge intensive, e.g. semiconductors (Freeman et al., 1983). The central idea behind this lack of performance and lack of ability to rationally account for their actions is that young firms have relatively weak internal organizational structures and environmental relations, or more specifically:

> "(a) New organizations, especially new types of organizations, generally involve new roles, which have to be learned... (b) The process of inventing new roles, the determination of their mutual relations and of structuring the field of rewards and sanctions so as to get the maximum performance, have high costs in time, worry, conflict, and temporary inefficiency... (c) New organizations must rely heavily on social relations among strangers. This means that relations of trust are much more precarious in new than old organizations... (d) One of the main resources of old organizations is a set of stable ties to those who use organizational services. Old customers know how to use the services of the organization, have built their own social systems to use the old products or to influence the old type of government, are familiar with the channels of ordering, with performance qualities of the product, with how the price compares, and know the people they have to deal with... "(Stinchcombe, 1965, p. 148-149).

These disruptive effects will gradually wear off once the initial founding activities are completed, and might even transform into positive effects as this experience transforms into improved capabilities and secured organizational structures and routines (Carroll and Hannan, 2000; Ruef, 2002). Thus, the likelihood of failure based on *these* liabilities decreases monotonically with age. The liability hypothesis that is closely associated with the liability of newness but which anticipates a non-monotonic age dependence is the so-called *liability of adolescence* (Brüderl and Schüssler, 1990), also referred to as the honeymoon effect (Levinthal and Fichman, 1988). Their association is based on the fact that, despite the different perspective on when the failure rate of new firms peak, both hypotheses uphold the idea that the early years are the most hazardous and that eventually failure rates will decline by age (Henderson, 1999). The non-monotonic age dependence is a result of the initial resource endowments that are present at founding, such as financial resources, initial trust of internal and external supporters,and commitment and

enthusiasm. (Fichman and Levinthal, 1991). So, despite a lack of inter-organizational *and* intra-organizational relationships, new firms are able to survive for a short while because they can draw from this initial stock of resources. Due to resource depletion the risk of failure will increase until a crucial point is reached, e.g. first year evaluation, after which the likelihood of failure decreases again by age on those liabilities as mentioned in the liability of newness hypothesis (Henderson, 1999; Ruef, 2002). Consequently, it is not likely that firms fail directly after founding; instead, these firms face their highest mortality after a couple of months, and depending on the industry up to a couple of years after founding (Singh et al., 1986; Brüderl and Schüssler, 1990; Brüderl et al., 1992).

Although the timing between these different type of liabilities is different, both approaches hold the view that the mortality rate of start-ups is influenced by: (i) the lack of an organizational culture (i.e. the high cost, worry, conflict and inefficiency due to the invention of new roles), (ii) the lack of internal social capital (i.e. relation among strangers and the resulting low level of trust), and (iii) the lack of inter-organizational relationships (i.e. the ties to those who use organizational services), where the first two factors are closely connected to each other because they both deal with personal relationships.

As explained earlier in this paper, start-ups rely on social networks in their recruitment and entrepreneurial team formation process. This reliance can help in overcoming the lack of internal social capital and the lack of an organizational culture. Internal social capital, or bonding ties, are the relations that create a higher degree of cohesiveness within the organization and accelerate the pursuit of collective goals, which foster cooperative relationships (Adler and Kwon, 2002). From the perspective of new firm creation, intra-organizational bonding ties can only be present whenever a relationship already existed prior to the recruitment or entrepreneurial team formation process. On top of that, the presence of a social tie in the new firm already indicates a level of trust and cohesiveness. There are, however, various types of direct and indirect pre-founding relationships present in a social network (e.g. friends, family, friends of friends, former colleagues, etc.). Each pre-founding relationship and associated level of trust is formed in a particular context; a change of this context might have an effect on the trust and cohesiveness in the new organization. To illustrate this, compare a non-work related bonding tie (e.g. a friend) with a work-related bonding tie (e.g. a former colleague) and both individuals move to a new firm. The context of the latter remains the same (i.e. based on work) while the friend moves from a predominantly social context to a work context; a context which is not familiar to both sides of the newly formed co-worker relationship, and which most likely does not accelerate the pursuit of goals as quickly compared to the collaboration with a former colleague.

This last point is related to the need of a strong organizational culture (Stinchcombe, 1965; Campbell, 2005), also for new and emerging organizations (Aldrich and Ruef, 2006) The problem is that new firms do not have such a culture because they lack (i) the homogeneity and stability of group membership and (ii) the length and intensity of shared experiences within the organization (Schein, 1984). Be that as it may, the fact that firms do not have a culture of their own does not mean it can, in the infancy phase, build on the shared experiences that have been formed in another organizational context. Involving former co-workers can lead to the creation of a strong culture and improved efficiency (Eisenhardt and Schoonhoven, 1990; Campbell, 2005). Each individual that enters the new start-up has internalized the organizational culture of the firms to which they were connected to in the past (Meek, 1988). If multiple individuals have the same previous firm experience, they bring the same organizational culture into the organization,

which might help to overcome any initial problem with efficiency and role determination. This transfer of organizational culture can be placed on the same line with the spin-offs literature and the transfer of organizational routines and resources that influence the survival and overall performance of spin-off (Baron et al., 1999; Burton et al., 2002; Dahl and Reichstein, 2006).

Finally, previous interaction with former co-workers functions as a strong screening mechanism. Co-workers are exposed to each others' skills and competences on a daily basis. In this position a person is able to judge whether these skills and competences are valuable for the new organization. If these skills did not prove to be valuable, the former co-worker would not be asked to join the new venture; this would also be the case if it were believed that the person did not fit into the organizational culture. On the other hand, these selection mechanisms can also work the other way from the potential recruit to the new organization. A high degree of co-worker experience might also indicate and influence the co-worker of whether those that run the business have the competences and capability of running a potential success business and putting together a good team.

Based on the above, I derive that the presence of previous co-worker experience would benefit the new start-up in three interconnected ways. First, there is the presence of a bonding tie between the different co-workers in the new organization that leads to a higher level of trust and a higher degree of cohesiveness. Second, the shared organizational context can create a stronger organizational culture because parts of the culture that existed in the previous workplace will be transferred to the new start-up. This familiarity to the organizational culture will lead to more efficiency and less conflict, which is an advantage for the firm to survive in the initial phase. Third, there is a selection mechanism in attracting a former colleague into the organization. Based on the shared working experience it is possible to make a first-hand judgment on whether individuals possess the resources that are needed to fulfill the task and whether this person will fit in the new firm. This results in the following hypothesis.

> *Hypothesis 1: An increase in the degree of previous co-worker experience increases the likelihood of firm survival.*

Hypothesis 1 focuses on the previous co-worker experience of all human resources in the knowledge intensive start-ups. The specific role these human resources fulfill, i.e. whether they are a founder or an employee or skilled and non-skilled, is not taken into account. Nevertheless, it can be assumed that founders are more committed to the start-up than employees. In addition, they are the main decision makers.

Founders are shaped by their previous job positions, hence the notion of founders as organizational products (Audia and Rider, 2006). These experiences have proven to be influential in determining the survival rate of start-ups because the routines gained in the previous forms of employment are transferred to the new organization (Dahl and Reichstein, 2006). In addition to transferring the routines, they also influence the nature of the organization (Huber, 1991), and determine the organizational culture within the new firm (Schein, 1983, 1984; Bass and Avolio, 1994). Whenever previous co-worker experience is present among the founders, this organizational culture is enhanced because they can build on shared experiences. Moreover, the fact that former co-workers decide to start up a business together indicates a high level of trust and reliance on each other's competences (Eisenhardt and Schoonhoven, 1990).

The role of the employees should, however, not automatically be overlooked. Founders are responsible for the recruitment of employees. By recruiting employees from previous workplaces the founder (i) increases the likelihood of recruiting a person that will fit in the organizational culture of the start-up, and (ii) had the opportunity to identify whether the skills this person has are suitable for the task this person is hired for. In close relation to the distinction between founders and employees is the co-worker relationship between the skilled workers that are present in the firm, the latter being the driving force behind these knowledge intensive start-ups. These perspectives lead to the formulation of the following hypotheses:

> *Hypothesis 2a: Previous co-worker experience among and with the founder has a stronger impact on the likelihood of firm survival than previous co-worker experience among the employees.*

> *Hypothesis 2b: Previous co-worker experience among the skilled workers has a stronger impact on the likelihood of firm survival compared to previous co-worker experience among other, non-skilled, workers.*

In addition to the internal social capital and the need of an organizational culture, there was a third liability, i.e. lack of inter-organizational relationships. To overcome this last liability component, a start-up needs to have industry specific knowledge, e.g. customer demand, products, technologies, suppliers and competition (Cooper et al., 1994; Shane and Khurana, 2003). A high degree of this knowledge will positively influence the surviving chances of the start-up. In the last mentioned hypothesis, I argue for a stronger effect of previous co-worker experience whenever the founder is involved in this relationship. For this reason, it should be taken into account whether there is a difference in the role of this previous co-worker experience, especially when the founder has experience in the same industry (i.e. if the start-up is an entrepreneurial spin-off) (Klepper, 2001; Helnat and Lieberman, 2002; Dahl et al., 2003). Earlier studies have already shown that this industry-specific experience of founders has a strong influence on the survival of firms (Agarwal et al., 2004; Klepper and Sleeper, 2005; Dahl and Reichstein, 2006). An entrepreneurial spin-off can build on the existing external relationships and will form a balance on the lack of internal social capital and organizational culture. For this reason, I hypothesize that entrepreneurial spin-offs rely less on previous co-worker experience than other types of start-ups.

> *Hypothesis 3: Entrepreneurial spin-offs rely more on founder experience, and previous co-worker experience will have less influence on the likelihood of firm survival compared to other start-ups.*

In the previous three hypotheses, I argued solely in favor for involving former co-workers into the organization. However, there might be a negative impact of too high levels of previous co-worker experience due to organizational inertia pressures. These inertia pressures put constraints on the adaptive capabilities that are needed to solve problems of complexity encountered by these new firms. Hannan and Freeman (1977, 1984) present different types of internal and external inertia pressures. These inertia pressures are mainly discussed in relation to organizational change; however, they can also be applied in connection to new venture creation. Start-ups with a

high degree of previous co-worker experience are strongly connected with the routines in the previous organization and can therefore be considered as a special form of organizational change. Because I focus on the internal factors that influence the survival of the firm, I will elaborate on the following internal inertia pressures: (i) sunk costs in plant, equipment and personnel, (ii) information constraints, (iii) the dynamics of political coalitions, and (iv) the tendency for precedents to become normative standards.

Of most concern are inertia pressures two and four; even more so because they are intertwined. The fourth inertia, related to the tendency for precedents to become normative standards, will have an additional impact on the information constraints. If a start-up has a high degree of previous co-worker experience, the information will predominantly build on the information and contacts that were present in the previous organization, which constrains the search for opportunities (Aldrich and Ruef, 2006, p.78). That is why Adler and Kwon (2002) argues for the importance of both bonding and bridging ties, where bridging ties provide access to unique knowledge and contacts (Beckman, 2006); and resources that otherwise would not be available to the firm (McEvily and Zaheer, 1999). As indicated earlier, one motivation for recruiting new employees into the start-up is to integrate diverse knowledge that the organization lacks (Song et al., 2003). A high degree of previous co-worker experience would result in a lack of structural holes due to the strong tie nature of these contacts, which results in less new knowledge entering the start-up (Burt, 1992).

> *Hypothesis 4: Large levels of previous co-worker experience will hamper the survival of new firms*

3 Method

3.1 Data

In order to investigate the impact of previous co-worker experience on the survival of knowledge intensive start-ups, I rely on the Danish Integrated Database for Labor Market Research (from now on referred to by its Danish acronym IDA). IDA is a longitudinal and universal linked employer-employee database constructed from government registers and maintained by Statistics Denmark (DST). This database contains detailed information on *all* individuals and *all* establishments in Denmark from 1980 onwards. Each individual and establishment has a unique identification number, which makes it possible to study firm dynamics (founding, growth and disbanding of firm) and the employment history of the labor force. These features make the database suitable for the analyses in this paper. Moreover, it is possible to identify personal (e.g. education and work experience) and firm characteristics, (e.g. number of employees, industry, ownership type and location). Given this structure, I can identify who worked at which establishment at any given year since 1980, which facilitates the identification of previous co-worker experience.[1]

[1] Timmermans (2010) provides a more in depth description of IDA.

3.2 Knowledge Intensive Start-ups, Founders, and Entrepreneurial Spin-offs

Before I can select knowledge intensive start-ups, I need to identify which firms in the database can be identified as start-ups. To identify these start-ups I use the establishment and firm identification codes. The first four digit of the establishment identification number indicates the year in which the establishment was founded. Consequently, all firms with an establishment identification number that indicates a founding in an earlier year will be removed. In order to assure that the firm did not change their establishment identification number I checked whether the firm identification number existed prior to the year it has been identified as a new start-up. The definition of a start-up in this paper is thus an establishment with no prior identify number that can be associated with a firm without a prior identify number (Dahl and Reichstein, 2006). Afterwards, the establishment identification numbers of these start-ups are linked to the employee database to identify the human resources of these new start-ups in the first year. Because I am interested in the first recruits of the organization, I will also, if the start-up is still present, identify the human resources of the start-up in the second year. The motivation for including the second year human resources is twofold. First, start-ups founded right before the November registration period had less time to recruit any potential human resources. By including second year human resources I do not run the risk of omitting start-ups later on in the process.[2] Second, important human resources are not necessarily recruited immediately after the founding of the start-up. Especially since entrepreneurs face difficulties in finding allegeable candidates.

From the population of start-ups, I need to identify those start-ups that I classify as knowledge intensive. This selection procedure will move beyond the traditional industry classification of knowledge intensive industries because not all start-ups in knowledge intensive industries are knowledge intensive *and* start-ups in traditional non-technology and non-knowledge intensive industries can be considered knowledge intensive. IDA provides detailed person and firm characteristics but does not identify the type of interactions and activities that takes place within the firm and between the firm and their environment. This puts limits on those quantifiable measures that can be used for identifying whether the start-up is knowledge intensive. Nevertheless, the person level characteristics puts me in the position to follow an approach often used by studies on knowledge intensive firms, i.e. a person centric perspective on knowledge intensity (Starbuck, 1992; Alvesson, 1993, 2000, 2001, 2004; Robertson and Swan, 1998; Swart and Kinnie, 2003; von Nordenflycht, 2009). This definition implies that a knowledge intensive start-up employs a relative high share of skilled workers. However, these skilled workers are not directly identified in the database and I will rely on two proxies, i.e. education background and income variables, to identify skilled workers. Human capital theory argues that higher wage levels are associated with better skilled workers (Juhn et al., 1993; Neal, 1995; Abowd et al., 1999; Dahl and Klepper, 2008). In addition, Brüderl et al. (1992) argues that entrepreneurs with a higher income as employees are better equipped because they have a higher level of human capital. [3]

In addition to the two above-mentioned proxies to identify skills, I include two individual restrictions before a person is identified as a skilled worker, i.e. the age of the worker and the

[2] In selecting knowledge intensive start-ups I will use a lower size limit.

[3] Within the literature a vast array of knowledge types have been identified. Among these types there is also knowledge that is regarded as experience-based (e.g. experience in the same industry). This particular type of experience-based knowledge would be easy identifiable in the database. However, the experience-based dimension is an important component to identify so-called entrepreneurial spin-offs. So, even though I recognize the importance of this type of knowledge for firm performance I will not use it to select the so-called knowledge intensive start-ups.

labor market attachment. In order to be identified as a skilled worker the person needs to be at least 25 years of age and have had work experience in the previous three years. Whenever these requirements are met, I regard those persons skilled if they have an academic degree (i.e. bachelor degree or higher) or belong to the top 20 percent wage earners; in addition to the top 20 percent, this wage level should be higher than the median overall income. Because these individuals all enter into employment in entrepreneurship, there might be a negative effect on the wage level. For this reason, I take the last earned income. In addition, to account for industry specific factors, the person needed to belong to the top 20 wage earners in the two-digit NACE industry class in which he or she was working.

For all the identified start-ups, the numbers of skilled workers, according to the definition above, are known. The next step is to identify the composition of knowledge intensive start-ups based on these skilled workers. Studies on knowledge intensive start-ups contend that these types of start-ups predominantly exist out of teams that consist out of two or more persons (Gartner, 1985; Chowdhury, 2005; Neergaard and Madsen, 2004; Ulhøi, 2004). They argue that it is unlikely that the required knowledge to run the activities in these type of start-ups are possessed by only one person (Gartner, 1985; Chowdhury, 2005). The size criteria for the number of skilled workers in knowledge intensive start-ups will be at least two, where I include all human resources in the start-up and do not focus solely on the founders. The degree of interaction among the skilled workers and between these skilled workers and the other employees is heavily dependent on the size of the new start-up. Only relying on a minimum of two skilled workers would not grasp these effects. For this reason, I select those start-ups where the skilled workers form at least 25 percent of the start-up's workforce. As a result, the sample will consist out of 4,110 knowledge intensive start-ups.[4]

Moreover, the human resources in these start-ups will be divided in founders or founding teams, and the first employees. To identify founders, I will fall back on a method similar to Nanda and Sørensen (2009) and Dahl and Reichstein (2007) who use the same database. The challenge in selecting these founders is the fact that structure of the database does not allow me to clearly identify founders. Nevertheless, it is possible to single out managers and owners. Here I ague, in line with Dahl and Reichstein (2006), that the majority of Danish firms are likely to be managed by their founders. This perspective is also shared by studies on entrepreneurial teams that take the perspective that these teams consist of those individuals who are responsible for the establishment and management of the new venture (Vyakarman et al., 1999; Dautzenberg et al., 2007). The selection of these founders differs depending on the type of ownership. In the case of sole proprietorship and ordinary partnerships a founder is identified as a person that according to the classification scheme as an owner or a high ranked manager. For corporate ventures, I use a similar founder identification method with the exception of ventures that have three or less employees; in which case, I consider all individuals part of the founding team.

The work history of the founders will be used to determine whether the start-up was founded by a person who has industry specific know-how (i.e. an entrepreneurial spin-off). Dahl and Reichstein (2006) identifies, by using the same database, an entrepreneurial spin-off as a start-up with at least two founders coming from the same firm within the same four-digit NACE industry class. I will follow a broader definition of such a spin-off due to (i) the small size of most start-ups, (ii) the low number of founders, and (iii) the co-worker tie that is already present in this

[4] A sample with 50 percent, 75 percent and 100 percent skilled workers would consist out of 2,848; 1,289; and 884 start-ups respectively.

Table 1: Structure of the Dataset Based on the Dependent Variable

FIRM ID	FOUNDING YEAR	YEAR	SURVIVE	AGE	INDEPENDENT VARIABLES
1	2000	2000	1	1	...
1	2000	2001	1	2	...
1	2000	2002	1	3	...
1	2000	2003	0	4	...
2	2004	2004	1	1	...
2	2004	2005	1	2	...
3	1995	1995	1	1	...
3	1995	1996	1	2	...
3	1995	1997	1	3	...
3	1995	1998	1	4	...
3	1995	1999	1	5	...
4	1998	1998	0	1	...

definition. In this paper, an entrepreneurial spin-off is a firm founded by at least one founder who has worked in the same four-digit NACE industry classification in at least one of their last three establishments. Within the sample I identified a total of 1,833 entrepreneurial spin-offs, i.e. 44,6 percent of all knowledge intensive start-ups.

3.3 Variables

Dependent variable: In this study, I will test the impact of previous co-worker on the survival of knowledge intensive start-ups. For firm survival I will identify whether the identified start-up is present in the database from one year to the other up to five years following the founding of the firm. In addition to these criteria, several other criteria need to considered. Some firms are still present but they have been taken over by an incumbent firm. This will be regarded as a successful exit. The firm will be treated as a survivor, but will be excluded for further analysis. There are also firms that failed but re-entered. In this analysis, re-entries will be considered as failures and therefore are removed from the dataset. Table 1 presents the structure of the dataset. In total the sample consists of 13,920 firm year observations. The method by which I created the different independent variables runs the risk of multicollinearity; however, multicollinearity tests have indicated that this is not the problem since the variance inflation factor stays below the critical boundary of five. Furthermore, due to the structure of the data, which are yearly observations, it is not possible to make a clear distinction whether the failure of firms follows the liability of newness and adolescence hypothesis.

Independent Variables: The main variables are those that measure the degree of previous co-worker experience. This previous co-worker experience is determined on all the human resources that are present in the first *and* second year. The motivation for choosing the human resources in the first two years is: (i) the observation that most firms start small and hardly change in size during their lifetime (Aldrich and Ruef, 2006); (ii) the initial resource profile can be used to predict start-up performance, including failure (Cooper et al., 1994); and (iii) early hiring decisions have lasting consequences for new organizations (Baron et al., 1999). As IDA uses unique personal identification numbers, I can avoid double counting.

To create these variables, I selected the three most recent establishments in which each individual was active before joining this new venture. Some individuals are not registered to have had any

work experience, either because they were new to the Danish labor market or experienced a long spell of unemployment. In total I created seven different previous co-worker experience variables. The first variable measures the degree of previous co-worker experience based on all individuals (i.e. founders and employees) who are associated with the new venture in the first two years. This variable, termed *know all* I calculated based on the following concentration measure:

$$C_i = \sum_{i=1}^{n} s_{ij}^2 \tag{1}$$

C_i= Concentration of employees with a previous co-worker relationship in the new firm.
s_{ij}= Share of individuals who can be associated to firm i and share a previous firm j with at least one other individual
n= Those shares where two or more current employees share the same previous workplace.

In order to calculate this measure, I identified those individuals who share a common establishments based on the last three establishments in which they were active. In addition, it is important to recognize that two individuals can share the same establishment even though they did not work at this establishment at the same time. Afterwards, I measure the share of all individuals who worked in each of the previous establishments and take the square value of each share to assign a higher value to larger groups in the firm. Contrary to a more ordinary concentration measure (e.g. Herfindahl-Hirschman Index) the square values of individuals who do not share a previous establishment with another individual will not be added. The reason for doing so is that a relationship exists between at least two individuals. To further illustrate this, imagine a firm with five individuals where two individuals share the same previous workplace. In this situation C_i will have a value of 0.16. If this same firm consisted of ten individuals but still with two from the same workplace, C_i would drop to 0.04. If no individuals share the same previous firm this value would drop to zero.

To disentangle the effect of knowing the founder or knowing other co-workers, I introduce the variable termed *know founderempl*. This variable indicates the share of employees who had a previous co-worker relationship with at least one of the founders. For calculating the degree of previous co-worker experience among the employees, *know employee*, and founders, *know founder*, I use the same measure as presented to calculate *know all*. A similar approach is adopted for identifying the impact of previous co-worker experience amongst the skilled (*know skilled*), non-skilled (*know non-skilled*), and the relation between skilled and other employees (*know skillempl*).

Control Variables: In addition to the above-mentioned explanatory variables, I need to control other for factors that explain differences in firm survival. The usual predictors are: initial size, age, year of founding, type of ownership, location, and industry. As a measure of initial size, I take the logarithmic value of the number of employees that are present in the first and second year of founding. This variables will be the same for all the yearly observations. The age variable is a categorical variable indicating the age of the start-up in number of years in combination with a dummy variable that indicates the year of founding. In addition to size and age I will also, as suggested by (Brüderl and Schüssler, 1990), control for the type of ownership being either

sole proprietorship, general partnership or a limited partnership. A dummy variable is created for each of these different ownership types. Another variable to control for is whether the new firm is located in the Copenhagen Metropolitan Area (CMA). Start-ups located in this area are said to face stronger competition compared to those located in other parts of the country. Such a variable has also been used in previous studies (Brüderl and Schüssler, 1990; Eriksson and Kuhn, 2006; Dahl and Reichstein, 2006). The last variable to control for is industry. To do so, I make a distinction between eight different industries based on their technology and knowledge intensity. Table 2 presents an overview of the different industry classes including the NACE codes in each class and the number of observations in the sample. Just over 77 percent of all the identified knowledge intensive start-ups are active in the so-called knowledge and technology intensive industries.

Table 2: High- and Medium-High -Technology and Knowledge Intensive Business Services (NACE Revision 1.1)

INDUSTRY NAME	NACE CLASSIFICATION	COUNT
High-Technology		
1. Aerospace	35.3	1
2. Computers, Office Machinery	30	14
3. Electronics-Communications	32	7
4. Pharmaceuticals	24.4	16
5. Scientific Instruments	33	38
Medium-High-Technology		
6. Motor Vehicles	34	7
7. Electrical Machinery	31	38
8. Chemicals	24 - 24.4	6
9. Other Transport Equipment	35.2 + 35.4 + 35.5	2
10. Non. Electrical Machinery	29	88
Medium-Low-Technology		
11. Rubber and Plastic Products	25	17
12. Shipbuilding	35.1	12
13. Other Manufacturing	36.2 through 36.6	19
14. Non-Ferrous Metals Transport Equipment	27.4 +27.53/54	3
15. Non-Metallic Mineral Products	26	18
16. Fabricated Metal Products	28	105
17. Petroleum Refining	23	0
18. Ferrous Metals	27.1 through 27.3 +27.51/52	7
Low-Technology		
19. Paper Printing	21+22	113
20. Textile and Clothing	17 through 19	27
21. Food, Beverages and Tobacco	15+16	32
22. Wood and Furniture	20+36.1	35
Knowledge-Intensive High-Technology Services		
23. Post and Telecommunications	64	80
24. Computer and Related Activities	72	939
25. Research and Development	73	92
Knowledge-Intensive Market Services		
26. Water Transport	61	21
27. Air Transport	62	2
28. Real Estate Activities	70	272
29. Renting of Machinery and Equipment	71	59
30 Other Business Activities	74 -74.7-74.8	1,439
Knowledge-Intensive Financial Services		
31. Financial intermediations	65	92
32. Insurance and Pension Funds	66	8
33. Activities Auxiliary to Financial Intermediation	67	28
Less Knowedge-Intensive Market Services		
34. Land Transport; transport via pipelines	60	205

Continued on Next Page...

Table 2 – Continued

Industry Name	NACE Classification	Count
35. Supporting and auxiliary transport activities and	63	106
36. Cleaning companies	74.7	27
37. Other business services	74.8	134

source: Eurostat (2008)

In addition to the above-mentioned overall firm characteristic, I also correct for human capital characteristics of the initial human resource composition. Even though a firm is subject to these characteristics changing due to the arrival and departure of employees, the initial composition has proven to be a good estimator for future performance (Cooper et al., 1994). First, I create a variable indicating the share of individuals with an academic degree as earlier studies have identified that education has a positive effect on performance. Second, the average number of years of total work experience (average number of years an individual has been present in the database since 1980). Third, tenure in the previous firm (average number of years an individual has been registered as employee of the previous firm), reason being that the majority of the previous co-worker experience is based on the last firm. Fourth average year of work experience in the same four-digit NACE industry class. The last variable will indicate the share of individuals who in at least one their last three establishments, worked in the same four-digit NACE industry class as the start-up.

4 Results

4.1 Descriptive Statistics

Table 3, Table 4, and Table 5 present the survival of all the knowledge intensive start-ups in the sample, entrepreneurial spinoffs, and other start-ups, respectively. Due to the successful exit as a result of a take-over, the numbers of start-ups in one year are not equal to the number of surviving start-ups in the previous year. In addition, firms founded after 2001 cannot be followed for the full five-year period and they will also disappear from the sample although they have survived up to that point. The numbers show that the survival rate of entrepreneurial spinoffs is higher compared to other knowledge intensive start-ups.

Table 3: Survival and Failure Entire Sample

YEAR	COHORT	ENTIRE SAMPLE			
		N	SURVIVE	FAIL	SURV. RATE
1	1995-2004	4,110	3,788	322	92.21 %
2	1995-2004	3,655	3,259	396	89.17 %
3	1995-2003	2,725	2,467	258	90.53 %
4	1995-2002	1,962	1,844	118	93.99 %
5	1995-2001	1,470	1,379	91	93.81 %

Furthermore, In Table 6, I present an overview of the descriptive statistics of the variables used in the regression analysis. Bear in mind that the averages and standard errors are calculated

Table 4: Survival and Failure Entrepreneurial Spinoffs

YEAR	COHORT	ENTREPRENEURIAL SPINOFFS			
		N	SURVIVE	FAIL	SURV. RATE
1	1995-2004	1,833	1,714	119	93.51 %
2	1995-2004	1,668	1,522	146	91.25 %
3	1995-2003	1,283	1,178	105	91.82 %
4	1995-2002	930	886	44	95.27 %
5	1995-2001	710	670	40	94.37 %

Table 5: Survival and Failure Other Start-Ups

YEAR	COHORT	OTHER START-UPS			
		N	SURVIVE	FAIL	SURV. RATE
1	1995-2004	2,277	2,074	201	91.16 %
2	1995-2004	1,987	1,737	250	87.42 %
3	1995-2003	1,442	1,289	153	89.39 %
4	1995-2002	1,032	958	74	92.83 %
5	1995-2001	760	709	51	93.29 %

based on the initial composition and the situation in the year of founding. The correlation is high between *know all* on the one hand and *know founder*, *know founderempl*, *know employee*, *know skilled*, *know nonskilled*, and *know skilledempl*, on the other. Because these are substitute variables in separate regression models this correlation is expected. Additional multicollinearity tests have been conducted and is shows that this is not the problem since the variance inflation factor stays below the critical boundary of five. In total, just over 70 percent of all the knowledge intensive start-ups (2,894) experience some degree of previous co-worker experience. The share of co-worker experience is highest among the entrepreneurial spin-offs (i.e. just over percent). As already indicated previously, almost 45 percent of the start-ups are entrepreneurial spin-offs and the highest share of start-ups is active in services. Moreover, most firms are limited partnerships and located in the local labor market of Copenhagen.

4.2 Regression Results

The results of the logistic regressions are summarized in Table 7, Table 8, and Table 9. Each table presents the impact of the degree of co-worker experience among all members of the start-up, degree of shared co-worker experience among the founders and the degree of co-worker experience among the skilled workers for the entire sample, entrepreneurial spinoffs, and other knowledge intensive start-ups, respectively. Please note that survival has the value *one* and death the value *zero* when interpreting the effects of each variable. A positive sign thus indicates a positive effect on the likelihood of survival.

Table 7 presents the impact of previous co-worker experience on firm survival in all the knowledge intensive start-ups in the sample. Model A1 shows the outcome of a logistic regression analysis including the control variables and the co-worker experience variable *know all*. After correcting for the usual predictors of firm survival, the analysis shows a significant and positive effect of previous co-worker experience on the likelihood of firm survival, although only significant on the

Table 6: Descriptive Statistics (n=4,110)

VARIABLE	MEAN	S.E.	MIN.	MAX.
High Tech	0.015	0.120	0.000	1.000
Medium High Tech	0.038	0.192	0.000	1.000
Medium Low Tech	0.044	0.205	0.000	1.000
Low Tech	0.051	0.219	0.000	1.000
Knowledge Intensive High Tech Services	0.270	0.444	0.000	1.000
Knowledge Intensive Financial Services	0.031	0.174	0.000	1.000
Knowledge intensive Market Services	0.475	0.499	0.000	1.000
Other Less Knowledge Intensive Services	0.076	0.265	0.000	1.000
Initial Employment Size (log)	1.714	0.725	0.693	4.585
Share of start-ups in 1995	0.060	0.237	0.000	1.000
Share of start-ups in 1996	0.068	0.252	0.000	1.000
Share of start-ups in 1997	0.079	0.269	0.000	1.000
Share of start-ups in 1998	0.081	0.273	0.000	1.000
Share of start-ups in 1999	0.103	0.304	0.000	1.000
Share of start-ups in 2000	0.144	0.351	0.000	1.000
Share of start-ups in 2001	0.133	0.340	0.000	1.000
Share of start-ups in 2002	0.114	0.318	0.000	1.000
Share of start-ups in 2003	0.103	0.304	0.000	1.000
Share of start-ups in 2004	0.115	0.319	0.000	1.000
Entrepreneurial Spinoff	0.446	0.497	0.000	1.000
CMA	0.632	0.482	0.000	1.000
Sole Proprietoship	0.136	0.343	0.000	1.000
Partnership	0.073	0.261	0.000	1.000
Limited Partnership	0.783	0.412	0.000	1.000
Average age employees	36.675	6.669	21.286	68.600
Average number of years of work experience in the same industry	1.547	2.577	0.000	23.000
Average tenure in the last firm	4.874	2.436	0.500	21.500
Average total work experience	12.158	3.569	0.667	22.500
Share of academics in the firm	0.354	0.326	0.000	1.000
know all	0.297	0.330	0.000	1.000
know founder	0.295	0.411	0.000	1.000
know employee	0.135	0.252	0.000	1.000
know founderempl	0.147	0.262	0.000	1.000
know skilled	0.365	0.412	0.000	1.000
know nonskilled	0.105	0.240	0.000	1.000
know skilledempl	0.164	0.282	0.000	1.000

10 percent level. When considering the other variables, a strong effect is visible for size, type of ownership and the manufacturing industries. In addition, the experience of the employees also contributes in the likelihood of firm survival, especially related to same industry experience. Being an entrepreneurial spinoff has a positive effect on the likelihood of firm survival. Finally, education does not appear to have a significant impact; however, this might be explained by the bias in highly educated workers in these type of start-ups.

In Model A2, I make a distinction between founders and employees by substituting *know all* with *know founder*, *know founderempl*, and *know employee*. This allows me to determine if there is a different effect when comparing founder-founder, employee-founder, and employee- employee ties. The outcome shows a positive and significant effect regarding the share of employees who worked previously with one of the founders on the likelihood of firm survival and the a lesser extent the previous co-worker experience among the founders. Previous co-worker experience among employees does not have any effect on the likelihood of firm survival. The remaining variables do not differ from those reported in Model 1.

Model A3 includes the variables that measure the impact of previous co-worker experience among

Table 7: Summary of the Regression Analyses on All Knowledge Intensive Start-Ups

Variable	MODEL A1 Estimate	S.E	MODEL A2 Estimate	S.E	MODEL A3 Estimate	S.E
Intercept	0.256	0.306	0.363	0.306	0.246	0.308
Year 5	0.214**	0.093	0.211**	0.093	0.213**	0.093
Year 4	0.271***	0.083	0.271***	0.083	0.271***	0.083
Year 3	-0.244***	0.063	-0.243***	0.063	-0.243***	0.063
Year 2	-0.345***	0.056	-0.344***	0.056	-0.344***	0.056
Year 1	*benchmark*		*benchmark*		*benchmark*	
High Tech	0.100	0.293	0.105	0.293	0.096	0.293
Medium High Tech	0.858***	0.264	0.838***	0.264	0.855***	0.264
Medium Low Tech	0.506**	0.220	0.479**	0.220	0.486**	0.220
Knowledge Intensive High Tech Services	-0.082	0.154	-0.086	0.154	-0.082	0.154
Knowledge Intensive Financial Services	0.316	0.234	0.310	0.234	0.315	0.234
Knowledge intensive Market Services	0.257*	0.149	0.257*	0.149	0.258*	0.149
Other Less Knowledge Intensive Services	0.173	0.185	0.181	0.185	0.179	0.185
Low Tech	*benchmark*		*benchmark*		*benchmark*	
Entrepreneurial Spinoff	0.148*	0.079	0.138*	0.079	0.145*	0.079
Initial Employment Size (log)	0.571***	0.054	0.516***	0.055	0.551***	0.056
CMA	0.014	0.067	0.019	0.067	0.020	0.067
Limited Partnership	0.573***	0.088	0.563***	0.090	0.568***	0.088
Partnership	-0.419***	0.126	-0.431***	0.127	-0.427***	0.126
Sole Proprietorship	*benchmark*		*benchmark*		*benchmark*	
Average age employees	-0.013**	0.006	-0.013**	0.006	-0.013**	0.006
Average number of years of work experience in the same industry	0.051***	0.019	0.047**	0.019	0.049***	0.019
Average tenure in the last firm	0.063***	0.017	0.061***	0.017	0.061***	0.017
Average total work experience	0.048***	0.014	0.044***	0.014	0.048***	0.014
Share of academics in the firm	0.154	0.107	0.141	0.108	0.174	0.108
know all	0.175*	0.102				
know founder			0.132*	0.084		
know employee			0.146	0.158		
know founderempl			0.441***	0.150		
know skilled					0.195**	0.081
know nonskilled					0.051	0.174
know skilledempl					0.103	0.139
start-up cohort dummies	yes		yes		yes	
N	13,920		13,920		13,920	
Likelihood ratio	460.899***		475.411***		465.877***	

*** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level

those workers that have been identified as skilled workers. The analysis show that there is only a positive impact of previous co-worker experience among the skilled workers. The other ties do not present a significant impact. The remaining variables show similar signs to the previous two models.

In Table 8 I present three models that test the impact of different types of previous co-worker ties in the so-called entrepreneurial spinoff. The first model, Model B1, presents the results of the logistic regression analysis including the control variables and the co-worker experience variable *know all*. After correcting for the usual predictors of firm survival, the analysis shows no significant and positive effect of previous co-worker experience on the likelihood of firm survival. When considering the other variables, a strong effect is still visible for size, type of ownership and the manufacturing industries. In addition, the experience of the employees also contributes in the likelihood of firm survival, especially related to same industry experience. Education, however, has a significant positive impact on the likelihood of survival among the entrepreneurial spinoffs.

Table 8: Summary of the Regression Analyses on Knowledge Intensive Entrepreneurial Spinoffs

Variable	MODEL B1 Estimate	S.E	MODEL B2 Estimate	S.E	MODEL B3 Estimate	S.E
Intercept	0.960*	0.515	1.012**	0.514	1.013*	0.520
Year 5	0.158	0.141	0.152	0.141	0.156	0.141
Year 4	0.372***	0.134	0.370***	0.134	0.372***	0.134
Year 3	-0.273***	0.099	-0.275***	0.099	-0.273***	0.099
Year 2	-0.326***	0.090	-0.323***	0.090	-0.326***	0.090
Year 1	*benchmark*		*benchmark*		*benchmark*	
High Tech	0.182	0.527	0.218	0.529	0.164	0.528
Medium High Tech	1.058**	0.475	1.090**	0.476	1.053**	0.476
Medium Low Tech	0.838**	0.400	0.837**	0.401	0.834**	0.400
Knowledge Intensive High Tech Services	0.026	0.253	0.058	0.254	0.029	0.254
Knowledge Intensive Financial Services	0.393	0.440	0.356	0.440	0.375	0.440
Knowledge intensive Market Services	0.306	0.247	0.362	0.248	0.304	0.248
Other Less Knowledge Intensive Services	0.271	0.275	0.328	0.275	0.266	0.276
Low Tech	*benchmark*		*benchmark*		*benchmark*	
Initial Employment Size (log)	0.657***	0.083	0.602***	0.087	0.631***	0.089
CMA	-0.058	0.109	-0.057	0.110	-0.063	0.110
Limited Partnership	0.385***	0.143	0.396***	0.146	0.386***	0.143
Partnership	-0.526***	0.203	-0.535***	0.206	-0.521**	0.204
Sole Proprietorship	*benchmark*		*benchmark*		*benchmark*	
Average age employees	-0.014	0.010	-0.014	0.010	-0.014	0.010
Average number of years of work experience in the same industry	0.067***	0.023	0.058***	0.022	0.066***	0.023
Average tenure in the last firm	0.070**	0.030	0.072**	0.030	0.069**	0.030
Average total work experience	0.016	0.023	0.012	0.023	0.016	0.023
Share of academics in the firm	0.342*	0.177	0.343*	0.177	0.342*	0.178
know all	-0.006	0.169				
know founder			-0.056	0.132		
know employee			-0.026	0.236		
know founderempl			0.684***	0.239		
know skilled					-0.054	0.131
know nonskilled					-0.058	0.254
know skilledempl					0.241	0.212
start-up cohort dummies	yes		yes		yes	
N	6,424		6,424		6,424	
Likelihood ratio	178.769***		188.776***		180.151***	

*** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level

Model B2 makes a distinction between founders and employees by in a similar fashion as Model A2. There is only a significant and positive impact of founders that recruit employees with whom they share a previous workplace. The previous co-worker experience among skilled workers, which is presented in Model B3, does not show any significant impact on the likelihood of firm survival.

The models in Table 9 show the impact of previous co-worker experience in those knowledge intensive start-ups where the founder does not have experience in the same four-digit NACE industry class. Here again, I make a distinction between the different roles of the human resources in these start-ups. Overall, as shown in Model C1, previous co-worker experience has a significant positive impact on the likelihood of firm survival. When dividing these human resources in founders and employees and skilled and non-skilled workers, which has been done in Model C2 and Model C3 respectively; the analysis shows that previous co-worker experience only has an impact whenever this relationship exists between the founders and/or skilled workers.

Table 9: Summary of the Regression Analyses on Other Knowledge Intensive Start-Ups

Variable	MODEL C1 Estimate	S.E	MODEL C2 Estimate	S.E	MODEL C3 Estimate	S.E
Intercept	0.026	0.387	0.169	0.387	-0.009	0.390
Year 5	0.249**	0.125	0.246**	0.125	0.246**	0.125
Year 4	0.200*	0.107	0.200*	0.107	0.199*	0.107
Year 3	-0.227***	0.083	-0.226***	0.083	-0.226***	0.083
Year 2	-0.357***	0.073	-0.356***	0.073	-0.355***	0.073
Year 1	*benchmark*		*benchmark*		*benchmark*	
High Tech	0.088	0.356	0.068	0.357	0.067	0.356
Medium High Tech	0.754**	0.321	0.717**	0.321	0.733**	0.321
Medium Low Tech	0.349	0.267	0.298	0.268	0.298	0.268
Knowledge Intensive High Tech Services	-0.130	0.195	-0.152	0.196	-0.141	0.196
Knowledge Intensive Financial Services	0.243	0.281	0.228	0.281	0.224	0.281
Knowledge intensive Market Services	0.206	0.189	0.182	0.189	0.196	0.189
Other Less Knowledge Intensive Services	0.058	0.277	0.039	0.277	0.037	0.278
Low Tech	*benchmark*		*benchmark*		*benchmark*	
Initial Employment Size (log)	0.510***	0.071	0.450***	0.073	0.490***	0.074
CMA	0.047	0.086	0.050	0.086	0.055	0.086
Limited Partnership	0.719***	0.113	0.697***	0.115	0.717***	0.113
Partnership	-0.330**	0.162	-0.355**	0.164	-0.345**	0.162
Sole Proprietorship	*benchmark*		*benchmark*		*benchmark*	
Average age employees	-0.013	0.008	-0.013	0.008	-0.012	0.008
Average number of years of work experience in the same industry	0.115*	0.060	0.120**	0.061	0.117*	0.060
Average tenure in the last firm	0.055***	0.022	0.052**	0.022	0.051**	0.022
Average total work experience	0.061***	0.018	0.059***	0.018	0.061***	0.018
Share of academics in the firm	0.038	0.137	0.024	0.137	0.069	0.138
know all	0.289**	0.131				
know founder			0.269**	0.112		
know employee			0.265	0.215		
know founderempl			0.309	0.193		
know skilled					0.353***	0.106
know nonskilled					0.145	0.243
know skilledempl					0.050	0.187
start-up cohort dummies	yes		yes		yes	
N	7,496		7,496		7,496	
Likelihood ratio	280.346***		288.517***		288.720***	

*** Significant at the 1% level, ** Significant at the 5% level, * Significant at the 10% level

Finally, in Table 10, I present three models (i.e. Model D1, Model D2, and Model D3) that test the impact of a large degree of previous co-worker experience in these knowledge intensive start-ups. This is done by testing whether there is a curvilinear relationship between previous co-worker experience and firm survival. There turns out to be a high degree of multicollinearity on the co-worker variables, with the exception of know all, which cannot be solved by normalization. However, based on the *know all* variable and the square value of this variable I can test for the presence of a curvilinear effect. Overall, the model suggests that there is a curvilinear effect of previous co-worker experience on the likelihood of firm survival; however, the negative effect is visible for those start-ups whenever there is a high degree of previous co-worker experience. In Model D2 there appears to be a weak significant effect of previous co-worker experience in entrepreneurial spinoffs. Model D3 shows that this curvilinear relationship is mainly explained by the negative impact of previous co-worker experience in the other knowledge intensive start-ups.

Table 10: Summary of the Regression Analyses on Curvilinear Effects

	MODEL D1		MODEL D2 spin-off		MODEL D3 other KI start-ups	
Variable	Estimate	S.E	Estimate	S.E	Estimate	S.E
Intercept	0.707**	0.315	1.237**	0.525	0.572	0.400
Year 5	0.209**	0.093	0.154	0.141	0.243*	0.125
Year 4	0.270***	0.083	0.369***	0.134	0.199*	0.107
Year 3	-0.242***	0.063	-0.272***	0.099	-0.225***	0.083
Year 2	-0.345***	0.056	-0.325***	0.090	-0.356***	0.073
Year 1	*benchmark*		*benchmark*		*benchmark*	
High Tech	0.109	0.294	0.189	0.528	0.088	0.356
Medium High Tech	0.813***	0.264	1.020**	0.475	0.701**	0.321
Medium Low Tech	0.473**	0.220	0.843**	0.401	0.285	0.267
Knowledge Intensive High Tech Services	-0.096	0.154	0.018	0.254	-0.154	0.196
Knowledge Intensive Financial Services	0.273	0.234	0.346	0.439	0.193	0.281
Knowledge intensive Market Services	0.238	0.149	0.298	0.248	0.177	0.189
Other Less Knowledge Intensive Services	0.157	0.185	0.259	0.276	0.035	0.277
Low Tech	*benchmark*		*benchmark*		*benchmark*	
Initial Employment Size (log)	0.466***	0.057	0.565***	0.090	0.401***	0.074
Entrepreneurial Spinoff	0.137*	0.079				
CMA	0.010	0.067	-0.054	0.109	0.041	0.086
Limited Partnership	0.571***	0.088	0.388***	0.143	0.715***	0.113
Partnership	-0.447***	0.126	-0.543***	0.204	-0.364**	0.163
Sole Proprietorship	*benchmark*		*benchmark*		*benchmark*	
Average age employees	-0.012**	0.006	-0.013	0.010	-0.012	0.008
Average number of years of work experience in the same industry	0.045**	0.018	0.062***	0.023	0.107*	0.060
Average tenure in the last firm	0.063***	0.017	0.068**	0.030	0.055**	0.022
Average total work experience	0.048***	0.014	0.017	0.023	0.060***	0.018
Share of academics in the firm	0.183*	0.107	0.360**	0.177	0.077	0.137
norm know all	0.261***	0.053	0.161*	0.085	0.321***	0.068
norm know all^2	-0.203***	0.040	-0.160**	0.063	-0.228***	0.053
start-up cohort dummies	yes		yes		yes	
N	13,920		6,424		7,496	
Likelihood ratio	487.008***		185.298***		299.537***	

*** Significant at the 1% level, ** Significant at the 5% level, *Significant at the 10% level

5 Previous Co-worker Experience and Survival

In this paper, I analyzed the effect of previous co-worker experience on the survival of 4,110 knowledge intensive start-ups in Denmark that were founded in the period 1994-2005. The argument behind the importance of this experience is that knowledge intensive start-ups, just as other start-ups, have a need for cohesion and an organizational culture to tackle their liabilities of young age. and the opportunity for previous colleagues to screen each others competences and skills to the needs of the new start-up. However, I also expect that too much of this previous co-worker experience will lead to organizational inertia; consequently hampering the organization in the search for alternative opportunities to solve complex problems. Based on these theoretical considerations, four hypotheses have been formalized.

Hypothesis 1, which argues in favor of previous co-worker experience on the likelihood of survival, is supported although the impact is only significant on the 10 percent level. Previous co-worker experience appears to have explanatory power in the survival of new ventures. Adding former co-workers to the organization seems to be a fruitful strategy to overcome a firm's liability of newness, as suggested by Eisenhardt and Schoonhoven (1990); Schoonhoven and Romanelli

(2001); Campbell (2005). Whether this is because these co-workers bring in the required internal social capital, organizational culture, or competences cannot, however, be identified. In addition, co-worker experience is based on the last three establishments before the person joined the new venture, which means that (i) members do not have to be present during the same time period and (ii) members who were never in contact with each other. Nevertheless, the likelihood that those individuals who shared a previous workplace without having known each other in this previous workplace is rather low. Even if they did not work together they still have internalized the previous firm's organizational culture (Meek, 1988).

Hypothesis 2a takes the first hypothesis as a point of departure but puts emphasis on the importance of the founder as the main decision-maker and the person that determines the organizational culture in the new firm. The results, which are presented in Model 2, support the hypothesis that previous co-worker experience with and among founders is more important in explaining the likelihood of survival. The founder should be part of the previous co-worker relationship in order to have an effect on the survival of new ventures. However, the co-worker experience related to the employees also has a significant impact, in particular for entrepreneurial spinoffs. This would support the argument that founders are not the only contributing factor to the success and failure of new ventures (Katz et al., 2000; Cardon and Stevens, 2004) and that there is a need for broadening the scope by including all human resources of the new organization. Hypothesis 2a argues on the importance of co-worker experience among the skilled workers. This hypothesis is supported, but only in those knowledge intensive start-ups that are not entrepreneurial spinoffs.

Hypothesis 3 makes a distinction between entrepreneurial spinoffs and other knowledge intensive start-ups and states that entrepreneurial spin-offs predominantly benefit from industry-specific knowledge lowering the impact of previous co-worker experience. This hypothesis is supported since entrepreneurial spin-offs do not seem to benefit in the same degree from previous co-worker experience as the other knowledge intensive start-ups. They benefit more from the fact that founders have experience in the same industry and that these founders bring along former colleagues to become employees in the new firm, which partly solves the inter-organizational liability problem. Other start-ups seem to benefit from the previous co-worker experience that existed among the entrepreneurial team. Because these start-ups lack these inter-organizational competences among the founders, they deal with the high level of uncertainty by creating an organization that is built on trust and cohesion. Furthermore, the overall work experience and the experience in the last firm has a stronger effect in these ordinary start-ups compared to entrepreneurial spin-offs. This can also be interpreted as the intensity of previous co-worker experience since most of the former co-worker relationships are based on the last establishment in which they were active.

The last hypothesis finds some support in the results of the regression analysis. There appears to be a curvilinear effect of previous co-worker experience where close to maximum values show a negative effect. Thus, there is an indication that a high degree of previous co-worker experience leads to some sort of structural inertia and hampers these start-ups in their search for opportunities (Aldrich and Ruef, 2006). This also supports the argument that there is a need for both bonding and bridging ties in the organization, where bridging ties provide the start-up with new sources of information (Davidsson and Honig, 2003). As it was shown, other start-ups can overcome their problem of liability by working together with former colleagues, which can enhance the level of trust and cohesion or simply enable the selection of better competences.

Nevertheless, too much previous co-worker experience creates an environment where too much of the same organizational culture and competences are applied in a completely different industry. This can lead to too much reliance on established routines which in turn can make a firm inflexible and slow to adapt and survive when there are changes in an unknown industry and/or the market.

6 Conclusion

New ventures in general and knowledge intensive start-ups in particular face a list of challenges, all related to what is called liability of newness (Stinchcombe, 1965) and liability of adolescence (Brüderl and Schüssler, 1990). Both these liabilities lie in the social domain of these ventures (e.g., personal and inter-organizational relationships). In addition, start-ups also face challenges in the recruitment process (Williamson et al., 2002), which results in a strong reliance on informal recruitment methods. This process might, besides the speed and costs, reduce the liability problem since it leads to the recruitment of individuals who have a relationship with the founder and trusted employees. Consequently, the internal social capital in these ventures can be improved. Furthermore, if these new recruits are former co-workers, these relationships can build on a strong bonding tie and bring established organizational cultures into an environment where this culture is crucial (Campbell, 2005). Up to now, I identified a few studies that address this issue of shared affiliation within new ventures, Beckman (2006); Beckman et al. (2007), but no studies have been found that include all human resources (i.e., founders and employees) into the analysis.

This study, based on a sample of 4,110 knowledge intensive start-ups, which were founded in the period 1995-2004 in Denmark, provided some micro level evidence on the importance of previous co-worker experience. This is consistent with what one would expect when looking at the theory on how these shared experiences would affect the survival of new ventures (Eisenhardt and Schoonhoven, 1990; Schoonhoven and Romanelli, 2001; Campbell, 2005). Thereby controlling the usual predictors of firm survival (e.g., industry, location, average age, education, and work experience), there is a clear indication that this previous co-worker experience has a significant and positive effect on the likelihood of firm survival, especially for those start-ups that cannot build on established routines within the same industry. This effect is mostly ascribed to the situation in which the founder is part of this previous co-worker experience between founders and employees, indicating the importance of founders in the process that determines the direction of the new organization. The results do not only show the importance of previous co-worker experience, but also provide support that there are inertia pressures as a result of a high degree of previous co-worker experience. Hannan and Freeman (1977) addresses this problem for the adaptive capability of organizations. These problems appear to be valid for all the knowledge intensive start-ups although the level of significance are stronger for those not founded by founders with experience in the same four-digit NACE industry class.

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