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Entrepreneurship in the knowledge
intensive services

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En svensktjänstesektor i industriell skala?

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The Knowledge Intensive Economy

We are interested in entrepreneurial in knowledge intensive sectors since these have been recognized as having potentially great economic value (Acs, 2002). We, as the field of research in entrepreneurship in general, is moving from a view where “all forms of entrepreneurship is good” towards a more nuanced view where some types of entrepreneurship, particularly self-employment and less innovative entrepreneurship towards a view where “high-potential entrepreneurship” is what matters for economic development (Autio & Acz, 2007; Henrekson & Johansson, 2009). By studying the entrepreneurial activities of this group we can better understand how new technological knowledge is converted into economic growth. As we will see, knowledge intensive does not equate with High-tech manufacturing. On the contrary, in the case of Sweden at least, knowledge intensive is to be tightly connected to the service sector in terms of number of employees, number of firms and total sales. We have arrived at a point in economic history where Adam Smith’s classical statement probably does not ring as true as it used to:

“the labour of a manufacturer adds, generally, to the value of materials which he works upon. The labour of a menial servant, on the contrary, adds to the value of nothing...[the servant]...does not fix or realize itself in any particular subject or vendible commodity. His services generally perish in the very instant of their performance.”

Following the viewpoint of Adam Smith about services as inherently unproductive, economists and other social scientists were generally uninterested in the role of services. Research into service industries did not start until the late 1960s and early 1970s (Metcalf & Miles, 2000). With the rise of the “service economy”, economists and management researchers have begun exploring services and of particular interest to researchers in the last decade has been the explosive growth of knowledge-intensive business services (KIBS). The evolution of these knowledge intensive service firms is part of larger economic changes stemming from an increasingly dynamic “market for knowledge” (Antonelli, 1999) and falling transaction costs due to the introduction of advanced information communication technologies (Langlois, 2003).

Despite their growing economic significance and importance for the industrial transformation of increasingly “service intensive” manufacturing sectors, our understanding of such firms remains under-explored (Mina, 2008). The need to

develop understanding of these activities has become all the more pressing with the low likelihood that manufacturing will grow substantially in real terms. Knowledge intensive firms are considered to be of strategic significance as they are often at the leading edge of innovation practices and have a systemic important role in the development and diffusion of knowledge (Acs, et al., 2009; Tether & Tajar, 2008).

Why Knowledge Matters: Spillovers

Endogenous growth theory distinguishes itself from neoclassical growth theory by emphasizing that economic growth is an endogenous outcome of an economic system, and not the result of forces that impinge from the outside. At the heart of endogenous growth theory is the assumption that technological changes arise from intentional investment decisions made by profit-maximizing agents (Romer, 1990).

Technological change leads to a change in the output per hour worked, and thus leads to increased growth. The reason that technological change plays such a central role is due to the basic characteristics of technology or technological discoveries¹. Technological discoveries differ from other inputs in the sense that many people can use them at the same time. In other words, knowledge related to technological discoveries can be used by many and for different products or services. In economic terms knowledge is a non-rival good. This implies that the use of the good (knowledge) by an individual or a firm in no way limits its use by others. For example, land is a rival good as its use by one agent precludes its use by another. The use of knowledge about software programming by a firm does not preclude the use of that knowledge by another firm. Investments generating those type of knowledge that can “spill over” tends to become adapted by other economic actors, stimulating economic vitality through the emergence and growth of new firms (Sarkar, Agarwahl & Audretsch 2007). Individuals and firms might be able to earn rents on newly discovered technologies as long as they retain control over knowledge necessary how to utilize this. It is not access or proprietary ownership of an innovation per se, but rather the knowledge how to use it can become important for these firms. Open source software firms relying on free software but advanced

¹¹ ‘Technology’ – originating in the word *techné* (Greek) that connotate ‘art’ or ‘craft’ – literally means the act of making or crafting, but more generally it refers to the diverse collection of processes and knowledge that enable people to extend their human abilities. As such, it indicates how people modify the natural world to suit their own purposes. While we often tend to think of “technologies” as tangible advances such as ITC systems or peer-to-peer software, social science research takes a broader view on technology as “set of pieces of knowledge” (Dosi, 1982). In this book, we think of technology as “a socio-technic system of production” (Geels, 2004) where also less tangible innovations such as management consulting methods can be seen as a type of production technology.

services and network administrations is a modern example (Dahlander & Magnusson 2005). Hence, technological knowledge can be a partially excludable good. It is possible for the economic agent (firm or individual) that possesses the knowledge how use a technology to prevent others from using it by preventing access or by preventing understanding of it. Schumpeterian growth theory argues that growth “is primarily driven by a sequence of quality improving innovations each of which destroys the rents generated by previous innovations” (Aghion, 2002, p. 855). Here, entrepreneurship in new independent firms has been argued to represent a “missing link” between generally new sources of knowledge, and economically relevant knowledge.

The observation that knowledge from technological change can be seen as a non-rival and partially excludable good provides an explanation to how economic growth is achieved (Romer, 1990). In endogenous growth theory, technological knowledge is no longer an entirely public good, as in the neoclassical view. This leads to technological spillovers: firms can acquire information created by others without paying for that information on the market, and the owners of such information have often no effective resources to hinder this to happen under prevailing laws, if other firms choose to use the information. Spillovers can take place in many ways. A first way is the mobility of highly skilled employees between firms (Eliasson, 1996). A second way is the use of new technological knowledge in production by the firm that has developed this. Even if the firm manages to protect the new technological knowledge, it increases the general level of publicly available knowledge because it is spilled over to other researchers who study its patent documentation. As such there is an increase in productivity because this set of new knowledge leads to the creation of further innovations in the research sector. A third way for new knowledge to enter production and create spillovers is related to the relationship between the total stock of knowledge and the human capital used in research and development. This relationship affects the creation of new knowledge. Human capital creates new knowledge, but the ability to do so is dependent on the productivity of that human capital. That productivity is dependent on the total stock of already available knowledge. The larger the size of the stock of knowledge, the higher the productivity of the human capital and the less expensive it is for firms to invest in the creation of new knowledge (Acs, 2002). Hence, as the stock of knowledge increases, the cost of producing new knowledge decreases. It is easier for an economy to generate Google if it has already generated Stanford and Microsoft. This is one of the reasons for the prolonged disparities in economic growth between nations and the difficulties for poorer nations to catch up to those more developed.²

² Another fundamental reason is differences across countries in societal institutions facilitating economic exchange (North, 1994).

Once they have managed to efficiently produce cars and ovens, the economic gains from producing cars and ovens is already decreasing compared to the gains from producing computers and software. This is why the creation and commercial use of new knowledge plays an important role in economic growth. This new knowledge comes from things that people do. They create new knowledge because they think they may be able to achieve market power and earn monopoly rents. The question then becomes who are the agents most likely to create the new knowledge and introduce it to the market for commercial ends, and why do they do this? Research suggests that certain agents in the economy are more likely to use new knowledge commercially than others.

Often, these agents – individuals or firms – try to commercialize new knowledge by setting up a new firm. The creation of new firms can be seen as either a subgroup of employee mobility between firms or as a fourth way for knowledge spillover to take place where employees leave a firm to utilize the experience and knowledge acquired with the former employer by setting up a new firm that might become a potential future competitor. We call this kind of firm startup for ‘spinout firm’ and we will look specifically at their role in this book.

Finally, technological knowledge, especially tacit forms of knowledge is based on individual-specific information and ideas that is difficult to explicitly write down (Nooteboom, 2009). Such ideas frequently arise through interpersonal information in a social environment. The social environment can spur business ideas within an incumbent firm (Nelson, 1995) as in the case of spinout firms. This implies an ‘organizational connection’ between established and new firms through the knowledge embedded in individual employees. The social environment can also lead to the formation of new firms through interaction among employees outside their existing workplaces where geographic location or clusters are more important sources of new opportunities than the confinement of the individual firm in itself (Saxenian, 1985). This suggests there are also ‘geographical connections’ between knowledge in a region and newly established firms. These organizational and geographic connections are likely to be confounded but it is important to separate them because they lead to different sources of advantages for new firms. We will therefore devote a substantial part of this book to the geographic impact on new firm evolution.

In the remainder of the chapter, we take a closer look at the data that we have chosen to use to investigate our basic research question of the potential contribution of new firms to the knowledge intensive economy and to economic growth.

Data used in this book

The data sources in this book originates from a combination of two longitudinal databass maintained by Statistics Sweden: RAMS, which provides yearly data on all firms registered in Sweden, and LISA, which provides yearly data on all Swedish inhabitants. We used RAMS to sample all firms in existence 1989 in the knowledge-intensive sectors (see appendix 1 for sectorial definitions) adding all new entrants until 2002 included. Hence, we study the full population of all firms present in any given year between 1989 and 2002. We linked these firms with their employees and their career experiences for the period of observation in the LISA database. The selection of knowledge-intensive sectors follows Eurostat and OECD's classification which is based on the ratio of R&D expenditure to GDP or R&D intensity (Götzfried, 2004). Sampling R&D intensive industries is motivated by modern growth theory which stresses the commercial use of new knowledge coming from research and development as a fundamental driver economic growth (Lucas, 1988; Romer, 1990).

Our choice of sampling only knowledge-intensive sectors is also motivated by a need to limit unobserved heterogeneity which plagues many contemporary studies of entrepreneurship (Shane, 2003). New ventures are extremely heterogeneous, ranging from 'mom and pop' retail stores to venture capital-backed start-ups in the high tech sector (Davidsson & Delmar, 2009; Dosi, 1988). Random samples of new firms such as the Panel Study of Entrepreneurial Dynamics (PSED) show that only one in ten of all new firms can be considered an 'innovative' business whereas most new firms are founded as replications or marginal variations of existing service or product (Samuelsson & Davidsson, 2009). If we wish to gauge the importance of new firms for economic development, our research design therefore have to take into account the large heterogeneity across subsectors. For example, mature industries such as heavy manufacturing often have large barriers to entry and exit and fewer entrepreneurial opportunities than emerging or rapidly growing industries (Shane, 2001).

Our choice of firm population in this book is therefore motivated on endogenous or new growth theory. To investigate the evolution of this population of firms we draw upon theoretical models developed in industrial organization economics, organizational ecology, and entrepreneurship. As we are interested in potentially high-impact entrepreneurship, we focus on their firm activities from an entrepreneurship theory perspective arguing that the quantity and quality of such entrepreneurship is dependent on the available opportunities based on new knowledge and the industrial context in which these opportunities are exploited (Aldrich, 1999; Baumol, 1993; Nelson & Winter, 1982; Schumpeter, 1934). We view entrepreneurship as a decisive link between the technological system and the

exploitation of opportunities within the market economy (Carlsson et al., 2003; Grebel, Pyka, & Hanusch, 2003). This study focuses on the entry, growth, and exit of firms in sectors characterized by high rates of R&D and skilled labor usage. Other forces represented by the industrial and market power of already established large firms also play a non-trivial role. While we acknowledge their importance as well, such an analysis is outside of the empirical endeavor in this book.

Our research project constitutes longitudinal studies of firm populations covering a large proportion of the industrial sector in a whole country. Hence, there is a large dispersion in the size, structure and functionality among these firms, ranging from small single-establishment firms with only 1 or a few employees to large firms with thousands of employees and establishments. We therefore start our analyses with providing a description of these new firms, their size, structure, and industrial scope of activities. Empirically, we investigate all firms in the knowledge-intensive economy. Exploratory research has led us to divide this broad subsector to six subsectors in our analysis. Those sectors are describe below, and their specific definition according to international NACE codes follows in table 2.1:

- *High-tech manufacturing* and *Medium High-tech manufacturing* are two subsectors consisting of fine machinery, computer hardware and telecommunications. This can also be part of traditional manufacturing companies which products and production processes are being upgraded and becoming more and more advanced. Examples of such firms are SKF, a traditional ball-bearing manufacturer who is now increasingly seen as an integrator of production systems with a large component of advanced after-sale services. The size of this sector has remained almost constant during the last two decades.
- *High-tech services*: Examples of firms in this sector includes internet/telecom operators and IT consultants .This sector has almost tripled in size during the last two decades.
- *Market services*: This is the largest part of the knowledge-intensive economy and consists of firms with a high knowledge content providing services primarily to other firms. Examples of firms in this sector include accounting and auditing firms, management consultancies, architects, engineering and design consultancies.
- *Financial services*: This is the smallest part of the knowledge-intensive economy in terms of firms operating, but in terms of assets and turnover it is tenfold larger. Bank and insurance companies are found here.
- *Other knowledge-intensive services*: This sub-sector consists of firms difficult to categorized in established industry classification codes such as Venture Capital and publishing firms. It is, together with Knowledge-intensive High-

tech services, the fastest growing part of the overall knowledge-intensive sector.

Table 2.1 Sector code descriptions

Sector	Description	NACE Rev 1.1 codes
	Manufacturing	15 to 37
(1)	High-tech manufacturing	30, 32 and 33
(2)	Medium high-tech manufacturing	24, 29, 31, 34 and 35
	Services	50 to 99
(3)	High-tech services	64, 72, 73
(4)	Market services	61, 62, 70, 71, 74
(5)	Financial services	65, 66, 67
(6)	Other knowledge-intensive services	80, 85, 92

Definitions of firm dynamics

This chapter provides some basic descriptions of the firms being studied. In these initial analyses, we use Statistics Sweden's definition to track firm dynamics. In subsequent chapters we will depart from these definitions when it is needed for either theoretical or methodological reasons. We will be clear about when this happens and what consequences this has.

The primary unit of analysis in this book is the firm. A firm is a legal entity with at least one employee and at least one establishment and having some economic activity. These firms are active in the knowledge intensive sector as defined above. A firm is either entering, is active or is exiting.

Entry. The entry of a firm can be understood the following ways. A firm can enter our population in two ways: (1) as created by one or several entrepreneurs as a new independent firm and a new establishment, or (2) as a *spin-off* (new establishment) from an already active firm. In the first case, the firm is an independent legal entity. In the second case the firm or the new establishment is partly owned by an incumbent firm. We chose not to investigate the role of spinoffs in this book because of their ownership structure. They are partly or fully owned by an incumbent firm, making them part of what we define as internal venturing or corporate venturing rather than the creation of independent firms.

If a firm or establishment is created as an independent legal unit, the people employed in the first year can have worked previously in the industry and employees or as self-employed. These types of firms are often labeled *spinout* (Agarwal et al., 2004). If the employees have not worked previously in the industry, we label those firms *de novo* startups. The technique used here is based on Statistics Sweden work of employment tracking. If an employee moves within an industry and becomes self-employed in a newly created establishment, this is considered a spinout³. If an employee migrates from one industry to another and becomes self-employed in a new establishment, this is considered a *de novo* entry.

A firm can also enter an industry if it is either a *split* of an existing firm or if it is a *merger* of two firms into a new independent establishment. Once more the tracking of labor from one establishment to another is used to define the type of entry. Finally, there is a form of entry by firms that migrate or diversify from one industry to another called *de alio* entry. Statistics Sweden does not track those changes. Since it does not represent the form of entrepreneurship we are interested in, *de alio* entrants are outside the scope of this book.

Active. In many prior studies of firm dynamics using micro data, some firms are erroneously identified as "new firms" when they change legal form or restart after being inactive for a number of years (e.g. Dunne, Roberts & Samuelson, 1988; Phillips & Kirchoff, 1989). We chosen not to accept this definition and we use Statistics Sweden's CFAR codes where firms are considered as active even if they change legal form or industry. According to CFAR, a firm is considered surviving if it keeps 50 percent or more of its employees from one year to another across establishments, allowing us to more stringently identify 'active' firms based on three theoretically definitional criterion of a 'population' (active in the same location, doing similar activities, employing similar personnel) (Carroll & Hannan, 2000). One could imagine that the addition of the CFAR definition could entail that firms would be denoted as 'inactive' if they restructure and sack the majority of employees. We believe this is less of a problem since absolute majority of firms have only one establishment, consisting of the founder(s) and a few employees.

Restarts. Some firms cease activities but start again after one or a few years in the same location and industry, with the same employees. In our data, almost 17 percent of entrants are comprised of this type of restarts, most of which are very small micro

³ Moving into a new establishment mean that this establishment is denoted as the primary workplace for the individual, and receiving self-employment earnings from this establishment (from 1990 this includes earnings from an incorporation) implies the individual is the owner or co-owner of the firm. In this way, we identify spinout firms based on the individuals working there during the first year. Often this is only the founder, but a sizeable minority of high-capable spinouts are also founded by several individuals (Wennberg, 2009b).

firms. If we would include these as new entrants, we would erroneously overestimate the level of churning (entries and exits) in the sector (Phillips & Kirchoff, 1989). According to the discussion above on what constitute an active firm, we note firms that are active in the same location, in the same industry, and with the same personnel (usually the founder and potentially a few employees) as “restarts”

Exit. Statistics Sweden tracks three forms of exit. Exit by termination which is the most common cause. In this case, the firm and their establishment(s) cease to exist in the industry. The employees migrate to other establishments. There are numerous reasons for termination, bankruptcies comprise only a small share of these (Wennberg, 2009b). Two other forms of exit are ‘termination by split’ and ‘termination by merger’. With termination by split, the firm is split in at least two new legal entities. With termination by merger, the firm is merged with another firm to form a new legal entity.

How to analyze firm dynamics

In this chapter we provide some overall descriptive analyses of stock and flows on firms and their employees for the whole population that we define as knowledge intensive. The reason for this is twofold: First, we want to provide a general overview of this important sector and how it has developed over the period of observation. Second, because we adjust the data set for analytic reason in the subsequent chapters, these descriptive analyses serves a general backdrop or benchmark for the subsequently more finely grained analyses. We cannot use the full data set in all chapters for three reasons. First, entrepreneurship is heterogeneous by nature and we need to deal with this problem in order to achieve a better understanding of causal mechanisms at hand (Davidsson & Delmar, 2009; Shane, 2008). This is especially problematic with observational data as the one we use here. Second, access to variables varies by year of observation we cannot always rely on the full observation period. Third, longitudinal data, while very helpful to deal with unobserved heterogeneity, still represent some limitations in that one cannot use years of data if the variables included or definitions of those variables have changed

Dealing with heterogeneity. New firms are highly heterogeneous and using the full population might lead to severe problems of misinterpretation as we cannot control for all source of heterogeneity in our models (Davidsson & Delmar, 2009). One unmeasured example is the entrepreneurial ability of the founders. Another is their estimated value of the opportunity at the emergence of the new firm. A third represents the career aspirations and personal goals of the founding entrepreneurs

(Carter et al., 2003). All these factors are likely to affect the evolution of new firms in unknown ways if they are not measured. It is therefore important to find samples that reduce these sources of variation so that they are not biased by these unmeasured variables. The subject of unobserved heterogeneity is closely linked to the use of theoretical model to explain our results. Theory allows us to define the pool of variables needed to be included in our model in order to achieve parsimony, while being able to control for problematic sources of disturbance.

Heterogeneity is a challenge in entrepreneurship for three reasons. First, the process by which firms are found itself is heterogeneous (Delmar & Davidsson, 2000). Entrepreneurs differ in their choice process; they have different preferences, habits, and demographic characteristics (Gartner & Carter, 2003). Their firms evolve in different contexts with different access to resources, and they strive for different outcomes. All these variables (measured and unmeasured) contribute to the total variance in the outcome of the entrepreneurial process. Because we cannot measure everything and that our models need to be parsimonious, many of these factors end up as not being measured in our models. This can lead to a specific challenge in our models that is related to unobserved heterogeneity. Unobserved heterogeneity is a serious threat to causality which is at the heart of empirical research. Unobserved heterogeneity becomes a problem in our models when we fail to measure or to correct for the impact of a variable that we do not measure but has an important impact on the outcome and is correlated with at least one of our explanatory or independent variables that we actually measure. This can lead to severely biased estimates and that we, as researchers, ultimately misunderstand the relationship studied. Hence, inferred causality by the model can be questioned, and therefore we fail to explain the phenomena at hand.

Second, we mostly rely on observational data, and rarely on experimental data, we therefore have limited ability to directly control for sources of heterogeneity. We cannot exclude alternative explanation by research method only as observational data allow several possible interpretations (Morgan & Winship, 2007). Theory is the main tool we use to establish what kind of causal relationships are possible. Therefore theory has a particular importance when dealing with unobserved heterogeneity. It is the theoretical model in combination with our knowledge of the empirical context that dictates what variables to include, what variables to exclude and why. We might leave out important variables because our current knowledge does not allow us to identify them. We might also leave them out because we do not know how to measure them.

Third, entrepreneurship is a multi-disciplinary field, and one role of entrepreneurship research is to try to integrate results from various studies to construct a body of knowledge that can be communicated to academics, students, managers and policy makers. Therefore, researchers must pay specific attention to how sensitive or robust results are from departure from theoretical assumptions and model specification. Each theory emphasizes its specific set of variables at the detriment of other variables identified by other perspectives. Many results may only be valid under certain theoretical assumptions and in specific empirical contexts (Zahra, 2007). This is a paradox that entrepreneurship as field has to deal with. As the field has grown as a result for an external demand of more and better knowledge about entrepreneurship, the field has moved towards fragmentation. The higher demand has created legitimacy for the field and has attracted research strongly grounded in theoretical perspectives. Such research has also become more and more published. This is good for the field and new and better knowledge is being produced. However, it makes it also more and more difficult to integrate this knowledge that is so highly demanded by our external stakeholders, because there is a relative little premium to do so in the academic fields compared to producing an empirical paper grounded in a single theory. This is also a reason to why we choose a book as an outlet for this research endeavour. We are convinced that there is from time to time, a need for the researcher to try to sum up a larger empirical work and put into an overarching context.

Data availability. A second reason for our choice of data period and analysis is the availability of reliable data. We have access to a unique data base from 1989 to 2002. However, some variables are only available for a shorter time period. An example on the firm level is financial data that we can access from 1994. This is important for our analyses of growth in Chapter 5. Another important variable is the ability to separate ownership from employment in small incorporated firms, which is available from 1993 onwards. This is an important source of information as it allows to clearly track all changes in employment to self-employment independent of legal form. Without this variable we cannot identify the founders and owners of new incorporated firms because they would all appear as employee. This is important for our analyses in Chapter 4 of spinouts and de novo firms.

Structure of panel data. A third reason is the structure of our panel data. We are studying the period of 1990 to 2002. This implies that we work with longitudinal data covering several cohorts as firm enter and exit on a yearly basis from our population. In total we have thirteen cohorts plus those firms that are already in existence prior to 1990. The thirteen cohorts represent all new firms that enter our

population each individual year. The data are comprised of two main categories of firms: those that have entered prior to 1990, and those entering 1990 or later.

All firms are at risk of becoming terminated, to grow, or to enter in a special region or industry. However our possibility to describe the difference between the two groups is limited. For the former group, we have no information of what happened prior to 1990. These cases are left-censored, as their trajectories are unknown before we start to measure it in 1989. For the latter group we follow them from the time they enter our population (defined as the year have at least one employee) and forward. However, in this group we can only follow them from a minimum of one year (those entering in 2002) to a maximum of twelve years (those entering in 1990). Thus we measure their early years of firm evolution. This time period might be too short for them to gain the needed capacities, routines, system and structures needed to fully expand to an optimal size. Hence, such quite new and small firms cannot simply be compared with established firm established at some unknown time before 1990.

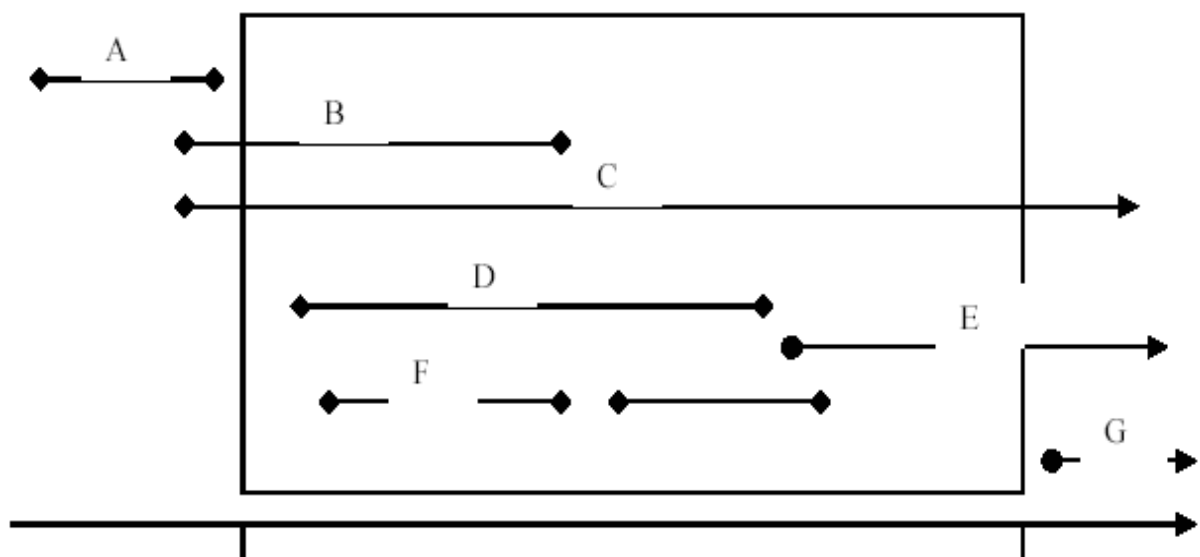


Figure 2.1 Possible different firm spells in the data

Figure 2.1 illustrates the structure of the data and a number of different possible spells (i.e. periods of firm activity) that are present in the data. Because our window of observation is limited we can observe the following spells of firm activity:

- Spells A (and G) represents case that enters before (after) the whole observation period and is also terminated before (after) the observation

period. Hence, both cases are completely unobserved and not included in our data.

- Spell (B) represents a case that enters before 1989 but is terminated before the end of the observation period. We only have information about them from 1989 onwards so we cannot determine for how long they have been active. This means that the spell is 'left censored'.
- Spell (C) represents a case that enter before 1989 and that is still active by the end of the observation period. Similarly to case (B), we only have information about them from 1989 so we cannot determine how long they have been active. Furthermore, we have no information about what happens after 2002. Indicating that these spell are both left censored and 'right censored'.

All of the above examples are in some sense left-censored and are all present in the data. Left-censored data often represents problem when analyzing longitudinal data while right censoring can be controlled for by statistical techniques. The only way to deal with left-censoring is to either gather more data or to eliminate such cases (Blossfeld & Rohwer, 1995). The more common, and less problematic, cases of firm evolution in our database are:

- In spell (D), a firm with one spell of activity. It enters and exits the population during the period of observation, which mean we have complete information on this firm during its entire life course.
- Spell (E) is a firm with one spell of activity, started during the period of observation and still active by the end of same period. This case is right censored as we only observe its year of entry and until the end of observation.
- Spell (F) has entered into and exited from our population twice. It is a case with multiple spells, which we call a 'restart' (see definitions in the preceding section).

As depicted in Figure 2.2 above, we are dealing with both left (no information before the period of observation) and right censoring (no information after the period of observation).

Furthermore, understanding the structure of the data is important for understanding how to present our results in various chapters. For example, we will have a number of cases that do not have an entry into our population, but only one exit (firms entering prior to 1989). We also have a number of cases that never exits in or before 2002. Obviously, the structure of data necessitates that we adopt a number of different measures to be able to describe what is happening in this particular population. As stated, choosing a homogenous sample to investigate is a strong remedy to unobserved heterogeneity. If we are also able to follow this sample over

time, we diminish the risk for unobserved heterogeneity further as the market selection processes render firms more similar as they strive to compete and reach what they perceive an optimal size of operations (Jovanovic, 1982). This is known not only in industrial economic research but also in e.g. research on women's entrepreneurship where entrepreneurial motivations and initial entry processes are often quite different from firms founded by men, but adaptation of preference and market selection renders surviving firms much more alike by conforming to industry standards (Holmquist & Wennberg, 2009). Entrepreneurship theory has a theoretical interest in such processes and how they develop (Aldrich, 1999).

Analysis of firm dynamics in the knowledge-intensive sector

Stock of firms. Figure 2.2a below outlines the stock of population of firms both in absolute numbers. This reveals that the total number of firms has increased during the period of observation from 45,840 firms in 1989 to 90,458 in 2002. Hence, the overall population has almost doubled in size in little more than a decade. The subsequent Figure 3b outlines the relative percentage of firms by subsector, as to describe the composition of the overall economic sector. This reveals substantial variation among the subsector in terms of growth in the industry. The two manufacturing subsectors, 'high- and medium-tech manufacturing' have remained unchanged during the period while all the service subsectors has grown considerably. 'Other knowledge intensive services' tripled in size and grew by 314 percent. The 'Knowledge High-tech services' subsector grew almost as much by 296 percent, while 'Financial services' grew with 244 percent and 'Market services' with 173 percent. The stagnation of the manufacturing sector and the growth of the services sector are by now well-known phenomena in the international literature (Mina, 2008). Compared to the rest of the Swedish economy, this sector represent close to 15 percent of all registered firms during the 1997-2002 period.

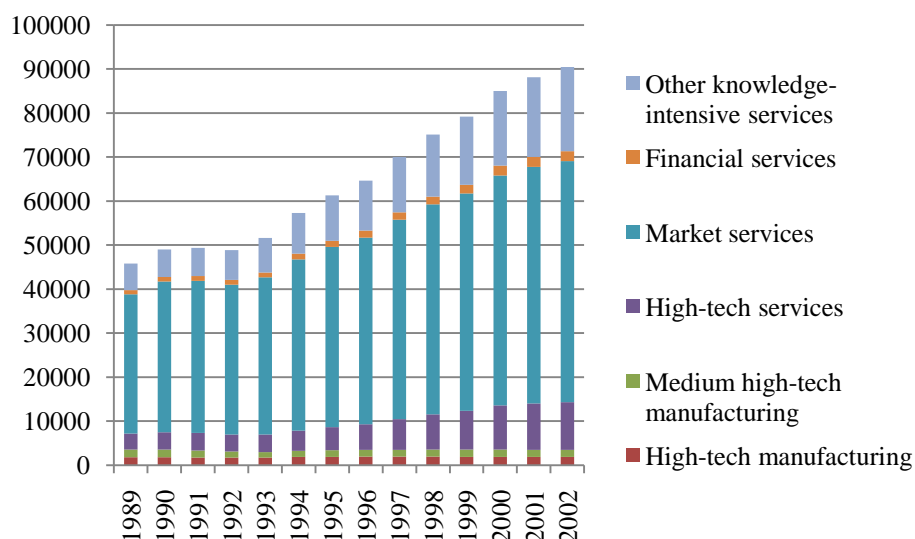


Figure 2.2a: Absolute stock of firms for the six subsectors

In relative terms, the market services subsector still dominates the overall population in number of firms as is shown in figure 2.2b. This subsector alone represents between 61 percent to 70 percent of all firms in our population. This is not surprising since it includes all ‘business services’ firms that are the most common startup in most industrialized economies. Other knowledge intensive services represent 13 percent of all firms in the beginning of our period of observation but its share grows to represents 21 percent of all firms in 2002. The two manufacturing subsectors represent 7 percent in 1989 and 4 percent in 2002. High-tech services represent 8 percent in 1989 and 12 percent in 2002. Financial services are stable at 3 to 4 percent of all firms identified.

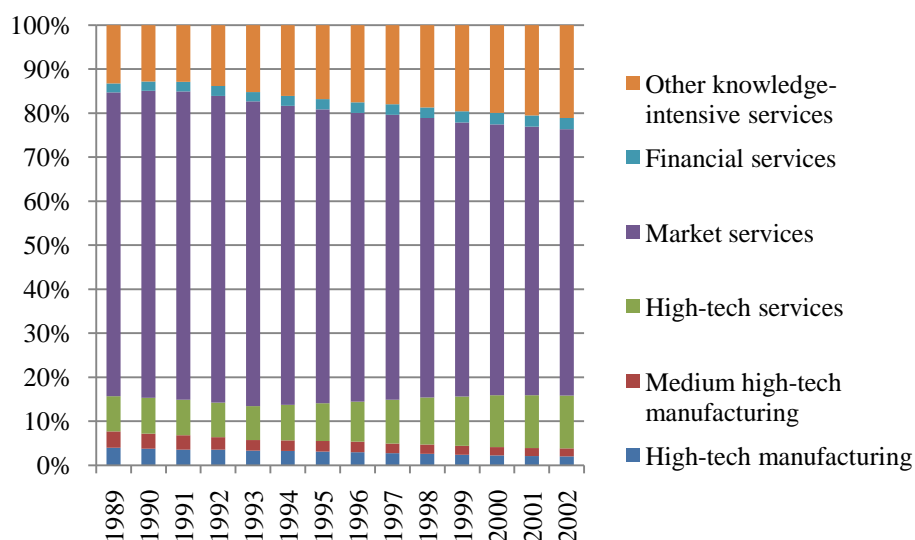


Figure 2.2b: Relative stock of firms for the six subsectors

Employment. The increase of number of firms can be an indicator of more employees in this sector, substantive sector differences in firm structure, or a trend where the average size in firms is diminishing where large entities are abandoned in favor for smaller and more flexible entities; or both. It is therefore of interest to examine the total number of employees, mean size and the standard deviation by subsector.

The employment by the different sectors is shown in the following Figure 2.3a. The growth in employees is less impressive than it is for number of firms. The number of employees remained, or diminished slightly from 1989 to 1993 to pick up by the end of the recession in 1994. Overall, between 1993 and 2002 the knowledge intensive sector grew in terms of employees with 65 percent from 544,068 to 898,553 employees. The largest subsector in terms of employment throughout the whole

period is Other knowledge-intensive services with a growth of 158 percent followed High-tech services with 130 percent. Also in terms of employment, the two manufacturing sectors show only moderate growth. Taken as a whole, the total number of employees in the overall in the knowledge sector compared to the rest of the economy grew from comprising 16 percent of all employment in 1993 to 24 percent in 2002 of all employment in Sweden.⁴

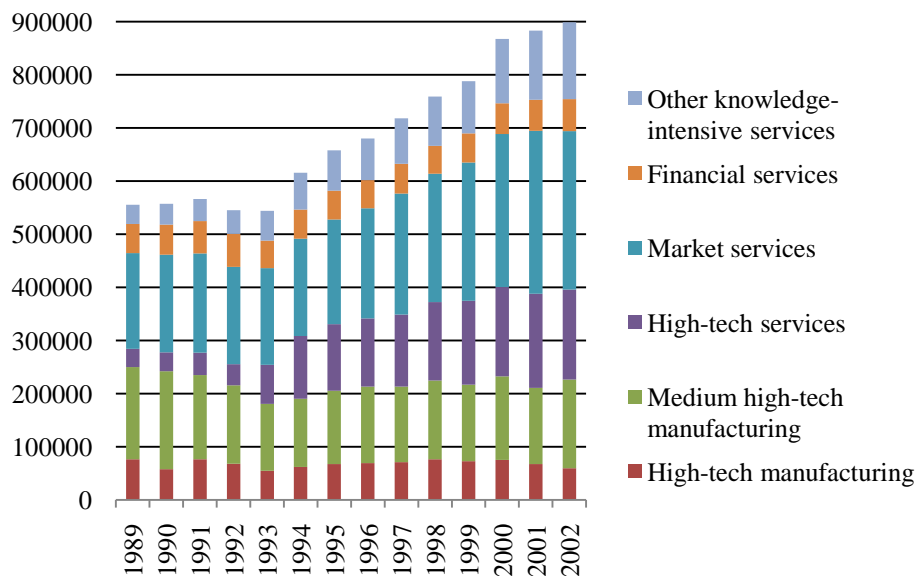


Figure 2.3a: Absolute number of employees in the six subsectors

Figure 2.3b shows the relative number of employees per subsector. We observe that the relative weights of the subsectors in terms of employees have shifted over the period of observation. The two manufacturing sectors represented together 45 percent of the total employment in 1989, but only 25 percent in 2002. High-tech services and other knowledge intensive services employed 13 percent of the labor force in 1989 and 35 percent in 2002. Market services and Financial services remained approximately the same relative size with 33 percent and 8 percent respectively of the total number of employees in the overall knowledge sector.

⁴ This figure may seem low but one should take into account that public sector make up 30 percent of all employment in Sweden.

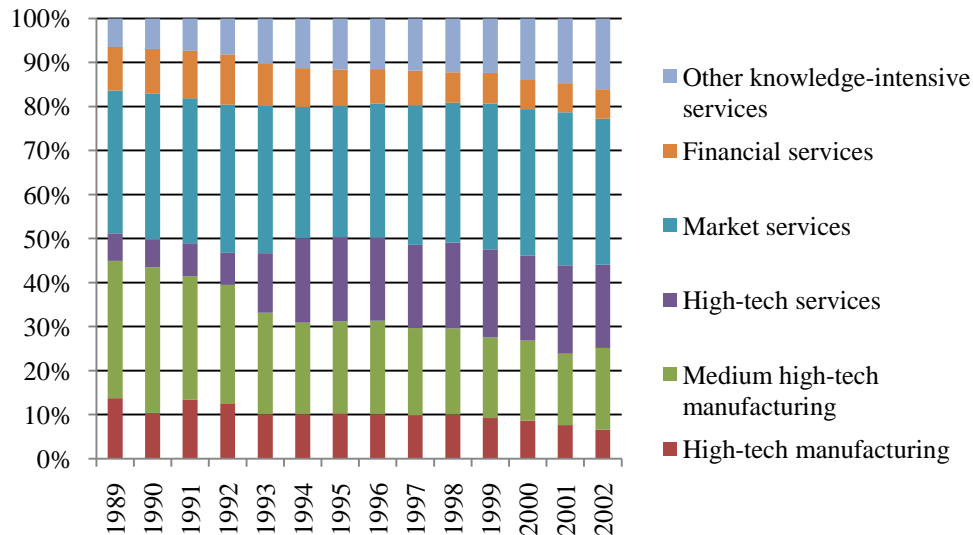


Figure 2.3b: Relative number of employees in the six subsectors

Firm size. We now go deeper into each subsector to investigate the actual size of firms in each sector. The graph in figure 2.4 below shows the average firm size by subsector. Comparing the relative positions of the lines reveals some important size differences among firms in each sector. The average size is highest in the medium High-tech manufacturing sector with somewhat less than a hundred employees. This sector and the High-tech sector have also the highest standard deviation which indicates that some very large firms dominate these two sectors. This can be compared with knowledge-intensive High-tech services, knowledge intensive market services and other knowledge intensive services that have less than ten employees on average. It is important to note that there is an important outlier introduced 1994 in the knowledge-intensive High-tech services. It is a large Swedish corporation that had its industry code changed.

Further, comparing the development of each line over time in the graph shows that the average size for firms has in many sectors diminished. The most dramatic change occurred in financial services where the average size went from 59 employees in 1989 to 26 employees in 2002. This can be explained with the deregulation of the financial industries between 1986 and 1991, spurring the entry of many new small firms in financial services (Wennberg, 2009b). High-tech manufacturing firms also decreased average size from 42 to 32 employees during the period of observation. However, in some sectors the average size increased. This is the case for High-tech services and other knowledge-intensive services that increased from 9 to 16 employees and from 6 to 8 employees, respectively, from 1989 to 2002. The other subsectors remained relatively stable. Thus we can conclude that industry sector in terms of average size has changed substantially during the period of observation.

The decrease in average firm size in these sectors mirrors the international development of these subsectors, explanations commonly revolving around the decrease in transaction costs and increasing use of information technology, allowing incumbent firms to shed employees and outsource much of their work (Brynjolfsson et al., 1994). Also, the flux of newly entering firms contributed to a decrease in the average firm size (Audretsch, 1995). We will now examine the entry and exit patterns across time.

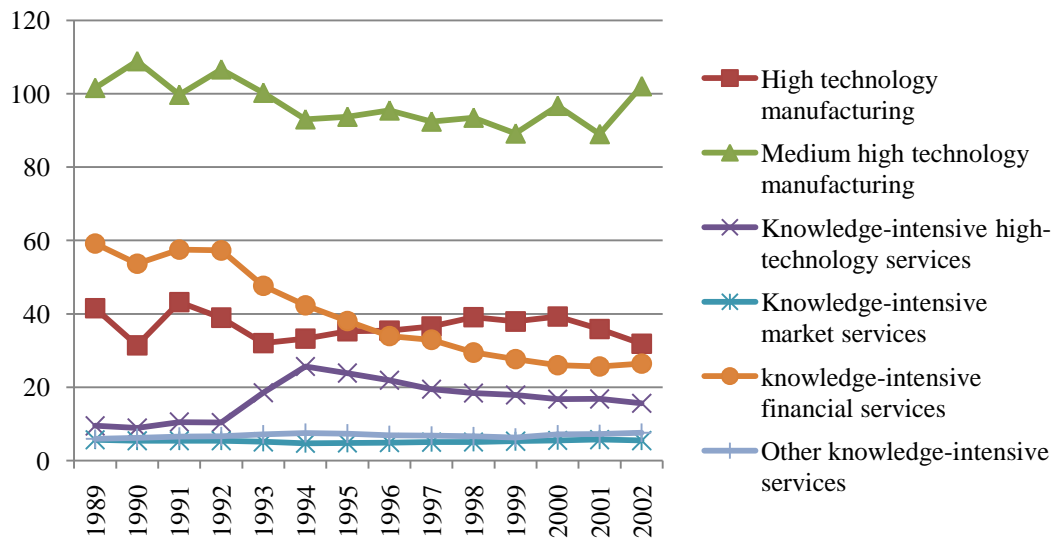


Figure 2.4: Average firm size by the six subsectors

Entry and Exit from the population of knowledge intensive firms

Figure 2.5 show the relative number of entries compared to the stock of firms over time. Figure 2.5a shows the absolute number of entries over time. In both figures we separate entries into four categories following Statistics Sweden original classification. The four types of entries are: merger; de novo; spinout; and entry by split. The exact definition of types of entries was described above in the method section.

The share of entries in our population varies between 22 percent and 27 percent of the total population of active firms depending of the year of examination. This indicate a very large 'churning' as in each year, almost one-fourth of the population of firms in each subsector gets replenished. The most dominating group is entry by spinout which varies between 12 percent and 17 percent. This is followed by de novo entry (4 to 7 percent). Entry by split or merger is a minor form of entry. They represent together 3 to 5 percent of the total.

In absolute numbers we observe a general increase of entries over time after a slump following the recession in 1991-1993. The increase in number of startups is 59 percent

between the start and the end of the period. 1994 and 1997 are years that stand out as they represent breaks in the trend. 1994 is special for three reasons. First, Statistics Sweden changed their way of classifying new firms. Second, the cost for incorporating a firm doubled in 1995 (Delmar et al., 2005). Three, there was a real surge of startups as many people let of during the recession had receive substantial compensation packages that they used to a certain degree to finance startups. 1997 represents the real start on the dotcom bubble and the breakthrough of internet as a technology with an important commercial value.

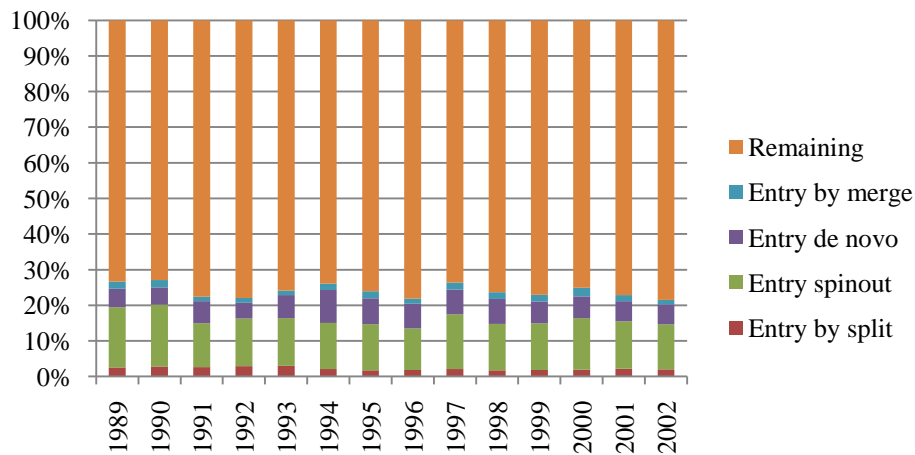


Figure 2.5a: Percentage new entries into the six sub sectors

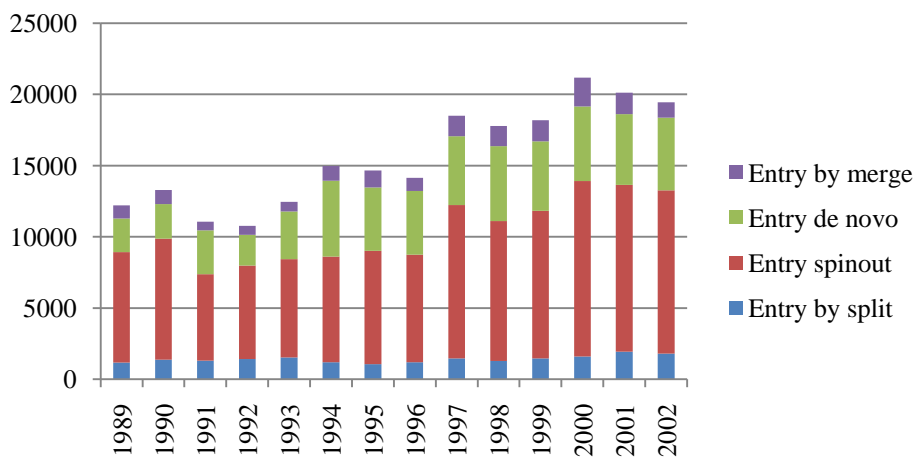


Figure 2.5b: Number and types of entries for the sector

We now move on to look at the exiting firms. Figure 2.6 illustrates the number of exits across time and type of exit. We examine three types of exit: exit through merger; exit by split and exit by termination. Termination is the most common type of exit. It represents on average 80 percent of all exits. Exit by merger represent somewhat more than 10 percent. As with entries, the total number of exits increased from a yearly 15,108 in 1990 to 22,636 in 2002. In relative terms between 19 and 30

percent (1991 and 1993 represent the high and low years) of the firms exit during any given year. In subsequent years, the exit rates are just below 20 percent. These rates are very close to the entry rates.

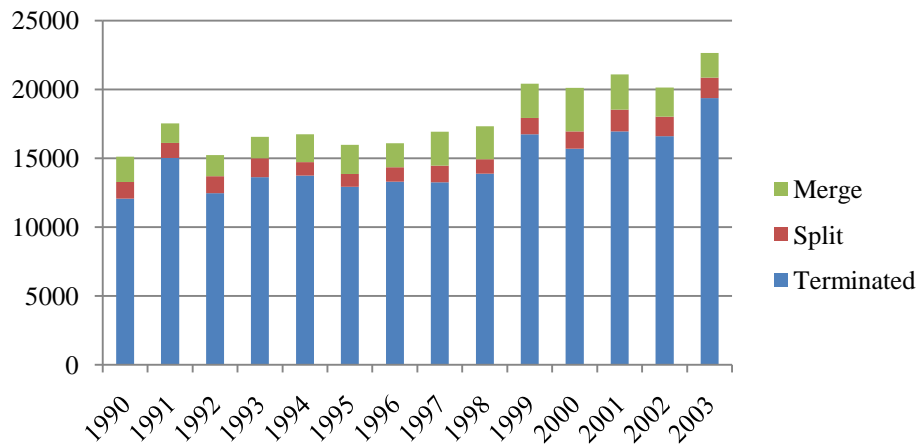


Figure 2.6: Number and types of exits

The relationship between entry and exit rates has also been noted in earlier research (Geroski, 1995; Picot & Dupuy, 1998). Entry and exit rates are parts of a larger process of change where a large number of new firms displace a large numbers of older firms without significantly changing the total number of firms in operation at any given time. This concept is known as “churning” and is positively associated with the economic cycle (Birch, 1979). By looking at the gross flows in and out of the population (i.e. entries and exits) we can determine the structural stability of the sector. The more stable the group is (the less entries and exits), the longer is the average life span of firms, and the less dynamics can be observed. This “dynamics” as measured as the gross flows of entries and exits of firms is more important than the number of net entries (i.e. entries minus exits) as a sign of economic vitality – as explained in Audretsch’s (1995) “revolving door hypothesis”.

Discussion of firms dynamics in knowledge intensive economy

In this chapter we have explained our reasons to study the knowledge intensive economy, outlining the increasing economic importance of this sector. Second, we presented and described the data set that is used throughout the various chapters in the book.

We argued that from an endogenous growth perspective, the study of entrepreneurial activities in the knowledge intensive sector allows us to better understand how new technological knowledge is converted into economic growth. A key to understand this change is the study of industrial dynamics of new and

established firms, and the shift from a manufacturing to a service intensive economy. With the rise of the “service economy”, economists and management researchers have begun exploring services and of particular interest to researchers in the last decade has been the explosive growth of knowledge-intensive business services (KIBS). The evolution of the knowledge intensive firms is part of larger economic changes stemming from an increasingly dynamic “market for knowledge” where service firms are increasingly important. (Mina, 2008).

The bridge to entrepreneurship research is provided by the observation that knowledge from technological change can be seen as a non-rival and partially excludable good. Thus, ‘spillovers’ or how new knowledge is transmitted in the economy is central to our understanding of how economies develop (Agarwal, Audretsch & Sarkar, 2007). The creation of new firms can be seen as either a subgroup of employee mobility between firms or as a way for knowledge spillover to take place where employees leave a firm to create a new utilizing experience and knowledge acquired with the former employer to construct a firm that might become a potential future competitor (Wennberg, 2009b). We call this kind of firm startup for spinout firms and we will look specifically at their role in this book (Chapter 4).

The longitudinal data we use encompass the period from 1989 to 2002 and thus covers one of Sweden’s largest recessions in modern time (1990 to 1993) as well as a strong period of economic growth (1994 to 1999). We use official register data provided by Statistics Sweden that covers all active firms and their employees during the period. The data is unique because it allow to link employer and employee data. We investigate six different subsectors, two in manufacturing and four in the service sector. These six sectors represent together close to 15 percent of all registered firms during the 1997-2002 period. In terms of number of employees, these six sectors grew from 1993 to 2002, from employing 16 percent of all employees to 24 percent with a stabilization around 2000. In terms of total sales, the sectors represented 27 percent in 1997 and 30 percent of total sales made by Swedish firms. This confirms the idea that this sector is growing in importance and that it represents an important part of the Swedish economy.

When plunging deeper into the evolution of the knowledge intensive sector we clearly see some important differences among the six subsectors. The different services subsectors grew considerably in employment, other knowledge-intensive services with 158 percent followed by High-tech services which grew by 130 percent. During the same period, the two manufacturing subsectors show only moderate growth. Also, we witness a considerably churning with a large number of firms

entering and exiting from the subsectors. This is normally an indicator of strong industrial dynamic, often leading to more rapid economic development in a sector (Audretsch, 1995). During any given year, about one fifth of all firms disappear as to be replaced by new entrants. Further, we could see that the overall number of firms present has grown while the average firm size has decreased. These are indicators of new type of industry dynamics going towards smaller and more flexible units (Brynjolfsson et al., 1994).

We have outlined a broad picture of the development of the knowledge intensive sector during the 1989 to 2002 period. Our intention was to establish the importance of this sector for the Swedish economy, and to use this overview as a backdrop to our more fine grained analyses where we dig deeper in trying to explain what forces lie behind the evolution of individual firms. We are particularly interested in the geographical and organizational contingencies that affect the emergence of new firms. Subsequent chapters will deal with this and also look more closely at the internal dynamics of the firms and how its affect their individual performance.

Appendix A :

Sector Code Description NACE Rev 1.1 codes

MA_TOTAL Manufacturing 15 to 37

MA_H_MH_TOT High and medium High-tech manufacturing 24, 29 to 35

MA_HIGH_TEC High-tech manufacturing 30, 32 and 33

MA_MHIGH_TEC Medium High-tech manufacturing 24, 29, 31, 34 and 35

MA_LOW_TEC Low-technology 15 to 22 and 36 to 37

MA_MLOW_TEC Medium low technology 23 and 25 to 28

SE_TOTAL Services 50 to 99

SE_KIS_TOT Total knowledge-intensive services 61, 62, 64 to 67, 70 to 74, 80, 85 and 92

SE_KIS_HT High-tech services 64, 72, 73

SE_KIS_MS Market services 61, 62, 70, 71, 74

SE_KIS_FS Financial services 65, 66, 67

SE_KIS_OT Other knowledge-intensive services 80, 85, 92

SE_LKIS_TOT Total less-knowledge-intensive services 50, 51, 52, 55, 60, 63, 75, 90, 91, 93, 95 and 99

SE_LKIS_MS Less-market services 50, 51, 52, 55, 60, 63

SE_LKIS_OT Other less-knowledge-intensive services 75, 90, 91, 93, 95, 99