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Abstract

Prior research has addressed the role of single large firms in Regional Innovation Systems (RIS), ascribing them the role of "flagships", "hubs" etc. Less attention has been given to RIS dynamics set in motion when a flagship abruptly rearranges or ceases local operations, as is often the outcome when it is acquired by, or merged into, a larger multinational enterprise. The two flagships of the Swedish pharmaceutical industry – Pharmacia and Astra - shifted from domestic to multinational ownership in 1995 and 1998. We study consequences of this shift focusing on the following issues:

i) Whether the shift in ownership brought about expansion or contraction of operations carried out internally by the two firms in Sweden. Observing notably declining activities in Pharmacia and expansion in Astra's case we discuss control rights as a factor in national regulation affecting long-term strategising on part of key investors.

ii) Whether the reduction of Pharmacia's Swedish operations has been substituted by new firms derived from Pharmacia in the forms of divestments, spin-offs or start-ups. Identification of the founders of new bio-pharmaceutical firms reveals very little manager-to-founder migration out of Pharmacia, whereas considerably derived activity comes out of firms divested or spun-off while Pharmacia was still fully operative.

iii) Whether the recombinatorial capacity of the innovation system in the Stockholm-Uppsala region plays a role in explaining the paucity of Pharmacia-derived start-ups. Compared to the Copenhagen region (the other major biotech concentration in

Scandinavia) Stockholm-Uppsala's RIS is shown generally to have been notably less effective in mobilising industrial managerial talent for bio-entrepreneurship. To better understand this inter-regional divergence we model differences between the two RIS in the supply of venture capital to the financing rounds of young biotech start-ups. In RIS dynamics venture capital has the critical function of connecting managerial talent with entrepreneurial resources. For new bio-firms this particular RIS-function is shown to have performed significantly weaker in the Stockholm-Uppsala region as compared to the Copenhagen counterpart. This deficiency may be expected to rank importantly among causes for the comparatively lower incidence of manager-to-founder transitions amongst Stockholm-Uppsala's new biopharmaceutical firms.

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Introduction

Prior research has addressed the role of single large firms in generating clusters and Regional Innovation Systems of (RIS), ascribing them the role of "flagships", "lead firms" or "hubs" (Audretsch 2000;Dunning 2000;Lazerson & Lorenzoni 2005). Much less attention has been given to the type of RIS development set in motion when a flagship abruptly rearranges or ceases its local operations, as is often the outcome when it is acquired by, or merged into, a larger multinational enterprise. Activities terminated by the flagship from a RIS perspective, may translate into dismantling of networks and relational capital, but may also set free resources and entrepreneurial potential. The present paper examines conditions affecting this outcome

The two flagships of the Swedish pharmaceutical industry – Pharmacia and Astra - shifted from domestic to multinational ownership in 1995 and 1998. We study consequences of this shift focusing on the following issues:

1) Whether the shift in ownership brought about expansion or contraction of operations carried out internally by the two firms in Sweden. Observing declining activities in Pharmacia and expansion in Astra's case (Section 2) we discuss control rights and long-term investment perspectives as causes behind this difference (Section 3).

2) The findings on Pharmacia open the second issue whether dismantled activities have been substituted through the emergence and growth of *new* Pharmacia-derived firms. Section 4 studies various organisational forms for such derivations, finding particularly weak substitutional activity coming out of new start-up firms.

3) By popular myth (e.g. Dagens Industri 2001;Kemivärlden Biotech med Kemisk Tidskrif 2001;Svenska Dagbladet 2000) the Stockholm-Uppsala (S-U) biotech cluster largely emerged through the bio-entrepreneurship derived from Pharmacia, so to speak arising from its ashes. Section 5 focuses on the prior organisational affiliation of founders of new biotech Drug Discovery Firms (DDFs), and finds that industrial managers were conspicuously absent specifically in creating entrepreneurial substitutes for Pharmacia. Moreover, compared to the Copenhagen region, the other major biotech concentration in Scandinavia, Stockholm-Uppsala's RIS in Section 5 is shown generally to have been notably less effective in mobilising industrial managerial talent for DDF-entrepreneurship. To contribute to the explanation of this difference Section 5 examines differences between the two regions in the way Venture Capital carried out its critical function of connecting managerial talent with entrepreneurial opportunities. Conclusions are presented in Section 6.

2 The Emergence of the Swedish Pharmaceutical Industry

2.1 General overview

In the early 20th century, German and Swiss companies were dominating the pharmaceutical market and Sweden was dependent on imports and as late as until the 1980s Sweden was net importer of pharmaceutics (Stankiewicz 1997). Pharmacists often founded firms in the early decades of the 20th century, which was the case for both

Astra and Pharmacia[1]. Domestic production of drugs discovered abroad was the main business approach (Stankiewicz 1997). Astra and Pharmacia were established in 1913 and 1911 respectively, but R&D and drug development started later in the 1930s and with modest achievements.

From an international perspective the Swedish pharmaceutical industry of the 1950s, was still of modest size, primarily adopting a follower strategy (Stankiewicz 1997). From the 1960s onwards, Swedish firms intensified R&D, innovating at a rate above the pharmaceutical industry in general, which exhibited a general decline of innovations in the 1960s and 1970s.

By the end of the 1970s Sweden recorded seven major pharmaceutical companies; Aco, Astra, Ferring, Ferrosan, Kabi, Leo, and Pharmacia. During the 1980's until 1991 the Swedish pharmaceutical industry were reduced to the three firms of Astra, Ferring, and Pharmacia. Despite the comparatively modest size of Swedish pharmaceutical, measured by number of employees and number of firms, through the 1990s they exhibited commercial success and accelerated growth. However, rapid growth of the pharmaceutical industry combined with shortage of university supply of graduates and declining public R&D spending in the 1980s resulted in faster growth of pharmaceutical activities in Swedish owned firms abroad compared to the domestic growth, which was especially the case for Astra (Stankiewicz 1997).

The 1990's were the time of large pharma mergers. Strategic incentives to merge included access to distribution channels and markets, spreading risks and getting access to drug development funding. The Swedish pharmaceutical companies followed the same trend and in the beginning of the 1990s. In the following, the histories of the two Swedish pharmaceutical firms – Astra and Pharmacia – are summarized.

2.2 Astra

Astra[2] started its R&D activities in the 1930s. The activities where accelerated during the second World War but resulted in only one important product on the international market in the early 1960s, Xylocain[3]. The success story of Astra is primarily based on the R&D investments in the 1960s and onwards. In the end of the 20th century the best selling Astra products were Losec, Pulmicort and Seloken. The strategy of long-term R&D investments and strategic acquisitions eventually paid off.

Astra has traditionally acquired companies and incorporated them as autonomous subsidiaries within the group with distinct R&D areas. Tika was acquired in 1939. Hässle was acquired in 1942 and Astra-Hässle was formed. At the time of the acquisition Hässle was undertaking basic pharmaceutical activities without any important R&D or new product development. However, R&D investments in the 1950s and 1960s contributed to create an important player in the Swedish pharmaceutical industry (Stankiewicz 1997). For instance, the beta-blocker Seloken is a drug developed

[1] The company Vitrum was formed as early as in 1877 by a pharmacist in Stockholm and may be regarded as the first Swedish pharmaceutical firm.

[2] Historical data presented in the following section is compiled from a number of sources; (Stankiewicz 1997), (Killing 2004), (Lundberg 2006), (www.astrazeneca.se 2007), (Dolk & Sandström 2005), (Östholm 1991), wikipedia.org

[3] Xylocain was originally invented by two academic researchers, not by Astra.

by Astra-Hässle[4]. In the 1960s two companies dominated the development of beta-blockers in the international pharmaceutical industry; Astra-Hässle and ICI. ICI spun-off Zeneca in 1993, the latter with whom Astra merged with in 1999. Draco was acquired in 1955, and became the second Astra R&D company developing, among others, Pulmicort.

In 1998, the year before the merger, Astra employed about 22.000 worldwide, out of which 8.000 were located in Sweden including 3.800 R&D employees. The annual turnover was around 57 billion SEK, net profit 16 billion SEK, and the annual R&D expenditures approximately 10.6 billion SEK. Corresponding figures for Zeneca was 34.000 employees worldwide, annual turnover of 5.5 billion GBP, net profit of 1.1 billion GBP, and annual R&D expenditures around 602 million GBP. In 2006, the number of employees in AstraZeneca located in Sweden amounts to 12.800, undertaking R&D and a large share of the manufacturing of drugs developed within the group. Detailed documentation on Astra's development is offered in Appendix 1,

2.3 Pharmacia's pre-merger history

Pharmacia's history[5] starts in the early 19th century and the company is the perhaps the only pharmaceutical company originating from the brewery industry. In 1889 a consortia of investors and brewers founded the company *Stockholms Bryggerier*, a merger of several breweries. In 1918 a decision was taken to centralize laboratories located in several small breweries within the brewery group of Stockholms Bryggerier into a large central laboratory, *Centrallaboratoriet*. Initially it's primary function was to monitor the beer production, but about 10 years later it became more focused on systematic research on research methods, production methods and alternative uses of raw materials others than for beer brewing, e.g. vitamins and proteins derived from yeast, production of malt extract for beer production, and enzymes for other industries such as textiles and bakeries.

A Danish brewery *De Forenede Bryggerier*, established in 1931 a daughter company in Malmö named *Kärnbolaget* for production and distribution of enzyme-based products for bakeries (e.g. flower) and binding compound for the moulding industry. In 1934 the Danes offered Stockholms Bryggerier to acquire Kärnbolaget in Malmö. Before long the deal was closed and activities moved to Stockholm. The acquisition of Kärnbolaget made the foundation of *Kabi* and the application of brewery competencies in other related industries. Kärnbolaget became an independent subsidiary to Stockholms Bryggerier. By 1945 Kärnbolaget had developed penicillin and in the following second part of the 1940s Kärnbolaget expanded R&D activities in penicillin and antibiotics. 1951 *Kärnbolaget Aktiebolag Biokemisk Industri* changed name to *Aktiebolaget Kabi* and in the following year a production site for penicillin was taken into use in Strängnäs, including a microbiology laboratory. In 1971 Statsföretag acquired Kabi and in the following year Statsföretag restructured its pharmaceutical division into the Kabi-Group, where Kabi became a subsidiary together with other related firms. In 1978 the

[4] (Stankiewicz 1997) provides a thorough history and analysis of the beta-blocker development in Astra-Hässle in particular and the international pharmaceutical industry in general.

[5] Historical data presented in the following section is compiled from a number of sources; Frankelius 1999; Eliasson & Eliasson 2006; Nilsson & Norell 1997; Eifrém, Rössel, & Kumlin 2000; Waluszewski 2004; Dolk & Sandström 2005; Kemivärlden Biotech med Kemisk Tidskrif 2001; Läkemedelsvärlden 2001; Läkemedelsvärlden 2002; www.pfizer.se 2007; www.swedenbio.org 2007; wikipedia.org

company changed name to KabiVitrum and signs the first gene-technology based industrial contract with Genentech. Genentech developed human growth hormone based on its DNA-technology. KabiVitrum financed the R&D and Genetech transferred knowledge to KabiVitrum. Genentech was a newly established CRO, which offered R&D services based on its new DNA-technology. As a result of increasing focus on DNA-technology, KabiVitrum and Statsföretag AB established a new company KabiGen AB, which became the first DNA-technology based company in Scandinavia.

In 1985/86 KabiVitrum faced major financial losses. Discussion flourished about to close down the firm. On of the main owners, Volvo, had built a conglomerate and wanted to focus on their core businesses. The second main owner, the Swedish Government, also planned to sell its shares. Both were focusing on finding a partner to merge with KabiVitrum. Growth was on top of the agenda to increase the competitive advantage of the company.

The other part of the emerging pharmaceutical company, Pharmacia, was established in 1911. It moved to Uppsala in 1951 and started to develop filtering and selection technologies in informal collaboration with Uppsala University. This technology became the foundation of biotechnology within Pharmacia.

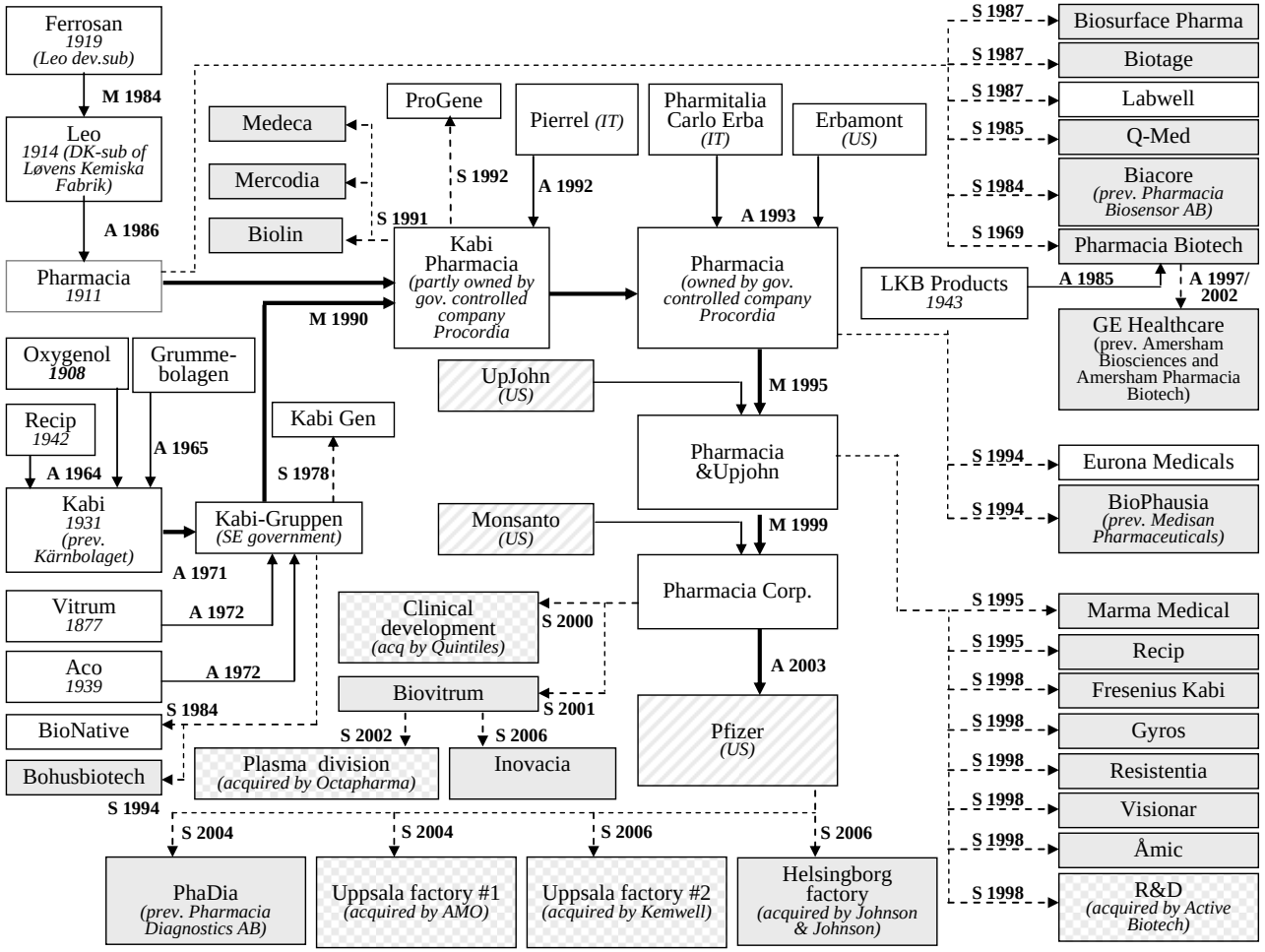
In 1990, Kabi and Pharmacia merged and formed KabiPharmacia. After acquiring three pharmaceutical companies the company changed name to Pharmacia in 1993. Figure 1 exhibits Pharmacia's Swedish genealogy and Appendix 2 exhibits more details about its history.

2.4 Pharmacia's M&A history

Management and board members in the newly formed Pharmacia found it too small to grow organically, despite previous mergers and acquisitions of Italian companies. Pharmacia initially was looking for a collaboration partner (primarily for marketing and distribution in the US) rather than a merger. However, a concurrent international wave of mergers in the industry increased the threat from large competitors to increase market shares and attract skilled people from Pharmacia. Pharmacia's pipeline was to deliver several new products and it was decided that the company needed more resources and market channels for the US market.

At the time of the merger with Pharmacia in 1995, Upjohn was in a spiral of negative development, which was an important reason why the merger was executed; expiring patents, huge cash flow spent on a massive but non-productive project portfolio, and no new block busters in the pipeline (Stankiewicz 1997). To get out of such a negative spiral either a *generative* or a *harvesting* strategy may be pursued (Stankiewicz 1997). The former means that firms invest in in-house R&D and stay innovative through creativity. The latter refers to exploitation and commercialization of results from previous R&D projects. Pharmacia, following a generative strategy, for several decades had developed R&D projects in-house combined with acquisitions of external R&D-organisations. In the 1990s Pharmacia was expected to move into a combination of generative and harvesting strategy, reaping the fruit of long-term R&D investments.

Figure 1 Pharmacia Swedish Genealogy



A = Acquisition, M = Merger, S = Spin-off

Dotted line indicates spin-off in an independent firm, solid line indicates integration of two or more independent firms, filled squares denotes firms still active.

Source: Own figure

However, Pharmacia needed resources, especially financial resources, competencies in structural chemistry to complement its focus on biotechnology and market penetration, for undertaking a full-scale exploitation and marketing activities. Upjohn, on the other hand, could offer the extra resources needed by Pharmacia but, as was revealed after the merger, did not match Pharmacia's R&D project portfolio with a corresponding quality of project pipeline. However, to accomplish an expected combined generative and harvesting strategy, Pharmacia and Upjohn merged in 1995.

From being completely controlled by Swedish shareholders, the share of Swedish ownership falls down to 20% in 1996. Critical voices argue (e.g. Biotech Sweden 2004; Dagens Industri 2004; Ny Teknik 2004) that the merger conditions for Pharmacia were less beneficial than for Upjohn and that the average pricing of US pharmaceutical companies was higher than for Swedish firm. Hence, US shareholders could buy a large stake of Pharmacia for less money. In addition, the R&D portfolio of Upjohn appeared to be less valuable than stated before the merger. In fact, the product portfolio consisting of products in pipeline and launched products of Pharmacia & Upjohn is primarily based on the output of Pharmacia's R&D. Despite of this fact, after the merger R&D activities were transferred to the US and in 1997 also the Pharmacia & Upjohn headquarters moves from London to the US.

Initially R&D activities were planned to expand in Sweden, but R&D activities in Uppsala closed down shortly after the merger. Protein substance 'Refacto' was sold to Wyeth and half of the instrument division of former Pharmacia established in 1969, Pharmacia Biotech, was acquired by the UK company Amersham International. The new company was named Amersham Pharmacia Biotech.

In 1999 Pharmacia & Upjohn merged with the US pharmaceutical company Monsanto and changed name to Pharmacia Corporation. Swedish government, holding 14% of the shares after the IPO in 1994 and 7% of the shares after the merger with Upjohn in 1995, sold the rest of its shares. The total share of Swedish ownership fell to 9%. Expansion of R&D activities in Sweden was completely abandoned and R&D started to be reallocated to the US.

Until the acquisition by Pfizer in 2003 further divestments took place; the rest of the shares in Amersham Pharmacia Biotech and Biovitrum. After Pfizer's acquisition the share of Swedish ownership fell down to 4% and there were no more Swedish board members or managers.

Pharmacia & Upjohn planned to close down the facilities in Helsingborg and move the production of Nicorette to Puerto Rico. Subsequently, these plans were abandoned by Pfizer, thereby keeping the production and labour force of around 1000 people in Helsingborg. Moreover, Pharmacia & Upjohn plans for closing down in Stockholm and Strängnäs were also abandoned. However, new production facilities in Uppsala, ordered by Pharmacia-Upjohn, were not being used. In 2004 Pfizer had about 3000 employees in Sweden, located in Helsingborg, Stockholm, and Strängnäs (out of 120.000 employees and 80 facilities worldwide). In the time period 2003-2006 Pfizer undertook further divestments and by 2006 all sites in Uppsala had been sold and closed down. The only exception was investments made in at site in Strängnäs. In 2005 the number of employees is about 2500, further reduced to about 1300 in 2006, all in production or administration. Activities based on pharmaceutical R&D, in other words, are no longer part of Pfizer's Swedish operations.

3 Pharmacia and Astra compared: The role of ownership and strategic intent[6]

The M&A histories of Pharmacia and Astra clearly represent two opposite cases. We identify two inter-related causes behind their differences: i) control based on a combination of break-through rules and on shares with differentiated votes, and ii) short- vs. long-term perspectives of the investors.

Control: Before the exit of its two main owners, Pharmacia considered acquiring another pharmaceutical company, as was the upcoming trend in the industry in the beginning of the 1990s. However, the exit of the main shareholders in 1993-1994 suddenly put Pharmacia in a much more defensive position. In 1993 the state acquires Volvo's share of Pharmacia and becomes the sole main owner. In the following year Pharmacia is divested through an IPO and the state retains 14% of the shares and 12% of the votes, enabled by the existence of shares of differentiated votes. Although the stake held by the state enabled it to control the company based on the break-through rules at a limit of 90%, the state had communicated its strategy to divest its controlling share of the company. Hence, from being in position of evaluating acquisition targets, Pharmacia found itself in the opposite role of becoming a potential acquisition target. The exit of the main shareholders resulted in loss of clear ownership and sources of financing. As a result, Pharmacia found itself in a weak position in its own subsequent negotiations with Upjohn, where the Swedish government retained only 7% of the shares and thereby lost its control of the company. Astra, on the other hand, despite being listed on the stock exchange as early as 1955, benefited from having Investor AB controlled by the Wallenberg family as a major shareholder, taking a long-term perspective on Astra. In contrast to the conditions faced by Pharmacia, Astra would not become an acquisition target without the consent of Investor AB, the decisive influence of which was based on shares of differentiated votes and Swedish break-through rules at a limit of 90%.

Sweden has had shares of differentiated votes for around 80 years, and Scandinavian firms still today tend to use dual class shares more frequently than their European counterparts (Bennedsen et al. 2007). The other control mechanism, break-through rules, imply that when at least 90% of all shares are acquired by an investor, the investor has the rights to acquire the remaining 10% without the possibility of any legal intervention by the remaining shareholders. In other words, hostile takeovers are not an alternative if a long-term investor holds more than 10% of the shares. In the case of Astra, the former mechanism played a crucial role combined with the ownership of shares with differentiated votes to gain influence on decisions taken in the company, although not to an extent where majority stake was obtained. In the case of Pharmacia, the main owners communicated their interest of not taking advantage of any of the mechanisms at hand.

In the majority of its investments, Investor holds more than 10% of the shares to be able to benefit from the Swedish shareholder legislation. Until 1998, the investment in Astra was not an exception. Before the merger between Astra and Zeneca in 1998, Investor

[6] This chapter is partly based on interviews with Mats Petterson (CEO of Biovitrum AB and former CEO of Pharmacia), Håkan Mogren (former CEO of Astra, now Investor), Staffan Ternby (communication director of Astra) and Erik Belfrage (advisor to the chairman of Investor).

owned 11% of the so-called A-shares, shares with differentiated votes of a factor 10:1. However, since the merger with Zeneca, the shares are no longer differentiated in votes. As consequence, Investor now holds only about 3,4% of the capital and the votes in AstraZeneca, but nevertheless holds 3 out 12 of the board members.

Long-term investment perspectives: Closely related to the control structure is the long-term perspective of the investors. Differences in these perspectives were already reflected in efforts spent on preparing the shift into multinational ownership. The transition was prepared significantly differently in the two cases, not least in terms of efforts spent on searching for, evaluating and negotiating with potential partners. While Astra spent more than two years to prepare the partnership, Pharmacia merely spent roughly 6 months. For Astra, the merger clearly appears to have been aligned with the long-term strategy. Particular attention was paid to finding a partner matching as perfectly as possible the targeted aims and visions of Astra's owners and management. Pharmacia, on the other hand, was under pressure to quickly find a partner to avoid being target for a hostile take-over. The main reasons were financial constraints for R&D funding and unclear ownership after the sudden exit of the two main shareholders of the Swedish government and Volvo.

There is an ongoing debate that these control mechanisms, disproportional ownership in comparison to the share of cash flow, a) impede takeovers and thereby the market for corporate control, and b) the contractual freedom to decide the ownership structures (Bennedsen, Junge, Jacobsen, Nielsen, & Jespersen 2007). We learn from the control mechanisms and the investment perspectives discussed above, that in the present case, break-through rules and shares with differentiated votes enable investors to take a long-term perspective on the involvement in firms. Without the control mechanisms, there is a risk of hostile take-overs would unless an investor acquires more than 50% of a firm and, hence, reduces its ability to spread risks in a higher number of investment objects. Also, firms may benefit from long-term perspective investors since they probably have a higher commitment even when firms invested in face financial downturns and requires additional investments.

In a recent study on the effect of disproportionate ownership structures in comparison to income rights, Bennedsen *et al* (Bennedsen, Junge, Jacobsen, Nielsen, & Jespersen 2007) study listed firms in 13 European countries and focus in particular on the disproportional ownership structures of Scandinavian firms. They claim that, in general, firms employing control mechanisms do not accomplish better economic performance measured as market to book ratio, return on assets, sales growth and employment growth. However, the pharmaceutical industry is an exception, where firms seem to generally achieve higher performance than for firms in other industries, with or without employment of control rights. The results indicate in particular increasing return on assets for pharmaceutical firms when employing disproportional ownership structures (*ibid.*). Further, negative effects on firm value do not seem to be driven by dual class share but by other control mechanisms, in particular pyramidal ownership structures.

To summarize, innovation processes in the pharmaceutical industry requires long-term planning and commitments. Therefore pharmaceutical companies, derive considerable advantages from having owners taking a long-term view on their investment. To induce that long-term perspective investors need the possibility to control their investments and thereby secure the rights to future potential returns. In other words, a causal cascade

links control rights, via investment perspectives, to long-term commitments and strategies for the company. In the case of the Swedish pharmaceutical industry, Pharmacia's story exemplifies that the mere formal availability of these control right in national legislation by itself will make no difference if they are not mobilised by owners with long-term commitments to the company. In Astra's case, on the other hand, the combination of break-through rules and shares with differentiated votes reinforced a long-term perspective on part of a stable owner configuration, leading them towards stronger strategic attention to the merger with Zeneca. In turn, that secured a much stronger post-merger contribution from Astra to the Swedish economy.

4 Tracing the transformation into post-Pharmacia activities

Producing a comprehensive mapping of Pharmacia's industrial legacy we establish the extent to which activities discontinued *within* Pharmacia by 2005 were substituted *outside* Pharmacia by new firms, in the form of start-ups, spin-offs or divestments, jointly referred to as Pharmacia derivatives. Extensive archival data was collected on firms qualifying as derivatives from Pharmacia. For identification of firms, we rely largely on previous studies (Nilsson & Norell 1997; Vinnova 2005; Eifrém 2000) supplementing with a few additional firms identified through press clippings, industry reviews, and on information on each firm in the industry, such as annual reports, homepages, and press releases. Along with few earlier small studies, we also record job creation/losses within Pharmacia and its derivatives. However, we differ from previous studies by updating data until 2006 for a more extensive set of firms and by categorising all Pharmacia derivatives on a combination of five dimensions:

i) *organisational form* of each derivative, distinguishing between: a) divestments, b) spin-offs and c)start-ups

ii) the *origin* of the derivative in each of Pharmacia's three lines of business: Pharmaceuticals, Diagnostics and Instruments

iii) domestic vs. foreign *ownership* of each derivative

iv) whether each derivative was formed *before or after the merger with Upjohn* in 1995

v) *job creation/loss* over a ten-year period

4.1 Previous studies

The literature offers two opposing views on the Pharmacia legacy. (Eliasson & Eliasson 2006), discuss whether large firms are more efficient in commercialising new technologies than new entrepreneurial firms. They propose a 'Shake Loose Hypothesis', arguing that resources set free from the dismantling of Pharmacia have been better allocated in new firms more capable of achieving commercial success. Without building on systematic statistical evidence, they conclude in favour of a positive effect of the restructuring of Pharmacia, arguing that the positive effects are still to be seen.

The second view, (Waluszewski 2004) confronts the generally positive assessment of the Pharmacia legacy, as reflected not only in (Eliasson & Eliasson 2006) but also in a press release from Uppsala's regional chamber of commerce presenting the downsizing

of Pharmacia activities as the basis for the emergence of the 140 firms constituting the local bio-cluster. However, the majority of these firms, Waluszewski argues, have grown out of established and stable industrial and academic units rather than growing out of resources set free by the downsizing of Pharmacia. Most of the life science and biotech firms of this region, she argues, were established before the restructuring of Pharmacia began in 1995, and they grew out of four organisations in particular: i) Pharmacia Biotech (now GE Healthcare), ii) Pharmacia Diagnostics (now PhaDia AB), iii) Uppsala University and iv) the University of Agriculture (Waluszewski 2004).

From the list of 140 firms (Waluszewski 2004) identifies 70 units with various types of Pharmacia affiliations, but finds that most of them do not operate in businesses relating to Pharmacia's former core areas. Adding the latter criterion brings Waluszewski's list of Pharmacia-related firms down to 20-25 units.

4.2 Method for identifying post-Pharmacia activities

We record spin-offs and divestments from Pharmacia for the entire period from 1969 until 2005. For the period 1990 until 2005 we also record start-ups, identified as founded by previous Pharmacia-employees. We do not confine firms to a particular geographic region but record firms situated all over Sweden. We delimit the study to Swedish firms related to Pharmacia. By "being related" we mean that firms are founded either as i) *spin-offs* (emerging from or building directly on the results of existing activities within Pharmacia, e.g. new R&D results or technologies), ii) as *divestments* (parts of existing activities that are separated and sold off), or new *start-ups* (stand-alone firms not emerging from existing activities, but from previous Pharmacia employees). Further, we apply the distinction used by (Waluszewski 2004) between firms originating from different entities of Pharmacia. By following this distinction of origin, we may connect different types of Pharmacia activities with corresponding effects on the formation of new firms. That enables us to assess whether the general effect of the restructuring may be derived from Pharmacia in general or specific parts of activities.

Identification of firms has been made through the public database of Bolagsverket (www.bolagsverket.se), official Swedish company registry. Firm specific data were sourced in the private database of Affärsdata (www.ad.se), which collects data from annual reports supplied by Bolagsverket.

4.3 Findings

We identify a total of 76 Pharmacia derivatives (see Table A1, A2 and A3 in Appendix 3) still operating in 2005, at that time employing 4.999 people. Of this employment 3.147 (63%) is found in foreign controlled firms.

Of the 4.999 employees in 2005, a total of 731 are employed in firms spun-off, divested or started up *before* the 1995 merger with Upjohn, hence being unrelated to the merger and the subsequent dismantling of Pharmacia. Consequently the net substitutional employment by Pharmacia derivatives generated subsequent to the merger comes to 4.268 employees in 43 firms, equivalent to 66% of Pharmacia's size as per 1995 of about 6.500.

The 4.268 jobs created by post merger derivatives are classified on two dimensions in Table 1. Vertically derivatives are distinguished by their origin in Pharmacia's three

main product divisions, horizontally by the organisational form of the derivative. The 9 cells give corner percentage share of the aggregate employment of these 43 derivatives as per 2005.

Turning first to *spin-offs*, their employment of 364 compares unfavourably with the 664 jobs created by *pre*-merger spin-offs (see Table A1 in Appendix 3), confirming previous observations by (Waluszewski 2004)

By far the highest number of employees is recorded for *divestments* made as part of the downsizing after 1995, resulting primarily in five large units, of which four are owned and controlled by foreign firms. In total 3.837 employees are found in divested firms, out of which 3.147 are employees by foreign owned firms.

Start-ups, finally, play a microscopic role as derivatives from Pharmacia. Only 67 jobs, 1,6% of all employment in Pharmacia derivatives, fall in this category.

Table 1 Distribution of employment in Pharmacia post-merger derivatives (1995-2005) by origin in Pharmacia's divisions and by organisational form. Corner percentage shares of all employment (4268) as per 2005

Origin in Pharmacia division	*Organisational form of derivative*			
	Divestment	Spin-off	Start-up	Total
Pharmaceuticals	1786 (41,8%)	310 (7,3%)	0 (0,0%)	2096 (49,1%)
Diagnostics	476 (11,2%)	0 (0%)	14 (0,3%)	490 (11,5%)
Instruments	1575 (36,9%)	54 (1,3%)	0 (0,0%)	1629 (38,2%)
Unknown	0 (0,0%)	0 (0,0%)	53 (1,2%)	53 (1,2%)
Total	3837 (89,9%)	364 (8,5%)	67 (1,6%)	4268 (100%)

Source: ScanBit

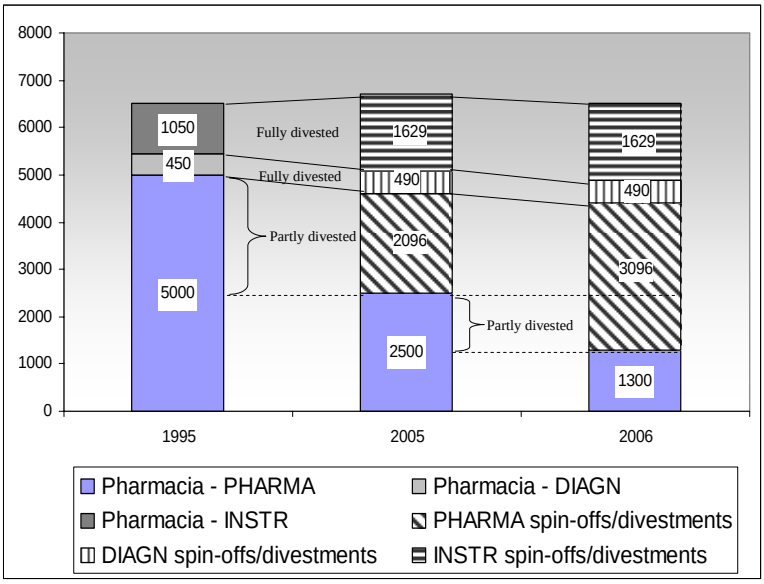
Turning to the breakdown by product areas, all former Pharmacia activities in *diagnostics* and *instruments* have been fully divested or spun-off, by 2005 accounting for almost all the 490 and 1629 jobs recorded for these product areas as shown in Figure 2. Compared to Pharmacia-internal employment in 1995, these 2005 levels represent in diagnostics an increase from 450 to 490. For instruments the increase is steeper from 1.050 to 1.629. Employment growth has occurred primarily in the two foreign owned firms of GE HealthCare and PhaDia.

For *pharmaceuticals* the same 1995-2005 comparison comes out less favourably. The initial 5.000 Pharmacia-internal employees have been reduced to 2.096 employees in firms derived from Pharmacia and 2.500 employees remaining in Pfizer in 2005. Out of the 2.500 employees remaining in Pfizer in 2005, about 1.250 are found in the Stockholm-Uppsala region, headquarter staff accounting for 450 employees. About 1.000 are located in Helsingborg and around 400 in Strängnäs. While Pfizer invests in the site in Strängnäs, manufacturing in Stockholm is scheduled to shut down by 2008, reducing the number of employees by 550. Activities will be allocated to other sites within Pfizer outside Sweden. Since our 2005 figures were gathered, the laboratory in Uppsala has been closed reducing the number of employees by 100, the manufacturing site in Uppsala is sold to the Indian company Kemwell, and the production facilities and manufacturing of Nicorette in Helsingborg with approximately 1.000 employees is to sold Johnson & Johnson. Consequently, all sites in Uppsala are by 2006 sold off. GE

Healthcare acquired Biacore AB in 2006 and the Swedish part of Pfizer now consists of the headquarters in Stockholm, the production facilities in Strängnäs and the site in Stockholm, which will be shut down in 2008. The reductions bring the total of Pfizer employees to 1.300 employees in 2006.

To see the context for the 67 jobs identified in Table 1 generated in start-ups, we compare them in Table 2 with the job creation of pre-merger start-ups. Distinguishing between start-ups established before and after 1995 Table 2 shows 85 employees for pre-1995 start-ups, and exactly the same number for start-ups begun after 1995. Data are missing for a few firms, but they total employment is estimated to 10-20 jobs.

Figure 2 Substitutional effects for three divisions within Pharmacia



Source: ScanBit

Moreover, Table 2 also records firms started up by academics based on university research for which *collaboration* with Pharmacia research played a significant role. University start-ups before 1995 in 2005accounts for 184 employees, while start-ups from 1995 and onwards only register 59 employees (Table 2).

Table 2 Pharmacia-related start-ups and university start-ups growing out of R&D collaboration with Pharmacia. Number of firms and their 2005 employment, separate for firms started up before and after 1995.

Industry classification	Pharmacia related start-ups				University start-ups			
	-1994		1995-		-1994		1995-	
	Firms	Empl.*	Firms	Empl.*	Firms	Empl.*	Firms	Empl.*
Manufacturing	1	8			3	169		
Wholesale	1							
Computer software	2	41						
R&D	5	8	6	64			3	59
Consultancy and services	8	7	5	3				
Medical services	1							
Unknown industry	7	21	2		1	15		
Closed down / unident.	9		9				2	
Total	34	85	22	67	4	184	5	59

** Employment figures as of 2005*

Source: ScanBit

Hence, for the 1995-2005 period we find an overall substitution effect in Pharmacia derivatives of 4.268 jobs. As compared to the domestic pre-acquisition employment in Pharmacia of app. 6.500, this amounts to a gross substitution of 66%. However, applying the above distinctions, we are able offer a more multifaceted mapping of this substitution, which brings out three important conclusions:

- First, only about 49% of the substitution refers to pharma-related activities, representing a major shift in the proportions compared to the *original* activities of Pharmacia, in which pharmaceuticals by far was the major field of activity (77%). As compared particularly to instruments, the business of pharmaceuticals appears to be considerably *less amenable* for restructuring.
- Second, actual substitution partly conforms to the argument of Eliasson's "shake-loose hypothesis" (Eliasson & Eliasson 2006) in that incoming foreign investments into existing units have played a more important role, whereas our findings indicate a much weaker role for new entrepreneurial start-ups amongst Pharmacia derivatives. Substitution to an overwhelming extent takes the more "orderly" form of divestments, carried out by Pharmacia while it was still fully operative. 90% of all observed substitution comes about as divestments. That is, in the case of Pharmacia and the Swedish pharmaceutical industry, it appears that divestments of complete business units from an existing incumbent are more viable than in assembling new business units made available from a shake-loose effect.
- Third, the Pharmacia legacy exhibits only six biotech start-ups in the period 1995-2005 with in total 64 employees, 36 of which are in Orexo accounts. Therefore, although the Stockholm-Uppsala biotech cluster expanded concurrently with the major reduction in Pharmacia's activities, the two processes appear to have been

largely disconnected from each other. Start-ups appear to a higher extent in other industries taken together, which tend to be characterized by low entry barriers and by subsequent low levels of employment growth.

5 Assessing the re-combinatorial capacity of the bio-pharmaceutical RIS of Stockholm-Uppsala

The above findings give rise to the second set of issues considered in this paper: *If a substantial pool of managerial talent for pharma-related business was set free by the termination of Pharmacia, why did it not re-emerge in the form of manager-founders of new biotech firms?* The ability to facilitate such recombination and redirection of managerial talent has been argued to be an important dimension of a Regional System of Innovation (RIS) (Coenen, Moodysson, & Asheim 2004; Dalum et al. 1999; Kenney & Von Burg 2001; Lawson 1999; Niosi & Banik 2005).

This section examines effects of such recombinatorial mechanisms on the emergence of new biotech firms in Scandinavian generally, and in the Stockholm-Uppsala region specifically. For this analysis we draw on unique micro-level data extracted from the SCANBIT database at CBS, which offers current and historical information on a large variety of attributes of all 117 biotech Drug Discovery Firms (DDFs) which until 2006 have operated in Sweden, Denmark, and Norway. It should be noted that our data and analyses, consequently, are restricted to biotech Drug Discovery Firms, not including e.g. larger integrated pharmaceutical firms or firms specialized in diagnostics[7].

5.1 Manager-founders and their prior firms

As a first step we examine the incidence of manager-founders in Scandinavian DDFs and the extent to which they become founders subsequent to a close down of their prior companies.

The 117 Scandinavian DDFs were established by a total of 262 founders. Table 3, column *d* identifies a total of 111 founders who exited from managerial positions in industry to found a DDF.

More fine-grained breakdown of the data, not reported here, shows that 41% of these transitions came directly out of pharmaceutical firms, while another 28% came out of other DDFs. The latter in many cases were made out of first-generation DDFs founded

[7] For a presentation of the SCANBIT database se (Valentin, Dahlgren, & Jensen 2006)

Table 3. Founders of Scandinavian DDFs by type and by region of their organizational affiliation prior to star-up

	A	*B*	*C*	*D*	*E*
Location of founder's prior Organization	Founders from public research org's	Manager-founders	Manager-founders as %share of all founders	Manager-founders from closed down firms	*d* as % of all founders
Stockholm-Uppsala	45	18	28.6%	2	3.2%
Copenhagen	29	59	67.0%	11	12.5%
Other Scandinavian	67	22	24.7%	2	2.2%
Outside Scandinavia	10	12	54.5%	2	9.1%
All	151	111	42.4%	17	6.5%

Source: Scanbit

by former pharma-managers. Together these direct and indirect routes of manager-to-founder transitions out of established pharmaceutical firms reveal the critical role of incumbents in the emergence of new biotech firms in Scandinavia.

However, notably only 17 manager-founders came from firms which had closed down before 2005, equivalent to 6.5% of all founders and to 15% of all manager-founders. Manager-founders, in other words, to an overwhelming extent exit from fully operational firms, only in rare cases establishing their new firm reactively to the shutdown of his/her prior firm.

An explanation for this pattern may be pieced together from different strains of literatures: A bio-start-up is a complex process, requiring highly diverse elements to be brought together (Casper, Jong, & Murray 2004;MacAulay & Boyce 2006;McKelvey 1998). From a managerial position in an incumbent firm you are in a better position to search for and to assess these elements. You also are given the possibility to wait for the "right moment", meaning the point of confluence of all those elements which factor into successful entrepreneurship (Shane 2003). Bio-ventures arguably are acutely sensitive in this respect, because they are particularly demanding in terms of integrative capabilities (Pisano 1996;Pisano 2006). This argument, in turn, is consistent with studies unpacking the emergence of the key entrepreneurial concept on which a high-tech start-up is made. Rather than emerging as an abrupt flash of entrepreneurial creativity this concept co-evolves with the gradual formation of the founder team (Beckman 2006). Together these literatures provide the argument *that for the start-up of new DDFs a position within a fully operating incumbent offers possibilities for search and combination of entrepreneurial opportunities superior to those available to laid-off managers trying to start a new firm as a reaction to the close down of their prior employer.*

Still, this argument addresses the overall low incidence of founder-managers from closed down incumbents amongst Scandinavian DDFs. Table 3 also gives a regional break-down, recording managers by the location of their organizational affiliation immediately prior to the start-up. In most cases that is identical to the region in which the new firm is founded, of course except for the 22 founders from outside Scandinavia.

Column *e* gives the regional breakdown for shares of manager-founders from closed down firms as a percentage of all founders. The share of 3.2% in the S-U region is half

of the overall average of 6.5% for Scandinavia as a whole, and a quarter of the Copenhagen (CPH)level of 12.5%. The opposite relationship could have been expected. S-U has seen Scandinavia's largest downsizing of a pharma incumbent, whereas the CPH region has no history of closed down or downsizing of its pharmaceutical incumbents.

Moreover, the low mobilization of managers from closed down incumbents appears to be part of a broader limitation on part of the S-U region to recruit managerial experienced talent for bio-entrepreneurship. Table 3 groups founders by the type of organisation from which they exited when starting up the DDF. A distinction is made between prior affiliations with Public Research Organizations (PROs, predominantly meaning universities) or with private firms. The latter manager-founders constitute 67% of all founders from the CPH region but a share less than half that level, 28.6%, in the S-U region. To a remarkable extent, DDFs in the S-U region have been founded by university scientists, constituting close to ¾ of all DDF founders in the region. These findings indicate significant differences between the two regions in terms of their efficacy in recombining local managerial talent into new bio-entrepreneurship. The next section looks into possible causes for this difference.

5.2 Patterns of early venture capital financing of DDFs

Theory

Clusters of high-tech firms to a large extent emerge and develop through the ability of its RIS to recombine critical resources into new configurations (Audretsch 2001;Nilsson 2000;Niosi & Banik 2005). A particularly critical role is played by venture capital (Champenois, Engel, & Heneric Oliver 2006;Zucker, Darby, & Armstrong 2002). Newly established firms are especially vulnerable in this respect, and rely strongly on local VC, whereas more mature firms to higher extent use non-local sources (Powell et al. 2005)

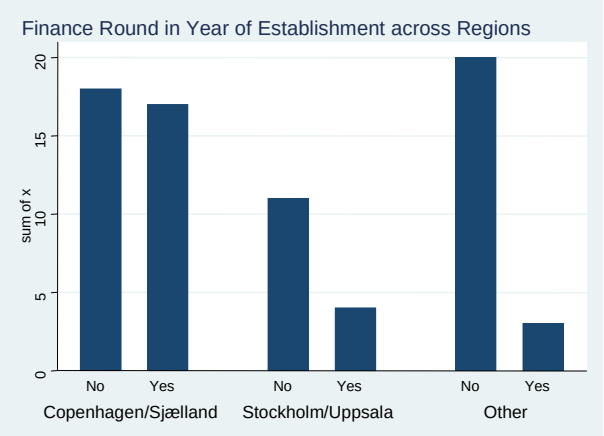
The ability of biotech firms to mobilize venture capital depends not only on the strength of their research or initial patent portfolio. The presence of acknowledged managerial expertise amongst founders and managers seems to be equally important, not only for defining the direction of the firm and for keeping it on course (Feldman, Valentin, & Yoon 2007), but also for mobilizing venture capital in the first place. Empirical confirmations of this relationship articulates it as the one-way relationship whereby managerial experience is seen as the attractor of venture capital (Beckman, Burton, & O'Reilly 2006; Depaauw 2007). In many cases this is undoubtedly the direction of the relationship. But particularly in emerging clusters the opposite direction probably is also at play, i.e. experienced managers in established firms being reluctant to undertake the manager-to-founder transition if it remains uncertain whether local venture capital will be available in required volume and timing.

There is a chicken-egg aspect in this relationship between VC and experienced managerial talent (Valentin, Dahlgren, & Jensen 2006). In practical terms they seem to be resolved through the types of iterations identified by (Beckman 2006) as critical for the emergence of a high-tech start-up (Baum & Silverman 2004). In turn, that makes it a crucial issue for the emergence of biotech clusters whether venture capital is prepared to move in early and with sufficient financing in the early stages of a bio-venture.

From this perspective this section examines the Stockholm-Uppsala region in terms of the patterns of the early venture capital investments in DDFs. To see the S-U pattern in context it is compared with the CPH region and with an aggregate of other smaller Scandinavian bio-regions.

Beginning descriptively Fig. 3 presents the share of firms obtaining a first financing round within the first year of it's establishment. CPH firms split almost 50-50 in this respect. In the S-U region more than 2/3 of newly established DDFs go through their first year without undertaking their first round.

Fig. 3 Number of bio -pharma start-ups carrying out first financing round within the year after establishment. Comparison of firms in Copenhagen, Stockholm -Uppsala and all other DDFs in Denmark and Sweden



Source: *SCANBIT*

To study the volume of VC financing we build a model comparing amounts raised by DDFs in Stockholm-Uppsala and other Scandinavian regions against the level of CPH separately for first and second-third financing rounds, and for rounds above the third round.

Method

The SCANBIT data we use form an unbalanced panel from 1997 to 2004. We follow the same firms and cannot assume the observations to be independently distributed across time. It is highly likely that some unobserved factor, such as personal and professional networks, affects the amount of the venture capital invested into a firm. There are several applicable methods for controlling for unobserved effects. Because of the small number of observations, we did not apply a first differencing approach. A fixed effects approach would be an obvious choice. But we found it to be inappropriate as one of our variable of primary interest, namely the regional location of the firms, is fixed. We would therefore not be able to study this particular variable in a fixed effects panel estimation. Assuming the unobserved effects have serial correlation effects on the error term and assuming the unobserved effect to be uncorrelated with the explanatory variables caused us to use a random effects model and therefore a generalized least square estimation technique.[8]

Before doing the regressions we studied the shape of the dependent variable. The raw venture capital variable exhibited a log-normal like distributional shape and hence to be significantly right skewed. Taking the logarithm of the venture capital amount left us with a symmetric and bell-shaped dependent variable which may be studied using standard regression techniques. A Kolmogorov-Smirnov test supported the assumption that the logarithm of the amount of venture capital is normally distributed. Additionally we used a cluster corrected method of estimating the standard errors and thereby controlling for intra firm correlations. This provides unbiased standard errors.

[8] After settling with a random effects model, we used a Hausman test to see whether the estimates of the random effects model were substantially different from a fixed effects model. The Hausman test came out inconclusive which may be attributed to the small sample.

The primary variables of interest in our model are categorical. First the region in which the firm is situated which has three possible outcomes; CPH, Stockholm/Uppsala, and Other regions. Secondly, we introduce the number of the finance round which also have three possible outcomes; 1st round, 2nd/3rd Round, and beyond the 3rd round. We also inter-acted these variables giving us a total of 8 dummies with respect to these two variables. We use CPH and 1st round as the benchmark categories. The categorical variables and interaction terms was introduced step-wise with the region variable first, the number of finance rounds variable second, and finally their interaction terms. By using a Wald Chi-Square test on the parameter estimates, we compare to what extent we may conclude that biotech firms in particular regions have an advantage in the amounts of venture capital received going beyond the 1st round as well as in total.

Findings

Benchmarked against CPH, the level of first round financing in Table 4 for Stockholm-Uppsala\s DDFs (a1) brings significant, negative estimates in all of models 2, 3, and 4. The estimate in model 4 of -1,34 indicates that S-U firms in this round on average generate 73% less than their CPH counterparts, when other variables are controlled for.

Unsurprisingly, with strongly significant estimates, financing rounds 2-3 (a3) and subsequent rounds (a4) for all Scandinavia firms rise progressively higher than the first-round CPH benchmark. Rounds above the 3rd round on average are 4 times higher than the first round.

Separately the interactions a5-a8 are significant only in the case of a7, where the negative estimate shows second and third round financing in other regions to be well below the level of first round financing in CPH

Table 5 presents Wald tests for differences in parameters and parameter compositions obtained in model 4. CPH estimates subtracted from S-U estimates remain insignificant when differences between rounds are tested separately, but obtains a negative estimate of -2.891 (significant at the 10% level) in calculation of the net difference for all rounds. I.e. when all rounds are considered together, DDFs in CPH are financed above the level observed for S-U firms, due primarily to the much higher amount mobilized by CPH firms in the first round.

Table 4: Determinants of VC amount, results of cluster corrected ordinary least square regressions

	(1)	(2)	(3)	(4)
Stockholm/Uppsala (a1)		-0.796 **	-0.775 **	-1.340 **
		[0.399]	[0.392]	[0.581]
Other Region (a2)		-0.958 ***	-0.900 **	-0.197
		[0.370]	[0.387]	[0.479]
Finance Round 2/3 (a3)			1.219 ***	1.279 ***
			[0.238]	[0.353]
Beyond 3rd Finance Round (a4)			1.398 ***	1.605 ***
			[0.378]	[0.557]
Stockholm/Uppsala*Finance Round 2/3 (a5)				0.785
				[0.650]
Stockholm/Uppsala*Beyond 3rd Finance Round (a6)				0.549
				[0.777]
Other Region*Finance Round 2/3 (a7)				-0.901 **
				[0.440]
Other Region*Beyond 3rd Finance Round (a8)				-1.281
				[0.814]
Years until next round	0.175	0.234	0.267	0.205
	[0.184]	[0.183]	[0.164]	[0.164]
Outsourcing of R&D activities	-0.085	-0.066	-0.007	0.033
	[0.265]	[0.270]	[0.241]	[0.256]
Quoted on Stock Exchange	1.342 ***	1.240 ***	0.915 **	0.772
	[0.465]	[0.446]	[0.465]	[0.494]
Number of patents	0.056	0.014	0.033	0.040
	[0.047]	[0.051]	[0.053]	[0.058]
Age of the firm in years	0.067 ***	0.092 ***	0.070 ***	0.077 ***
	[0.021]	[0.026]	[0.018]	[0.018]
Small Molecules Biotechnology	0.181	0.136	0.301	0.315
	[0.295]	[0.283]	[0.288]	[0.287]
Constant	15.003 ***	15.254 ***	15.077 ***	15.591 ***
	[0.934]	[0.833]	[0.821]	[0.830]
Year Fixed Effects	Yes	Yes	Yes	Yes
Number of observations	194	194	194	194
Number of Firms	72	72	72	72
R-Square Within	0.064	0.082	0.253	0.296
R-Square Between	0.366	0.423	0.435	0.446
R-Square Overall	0.232	0.273	0.325	0.346
Wald Chi-Square	75.374 ***	89.964 ***	169.249 ***	234.917 ***
Sigma u	0.835	0.809	0.885	0.893
Sigma e	1.307	1.307	1.193	1.171
Rho	0.29	0.277	0.355	0.368

Note: * p<0.1, ** p<0.05, *** p<0.01, Numbers in square brackets are the associated standard deviations

The positive and significant results for all subtractions of Other Regions from CPH indicate consistently higher financing across rounds for DDF in the CPH region.

The analogous subtraction of Other Regions from Stockholm-Uppsala shows lower financing in Other Regions from 2-3 rounds onwards. First round financing, however, show a moderate bent in the opposite direction. For this first stage in the life of DDFs, Stockholm firms on the whole come out as being financed not only below the level of CPH, but also below the rest of Scandinavia.

Table 5: Wald test for differences in parameters and parameter compositions using model 4 results

	Parameter equations	Value	Chi-Square	
Subtracting Copenhagen from Stockholm/Uppsala				
2/3 Round	a(3)-a(5)	0.494	0.290	
Beyond 3rd Round	a(4)-a(6)	1.057	0.750	
Total	a(1)-a(3)-a(4)+a(5)+a(6)	-2.891	3.720	*
Subtracting Other Regions from Copenhagen				
2/3 Round	a(3)-a(7)	2.180	8.920	***
Beyond 3rd Round	a(4)-a(8)	2.886	5.390	**
Total	a(2)-a(3)-a(4)+a(7)+a(8)	5.263	12.690	***
Subtracting Other Regions from Stockholm/Uppsala				
First Round	a(1)-a(2)	-1.143	3.470	*
2/3 Round	a(5)-a(7)	1.685	7.820	***
Beyond 3rd Round	a(6)-a(8)	1.829	5.190	**
Total	a(1)-a(2)+(a5)+(a6)-a(7)-a(8)	5.052	6.700	***

Note: * p<0.1, ** p<0.05, *** p<0.01

To summarise, a much smaller share of DDFs in S-U undertake a financing round during their first year of operations as compared to their CPH counterpart. When SU firms eventually obtain a first financing round it tends to generate comparatively small amounts. First round amounts on average are 73% below the level for CPH firms. Indeed S-U first round financing seems to be below the level also for DDFs in an aggregate of all other regions in Scandinavia.

For the experienced manager contemplating the shift to founding a new firm the availability and sufficiency of first round financing arguable is the critical point. Availability and size of first round financing decides if the firms from early on will be able to progress at the speed required in the innovation races characterising this business. Again at this initial stage the availability of *local* VC is much more significant compared its role in later stages (Powell, White, Koput, & Owen-Smith 2005).

Venture capital operates with fairly specialized reference to specific high-tech sectors {Avnimelech, 2006 2309 /id, so we have not reason to assume that our findings have general validity for S-U high-tech generally. But within the sector of bio-drug discovery firms our findings quite clearly indicate a poorer performance in the supply of venture capital for newly established firms in the S-U region.

We suggest that this shortcoming is an important part of the reason why the S-U region has had a comparatively lower rate of manager-to-founder transitions and even lower rate for such transition for managers laid off from closed-down incumbents.

In this sense findings from this section indicate a comparatively weaker RIS-performance in S-U in terms of the efficacy with which venture capital facilitates the recombination of experienced managerial expertise into the founder teams of new biotech firms. Most likely this is one of the causes for the paucity of DDF start-ups to have emerged as part of the out of the Pharmacia legacy.

6 Conclusions

This study has demonstrated that Scandinavia's new biotech firms to a considerable extent emerged as derivatives of large pharmaceutical firms. These "derivatives" take various organisational forms, of which we have reported on divestments, spin-outs and start-ups by manager-founders.

Pharmacia/Pfizer generated derivatives primarily while being fully operative, and did so almost exclusively in the form of divestments and spin-outs, but very little in terms of manager-founder start-ups, particularly when the outcome is measured by job creation. This contrasts with the general pattern by which large pharmaceutical firms have supplied a substantial share of the transitions from manager to bio-founders. However, only few manager-founders undertook that transition reactively because their employer closed down.

The losses from downsizing and discontinuing a leading pharmaceutical firm should not be downplayed by reference to the entrepreneurial opportunities it may set free. The specific example of Pharmacia's legacy demonstrates that even in the heart of one of the most advanced economies these opportunities may fail to materialise. Recent theorising on the nature of high-tech entrepreneurship is consistent with the lessons from this example.

Astra's M&A history diverged so strongly from Pharmacia's example primarily because it was controlled by investors taking a long-term perspective on their interests in the company. They used their influence to carefully prepare over several years a merger which would unfold consistently with their strategic vision. In turn this influence was based on the control rights offered by Swedish legislation in the form of break-through rules and shares with differentiated votes. Interviews conducted for this paper with Astra's key owners clarified that without these control rights they would not have pursued this long-term strategy.

Operating under the same national set of control rights, the Pharmacia case demonstrates that by itself this regulation does not guaranty that owners act out of long-term interests. But our juxtaposition of the two cases has brought out that if investors are available with propensity for the longer view, then Swedish control rights also induces them to act accordingly, offering an inroad into multinational ownership fundamentally different from that exemplified by Pharmacia.

Quite separately from the Pharmacia story the innovation system in the Stockholm-Uppsala region performs notably weaker than its Copenhagen counterpart in terms of transforming pharma-managers to bio-founders. Since venture capital is recognised as a key mechanisms for connecting managerial talent to new entrepreneurial opportunities a comparison is made of venture financing of DDFs in the S-U region with that in CPH. A much larger share of S-U start-ups is shown to go through their first year without obtaining a first financing round. Furthermore, regressions allowing control for a number of firm and business cycle attributes, demonstrate that first rounds (regardless of their timing) generate remarkably lower amounts for DDFs in S-U compared not only to CPH, but also compared to an aggregate of all other Scandinavian regions. In this sense the innovation system in the S-U region has been comparatively poorer prepared for the recombinatorial challenges of transforming managerial talent from downsizing Pharmacia/Pfizer's into new bio-founders.

The local presence in the CPH region of large pharma companies plays a role also for its stronger contribution of venture capital to emerging DDFs. Based on their long-term commitment to development of the region's bio-capabilities CPH's large pharmaceutical firms have set up venture finance activities as one of several ways in which they make managerial talent and resources available for new local biotech start-ups.

APPENDIX 1

A1 Concise history of AB Astra

1904	Draco was founded in Lund.
1913	AB Astra (or Aktiebolaget Astra Apotekarnas Kemiska Fabriker) was founded by the pharmacist Adolf Rising in Södertälje.
1931	Initiates its first R&D activities.
1934	Founds subsidiaries in Finland and Latvia, its first export markets.
1939	Acquires Tika.
1942	Acquires Hässle and forms the subsidiary Astra Hässle.
1947	Forms an US subsidiary.
1955	Listed on the Stockholm stock exchange. Acquires Draco and forms the subsidiary Astra Draco.
1979	Focuses on pharmaceutical activities, abandons other activities.
1981	Builds manufacturing facilities and headquarters in US.
1982	Signs agreement with Merck covering clinical trials, registration and marketing in the US of products resulting from Astra's R&D.
1986	Acquires Arcos and forms the subsidiary Astra Arcos.
1987	Acquires 25% of Symbicom AB (est. 1984).
1994	Forms a joint venture with Merck, Astra Merck Inc., focusing on marketing, sales and drug development.
1995	Acquires all shares of Symbicom AB and incorporates it in Astra Hässle.
1998	Astra Pharmaceuticals, combined by Astra Merck Inc. and Astra USA becomes the US subsidiary of Astra.
1999	Merges with Zeneca Group PLC.

A2 Concise history of Zeneca Group PLC

1926	ICI – Imperial Chemical Industries – was founded as a merger of four British companies.
1936	ICI initiates pharmaceutical R&D by forming a R&D organization in Blackley, UK, to synthesize medically active compounds.
1957	ICI forms a separate Pharmaceuticals Division as a response to the rapid growth of its R&D activities.

1967 ICI establishes US office.

1992 ICI PLC, UK, changes name on its US subsidiary (ICI Americas Inc. changed name to Zeneca Inc.) and concurrently creates a new US company. Zeneca comprises ICI's bioscience businesses while the new company comprises its chemical businesses.

1993 Zeneca Group PLS, UK, was founded as a spin-off from ICI, becoming a global bioscience company within pharmaceuticals, agricultural chemicals and specialty chemicals.

1999 Merges with AB Astra.

A3 Concise history of AstraZeneca

1999 Headquarter located in London while R&D headquarters located in Södertälje (SE).

Strategic review of R&D activities results in realignment of resources in UK and Sweden, and expansion in the US. Discovery organization will consist of about 3.500 people worldwide

Development organization will consist of about 4.000 people mainly located in six major R&D sites in the US, UK and Sweden.

36 manufacturing sites in 20 countries employ 12.500 people. Active bulk pharmaceuticals produced on 8 sites. $700 million invested in manufacturing facilities globally. Further investments are planned in Sweden, UK, Puerto Rico, France, and Germany. Marketing activities handled on 33 sites worldwide.

AstraZeneca's agrochemical business unit merge with Novartis' crop protection and seeds business and forms a new company called Syngenta AG.

2002 $557 million USD investments in R&D and production made in Sweden, UK and the US.

11.000 R&D employees worldwide at 9 R&D sites in UK, the US, Sweden, Canada and India.
12.500 employees engaged in formulation and delivery.

32 manufacturing sites in 20 countries employing 15.000 people. Most important sites found in France. Germany, Puerto Rico, Sweden, UK, and the US, Australia, Italy, Japan

New packaging sites in Puerto Rico, Sweden and UK.

Active bulk pharmaceuticals mainly produced in UK, Sweden, France and Puerto Rico.

Opens state-of-the-art R&D facilities in MA.,US, comprising 170 scientists.

2003 Invests in new laboratory and office space in Boston comprising more than 100 scientists.

2004 Opens state-of-the-art automated compound management facility in US as part of a $165 million investment in US R&D facilities.

Out of 11.600 R&D employees globally, 5.100 are employed in Sweden.

Main Swedish shareholder Investor AB reduces its share to 3,5% of the stocks.

Swedish firms within the group expand business: AstraZeneca (Mölndal), Astra Tech, Nobel Biocare and Mölnlycke.

2005 Further investments in R&D in Sweden, UK and the US.

Most important R&D unites are found in UK, Sweden (Lund, Mölndal and Södertälje), the US, Canada, and India. Additional R&D activities are also undertaken in France and Japan.

27 manufacturing sites in 19 countries, Largest found in UK, Sweden (Snäckviken and Gärtuna, Södertälje), the US Australia, and France, Germany, Italy, Japan, and Puerto Rico.

Active bulk pharmaceuticals mainly produced in UK, Sweden, and France.

2006 12.800 people employed in Sweden in R&D, manufacturing and marketing.

A large share of AstraZeneca's manufacturing takes place in Sweden, among others in the world's largest tablet manufacturing site in Södertälje. Swedish export accounts to 39 billion SEK in 2005.

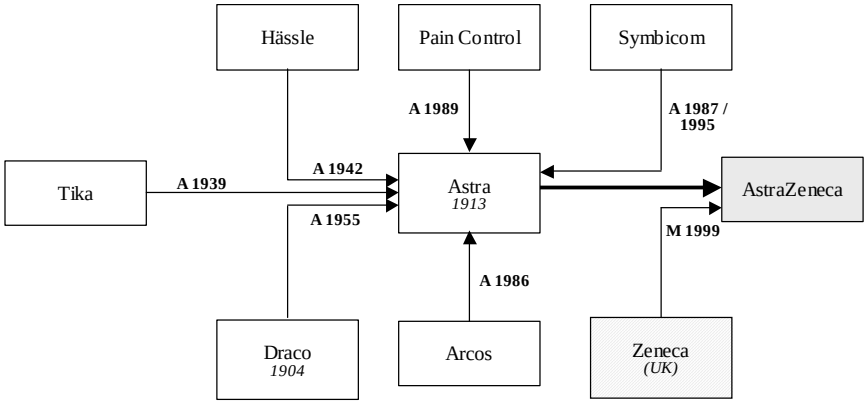
Operations (manufacturing and supply) worldwide employ 14.000 people in 19 countries, out of which 5.000 are employed in Sweden.

Swedish R&D units are found in Mölndal, Lund and Södertälje. Production is located in Södertälje.

Six of the 9 best selling AstraZeneca products are derived from Swedish R&D.

Acquires the British biotech firm CAT.

Figure A1 Astra Swedish Genealogy



A = Acquisition, M = Merger, S = Spin-off
Dotted line indicates spin-off in an independent firm, solid line indicates integration of two or more independent firms, filled squares denotes firms still active.

Source: Own figure

APPENDIX 2

A4 Concise history of Pharmacia AB

1877 Vitrum is founded.

1889 Stockholms Bryggerier is founded.

1911 Pharmacia is founded as a distributor of medical products.

1913 Pharmacists lost exclusive rights to produce and distribute pharmaceuticals. Private companies were able to develop, manufacture and distribute pharmaceuticals. However, not until 1934 the Swedish government stated a law requiring pharmaceutical to be controlled and registered before market launch.

1914 The Danish company Løvens Kemiska Fabrik establishes a subsidiary in Helsingborg, Leo.

1918 Stockholms Bryggerier establishes Centrallaboratoriet.

1919 Leo founds a development company, Ferrosan.

1931 The Danish company De Forenede Bryggerier establishes a subsidiary in Malmö, Kärnbolaget.

1934 Stockholms Bryggerier acquires Kärnbolaget.

1939 Apotekarsocieteten establishes Apotekens Kompositionslaboratorium (ACO).

1941 Recip is founded.

1943 Stockholms Bryggerier and two other companies founds as a joint company, LKB-Produkter AB, focusing on R&D of instruments and chemicals.

1947 Pharmacia launches Dextran, a blood substitute developed in collaboration with Uppsala University.

1951 Kärnbolaget Aktiebolag Biokemisk Industri changes name to Aktiebolaget Kabi.

Pharmacia moves to Uppsala. Development of filtering and selection technologies in informal collaboration with Uppsala University is the foundation of biotechnology within Pharmacia.

1952 Kabi opens production site for penicillin in Strängnäs.

1958 Kabi establishes its first foreign subsidiary, Deutsche Kabi GmbH, situated in München.

1959 Kabi develops a competing product, Kabipastin, to be a produced by Ferrosan.

Apotekarsocieteten acquires the majority of shares in Vitrum. Critique from the industry since Apotekarsocieteten was the monopoly of pharmacies.

1961 Kabi establishes subsidiaries in Norway (A/S Kabi) and the UK (Kabi Pharmaceuticals Ltd.).

1962 Kabi establishes an internal biochemical laboratory dedicated to find new substances for pharmaceutical development, primarily blood related products and peptide hormones. From the 1940s until 1962 Kabi had a biochemical laboratory together with LKB using their competencies, a company later to be acquired by Pharmacia Biotech in 1985.

1964 Kabi acquires chemical/technical company AB Oxygenol and its daughter company Recip, in total 110 employees (about ¼ of Kabi). Oxygenol had roots in Pharmacy "Elgen" established in Stockholm in 1908. Recip was est. in 1942, focusing on synthetic substances for pharmaceutical treatment.

Kabi collaborates with a number of scientific institutions as well as pharmaceutical companies. Kabi products were produces under license and in 17 countries and marketed by agents in 35 other countries. In total 75 products were sold on the Swedish market, whereof 25 stemmed from Recip.

1965 Kabi opens new production facilities for blood plasma.

Kabi acquires Grummebolagen (consisting of six companies, the oldest est. 1841, producing cosmetics, soaps, shampoo, toothpaste, industrial cleaning products, and candles.) Oxygenol was later integrated in Grummebolagen.

1966 Kabi was owned by Stockholms Bryggerier, which in 1964 decided to merge with another brewery, Pripp & Lyckholm. The merger was done in 1966 and the new company name was "Pripp-Bryggerierna AB". The number of brewery managers increased which led to that Kabi was sold to the Swedish Government in 1971.

1968 Kabi manufactures pharmaceutics on license from Farmitalia.

1969 Pharmacia Biotech was formed as a spin-off from Pharmacia based on its dextran based filtering technology.

1970 Swedish Government owned Apoteksbolaget AB was founded.

1971 Swedish Government acquires Kabi and the company becomes fully owned by Statsföretag.

1972 Kabi acquires Vitrum and forms the Kabi-Group.

Restructuring in Statsföretag: ACO AB, Vitrum AB, AB Grummebolagen and Kabi pharmaceutical division becomes subsidiaries of AB Kabi (The Kabi Group)

1973 Astra and Kabi decide to build joint manufacturing site for penicillin.

A new company was established, Fermenta, which acquires Kabi's fermentation facilities in Strängnäs, which is included in the new manufacturing site. A joint site was considered cost the most efficient option, since penicillin was not allowed to be manufactured in the same sites as other drugs.

1974 Grummebolagen and Oxygenol were sold to Svenska Tobaks AB, also part of Statsföretag Group.

Kabi group total sales ca 283 MSEK, out of which 104 on export markets.

1975 Kabi pharmaceutical division was divided into three business areas; Kabi Blodprodukter (blood plasma products), Kabi Läkemedel (pharmaceuticals) and Recip (development and production of growth hormone was placed in Recip).

Kabi Diagnostica was established, 60% owned by Kabi and 40% by AB Atomenergi

Atomenergi specialized in "Radiofarmaka". Kabi specialized in dry-freezing since 1930s of, among others, reagents for laboratories

1976 The company Linsoninstrument was transferred to Kabi from the Statsföretag Group. Device manufacturing was not part of Kabi's strategy and Linsoninstrument was split up and dispersed in Kabi Group.

Kabi and Astra swap products; Astra acquires Kabi's share of Fermenta and penicillin products. Kabi acquires products from Astra. Astra sells Fermenta in 1982 to Refaat El-Sayed.

1978 KabiVitrum (changes name) signs the first gene-technology based industrial contract with Genentech.

KabiVitrum and Statsföretag AB found KabiGen AB with shared ownership to exploit molecular biology. KabiGen becomes the first DNA-technology based company in Scandinavia.

1979 Pharmacia launches a stabilizing medium for eye surgery, called hyaluron acid, a natural substance becoming the base for new Pharmacia products. The spin-off (1994) Bohusbiotech acquires the substance.

1980s Volvo acquires Pharmacia and initiates an expansion strategy.

1983 The CEO of KabiGen leaves the position and founds Scandigen.

1984 BioNative is established based on research in KabiVitrum.

Ferrosan merges with Leo.

Pharmacia Biosensor AB is established by people from Pharmacia (later to be named Biacore AB).

1985 Statsföretag AB changes name to Procordia AB.

Pharmacia acquires LKB Products, the main competitor in biotechnical separation instruments. LKB Products is integrated in Pharmacia Biotech and located in Umeå.

Q-Med is spun off (cosmetics based on a synthetic version of the hyaluron acid).

1986 Pharmacia acquires Leo.

1987 Labwell[9] is spun off (technology for speeding up chemical syntheses in microwave ovens).

Biosurface Pharma is spun-off as a subsidiary to Pharmacia. Dental research activities stems from a Ferrosan project.

1988 KabiVitrum acquires the West German company Pfrimmer & Co.

KabiVitrum changes name to Kabi.

1989 Kabi acquires the Spanish company Fides.

1990 Procordia AB and Provendor (Volvo's food division company) merge to form Procordia group and jointly acquires Pharmacia. Volvo and the Government (Procordia) own 42,5% of the company each.

Pharmacia merges with Kabi and forms KabiPharmacia.

1991 KabiPharmacia acquires patent of the "superprotein", a protein able to eliminate bad cholesterols from the body.

Biolin is spun off (investment and market consulting).

[9] Later renamed Personal Chemistry, which merged with PyroSequencing in 2003 and acquiring Biotage (US) in 2003 and changing name to Biotage.

Mercodia is spun off (diagnostic kits).

Medeca is spun off (product agents).

1992 ProGene is spun off (genetic test).

KabiPharmacia acquires the Italian pharmaceutical company Pierrel with about 900 employees.

KabiPharmacia establishes a company within the group named Bioscience Center, which includes, among others, the company KabiGen.

1993 KabiPharmacia acquires the Italian pharmaceutical company Pharmitalia Carlo Erba and the US pharmaceutical company Erbamont Inc.

KabiPharmacia changes name to Pharmacia.

The Government completely acquires Pharmacia by buying Volvo's share and sells its share of Procordia (other business units of tobacco, food etc.) to Volvo.

1994 Swedish government sells main part of its shares (retains 14% of the shares and 12% of the votes) through an IPO.

Eurona Medicals is spun off (genetic diagnostics and personalized medicine).

Medisan Pharmaceuticals (later BioPhausia) is spun off (dextran based infusion solutions and clinical dextran for surgery and advanced ulcer treatment).

Bohusbiotech is spun-off.

1995 Pharmacia merges with the US company Upjohn. Swedish government retains 7% of the company. At this time, Pharmacia has about 6500 employees in Sweden, out of which 25% were R&D people.

Recip AB is spun off.

Marma Medical is spun off (technical and management consulting).

1996 Development and production of the "superprotein" is closed down.

1997 Half of the instrument division of former Pharmacia established in 1969, Pharmacia Biotech, is acquired by the UK company Amersham International. The new company is named Amersham Pharmacia Biotech.

Two Pharmacia-Upjohn scientists acquire the "superprotein" patent and establish Esperion Therapeutics.

1998 Active Biotech AB acquires parts of Pharmacia's cancer and immunology R&D.

Fresenius Kabi is established as a result of a spin-off and acquisition of a German company.

Åmic is spun off (microsystems in plastics for bio applications).

Gyros is spun off (based micro laboratories).

Visionar is spun off (CRO).

Resistentia Pharmaceuticals is spun off (develops allergy vaccine).

1999 Pharmacia-Upjohn merges with the US company Monsanto and changes name to Pharmacia Corporation.

Swedish government divests its remaining share (7%) of Pharmacia-Upjohn. The total share of Swedish ownership falls down to 9%.

2000 Quintiles AB acquires Pharmacia-Upjohn's clinical development activities.

Pfizer acquire Esperion Therapeutics.

Pharmacia Corporation divests the last basic research activities and plasma production including about 900 employees in a new company Biovitrum.

2002 Amersham International acquires all shares of Amersham Pharmacia Biotech and changes name to Amersham Biosciences. At this time there are about 3400 employees in Uppsala, including spin-offs.

Pharmacia Corp. establishes Monsanto based on a spin-off of its agro business.

Biovitrum divest the plasma division including about 450 employees (stemming from the manufacturing of dried plasma starting in the 1940s in Kärnbolaget) to the Swiss pharmaceutical company Octapharma.

2003 Pfizer acquires Pharmacia Corporation. Total number of Swedish employees is 3900. Pfizer's Swedish marketing company has about 300 employees. The share of Swedish ownership falls down to 4%. No more Swedish board members or managers.

2004 Pharmacia Diagnostics AB is formed as the result of a spin-off, including 1200 employees, and sold to two UK investment funds.

Production facilities and manufacturing of Healon is sold to AMO, American Medical Optical.

The rest of the shares of Active Biotech is sold (8% of the shares).

GE Healthcare acquires Amersham Biosciences.

2005 Total number of Swedish employees is about 2500. Half of the employees are found in Uppsala/Stockholm (headquarters counts for 450 employees), about 1000 in Helsingborg and around 400 in Strängnäs.

Manufacturing in Stockholm is decided to shut down by 2008, reducing the number of employees by 550. Activities will be allocated to other sites within Pfizer.

Laboratory in Uppsala is closed, reducing the number of employees by 100.

2006 Manufacturing site in Uppsala is sold to the Indian company Kemwell.

Production facilities and manufacturing of Nicorette is sold Johnson & Johnson. About 1000 employees.

GE Healthcare acquires Biacore AB

The Swedish part of Pfizer now consists of the headquarters in Stockholm, the production facilities in Strängnäs and the site in Stockholm, which will be shut down in 2008. In total 1300 employees.

APPENDIX 3

Table A1 Pharmacia related spin-offs, divestments and start-ups

OrgNo	Company Name	Year est.	Industry code	*Ownership* Domestic	Foreign	*Origin* Pharma	Diagn	Instr	*Type* Spin-off	Divestment	Start-up	Empl 2005
5561307728	Biacore AB	1984	33200	x				x	x			182
5562586882	Q-Med	1985	24420	x				x	x			350
5564874922	Biotage Sweden AB*	1987	73103	x				x	x			68
5563374759	Carmetec (now Nocet Invest AB)	1988		x			x				x	18
5564181211	Medeca Pharma AB	1991	51460	x		x			x			3
5564591393	Biolin Medical AB	1991	73103	x		x			x			0
5561575100	Mercodia AB	1991	73103	x			x		x			36
5564850153	BioPhausia AB	1994	51460	x		x			x			7
*	*Includes previous firms Labwell/Personal Chemistry, Pyrosequencing and Biotage (US)*											**664**
5564989951	Marma Medical AB	1995	74140	x		x			x			1
5564988425	Recip (Haninge)	1995	74150	x		x			x			82
5566624366	Recip (Karlskoga)	1995	24420	x		x			x			196
5565875753	Visionar Biomedical AB	1998	73103	x		x			x			5
5565468476	Ämic AB	1998	73103	x		x			x			26
5566725429	Gyros AB	2004	73105	x				x	x			54
												364
5565418323	Active Biotech Research AB	1998	73103	x		x				x		86
5564134517	Quintiles Services AB	2000	73103	x		x				x		0
5560389321	Biovitrum	2001	73103	x		x				x		604
5561081919	GE Healthcare Biosciences AB prev. Pharmacia Biotech	1997	24140		x			x		x		1575
5565616058	Fresenius Kabi	1998	24420		x	x				x		743
5565504833	Octapharma AB	2002	24420		x	x				x		353
5560413204	PhaDia AB	2004	24660		x		x			x		476
												3837
5565557781	Anamar Medical AB	1998	73102	x			x				x	14
												14

TOTAL 95	4215
PHARMA	2096
DIAGN	490
INSTR	1629
FOREIGN	3147

Source: ScanBit

Table A2 Pharmacia related university start-ups

OrgNo	Company Name	Year est.	Empl 2005	Industry code
	Pre M&A spinn-offs			
5561467829	Medical Products Octagon	1971	2	24420
5563362473	Pegasus Lab	1984	15	NA
5563359446	Radi Medical Systems	1988	153	33101
5564897741	Neopharma	1994	14	24420
			184	
	Post M&A spinn-offs			
5563135598	Melacure Therapeutics AB	1997	37	73103
5565541587	Resistentia Pharmaceuticals AB	1998	17	73103
5565494019	Isconova	1999	5	73103
			59	
	Unidentified spinn-offs or closed down activities			
NA	Bio-Agri	1996		Acquired
5562866508	Hemapure Systems AB	1998		Closed down

Source: ScanBit

Table A3 Pharmacia related start-ups

OrgNo	Company Name	Year est.	Empl 2005	Industry code
	Pre M&A start-ups			
5564702065	MiniDoc AB	1986	0	72210
5565819249	Radi Medical Devices AB	1988	2	73103
5563317840	CES Management AB	1988	0	74140
5563374759	Carmetec (now Nocet Invest AB)	1988	18	NA
9166710310	Allect Consulting HB	1989	NA	85144
5564303922	TdB Consultancy AB	1990	2	74202
5564106234	Mark-In AB	1990	1	74409
5565244737	Göran Andrae Konsult AB	1990	1	NA
5564079498	Kiptech AB	1990	1	74202
5563949774	Ollajvs Produktutveckling AB	1990	1	74202
5563990976	Projektekonomi Bengt Jacobowsky AB	1990	NA	NA
5564384674	Olle Rückertz Public Relations AB	1991	NA	NA
5564170743	Corline Systems AB	1991	4	73105
5562873124	C-O Sjöberg Engineering AB	1991	1	74202
5564509981	Upsal Biologicals & Pharmaceuticals AB	1991	NA	51460
5564270881	Agorand AB	1991	1	NA
5564362621	BPT Optik AB	1991	1	74202
5564277993	Pricer AB	1991	41	72210
5564584729	Scandinavian Regulatory Services AB	1992	8	24420
5564403391	Mediject AB	1992	NA	NA
4804035113	Mizarra Business Management	1993	1	NA
9696034322	Bojama Consult KB	1993	NA	74140
5564955788	Gunilla Eketorp Kemdok AB	1994	1	73103
5564861374	M & D Packaging AB	1994	1	73103
9696029678	Tesseco HB	1994	NA	74202
			85	
	Post M&A start-ups			
5565000600	Orexo (prev. Diabact)	1995	36	73103
5565061834	Jan Gustavsson Personalkonsult AB	1995	NA	NA
5565138830	Magnolia - För kreativ utveckling AB	1995	1	74140
5562723840	Ardevo AB	1996	0	74140
5565557781	Anamar Medical AB	1998	14	73102
5566022728	Innoventus	1999	0	NA
5565238382	Bioventia Capital AB	2000	2	74140
9166720657	Midas Innova HB	2000	NA	74140
5566168356	Innoventus Project AB	2001	4	73103
5565900791	Niconovum AB	2003	4	73103
5566590658	Acure Pharma AB	2004	4	73103
5566636998	Olink	2004	2	73102
5566651484	Saromics	2006	NA	74202
			67	
	Unidentified start-ups or closed down activities			
NA	Lots AB	1979		Acquired
NA	KP Elteknik	1986		Unknown activity
NA	Projekt Organisation AB	1987		Unknown activity
5563396877	Svenska H-Gruppen Konsumentprodukter AB	1989		Unknown activity
NA	Arcsoft AB	1990		Unknown activity
NA	Åke Strömberg Ledarcoach	1991		Unknown activity
NA	Qraft AB	1992		Unknown activity
NA	SumIT System AB	1993		Unknown activity
5560386715	PGL Professional Genetics Laboratory AB	1993		Closed down
NA	Snabb Personal AB	1995		Unknown activity
NA	Subjecta Scandinavia AB	1996		Unknown activity
NA	Mizarra Medical	1996		Unknown activity
5565323440	Engema AB	1996		Closed down
NA	Företagsjuristen FJS	1996		Non-active
5565332664	Qualimetrics AB	1996		Closed down
NA	AproPos	1997		Unknown activity
NA	Inbio	1999		Unknown activity
NA	Micro-Morph	2006		Unknown activity

Source: ScanBit

References

Audretsch, D. B. (2000), "Knowledge, Globalization, and Regions," in *Regions, Globalization, and the Knowledge Economy*, J. H. Dunning, ed., Oxford University Press, Oxford

Audretsch, D. B. (2001), The Role of Small Firms in U.S. Biotechnology Clusters. *Small Business Economics*. V. 17, (1-2): 3-15

Beckman, C. M. (2006), The Influence Of Founding Team Company Affiliations On Firm Behavior. *Academy of Management Journal*. V. 49, (4): 741-758

Beckman, C. M., Burton, M. D., & O'Reilly, C. (2006), Early teams: The impact of team demography on VC financing and going public. *Journal of Business Venturing*. V. 22, 147-173

Bennedsen, M., Junge, M., Jacobsen, J. K., Nielsen, K. M., and Jespersen, S. T. (2007), *Ownership Structure and Economic Performance of European Corporations*, Centre for Economic and Business Research, Copenhagen

Biotech Sweden, *De vackra orden måste bli till handling*, 15-6-2004

Casper, S., Jong, S., & Murray (2004), "Entrepreneurship and Marketplace Formation in German Biotechnology", Society for Comparative Research 2004 Annual Graduate Retreat in San Diego, 2004

Champenois, C., Engel, D., & Heneric Oliver (2006), What kind of German biotechnology start-ups do venture capital companies and corporate investors prefer for equity investments? *Applied Economics*. V. 38, (5): 505-518

Coenen, L., Moodysson, J., & Asheim, B. T. (2004), Nodes, Networks and Proximities: On the Knowledge Dynamics of the Medicon Valley Biotech Cluster. *European Planning Studies*. V. 12, (7): 1003-1019

Dagens Industri, *Pharmacia's Move puts Life Into Uppsala*, 24-1-2001

Dagens Industri, *Så sjabblade Sverige bort unik forskning*, 21-2-2004

Dalum, B., Holmén, M., Jacobsson, S., Praest, M., Rickne, A., & Villumsen, G. (1999), "Changing the regional system of innovation," in *The Economic Challenge for Europe*, J. Fagerberg, P. Guerrieri, & B. Verspagen, eds., Edward Elgar, Cheltenham

Depaauw, L. (2007), "Appropriability, Proximity, Routines And Innovation", DRUID Summer Conference, CBS, Copenhagen June 2007

Dolk, T. & Sandström, A. (2005), *Nationella och regionala klusterprofiler - Företag inom bioteknik, läkemedel och medicinsk teknik i Sverige*, VA 2005:02

Dunning, J. H. (2000), "Regions, Globalization, and the Knowledge Economy: The Issues Stated.," in *Regions, Globalization, and the Knowledge Economy*, J. H. Dunning, ed., Oxford University Press, Oxford

Eifrém, A.-K., Rössel, Å., & Kumlin, L. (2000), *Pharmacia-Veteraner Väger Tungt I Life Science-Sektorn*, Uppsala University, Uppsala,

Eliasson, G. & Eliasson, Å. (2006), The Pharmacia story of entrepreneurship and as a creative technical university - an experiment in innovation, organizational break up and industrial renaissance. *Entrepreneurship & Regional Development*. V. 18, (5): 293-420

Feldman, M. P., Valentin, F., & Yoon, J. W. (2007), "Organizational Legacy and Firm Performance", DRUID Summer Conference, CBS, Copenhagen June 2007

Frankelius, P. (1999), *Pharmacia & Upjohn: Erfarenheter från ett Världsföretags Utveckling*, Liber, Värnamo

Baum, J. A. C. & Silverman, B. S. (2004), Picking winners or building them? Alliance, intellectual, and human capital as selection criteria in venture financing and performance of biotechnology startups. *Journal of Business Venturing*. V. 19, (3): 411-436

Kemivärlden Biotech med Kemisk Tidskrift, *När fjättrarna brista ...*,

Kenney, M. & Von Burg, U. (2001), "Paths and Regions: The Creation of Silicon Valley," in *Path dependence and creation*, R. Garud & P. Karnøe, eds., Lawrence Erlbaum Associates, London

Killing, P. (2004), "Merger of Equals: The Case of AstraZeneca," in *Managing Complex Mergers: Real World Lessons in Implementing Successful Cross-Cultural Mergers and Acquisitions*, P. Morosini & U. Steger, eds., Pearson Education Ltd, Harlow

Läkemedelsvärlden, *Biovitrum sist ut från Pharmacia i Sverige*, 26-8-2001

Läkemedelsvärlden, *Nyponextrakt, tuggummi och fusioner: Så skapades de svenska delarna av Pharmacia*, 24-2-2002

Lawson, C. (1999), Towards a competence theory of the region. *Cambridge Journal of Economics*. V. 23, 151-166

Lazerson, M. H. & Lorenzoni, G. (2005), "The Firms that Feed Industrial Districts: a Return to the Italian Source," in *Clusters, Networks and Innovation*, S. Breschi & F. Malerba, eds., Oxford University Press, Oxford

Lundberg, J. (2006), *Astra, Pharmacia and Swedish Academic Research: Swedish Universities' Influence on Product Development at Astra and Pharmacia during the 20th Century*, Karolinska Institutet, Stockholm,

MacAulay, S. & Boyce, G. (2006), "Tuning Innovation Landscapes in the Biotechnology Industry: the Influence of Information Diversity and Network Structure on Innovation Performance", DRUID Summer Conference, CBS June 18-20 2006

McKelvey, M. (1998), Evolutionary Innovations: learning, entrepreneuship and the dynamics of the firm. *Journal of Evolutionary Economics*. V. 8, (2): 157-175

Nilsson, A. (2000), Biotechnology Firms in Sweden. *Small Business Economics*. V. 17, (1-): 93-103

Nilsson, M. & Norell, K. (1997), *Entreprenörsavknoppning från et Storföretag: En studies af Pharmacia 1985-96*, Uppsvenska Handelskammaren, Uppsala

Niosi, J. & Banik, M. (2005), The evolution and performance of biotechnology regional systems of innovation. *Cambridge Journal of Economics*. V. 29, (3): 343-357

Ny Teknik, *"Pharmaciaeffekten" borta*, 18-2-2004

Östholm, I. (1991), *Från örtavkok … till läkemedel: Framgångar och Bakslag i Medicinernas Värld under 50 år*, Apotekarsocieténs Förlag, Stockholm

Pisano, G. P. (1996), *Development Factory: Unlocking the Potential of Process Innovation* , Harvard Business School Press, Boston, Mass

Pisano, G. P. (2006), *Science Business*, Harvard Business School Press, Cambridge, Mass

Powell, W. W., White, D. R., Koput, K. W., & Owen-Smith, J. (2005), Network Dynamics and Field Evolution: The Growth of Interorganizational Collaboration in the Life Sciences. *The American Journal of Sociology*. V. 110, (4): 1132

Shane, S. (2003), *A General Theory on Entrepreneurship*, Edward Elgar, Cheltenham

Stankiewicz, R. (1997), "The Development of Beta Blockers at Astra-Hässle and the Technological System of the Swedish Pharmaceutical Industry," in *Technological Systems and Industrial Dynamics*, B. Carlsson, ed., Kluwer Academic Publishers, Boston/Dordrecht/London

Svenska Dagbladet, *Pharmacia's Move is the Start of Something New*, 7-11-2000

Valentin, Finn, Dahlgren, Henrich, and Jensen, Rasmus Lund (2006), *Structure, employment and performance in biotech firms - Comparison of Danish and Swedish drug discovery firms*, Biotech Business Working Paper, Research Centre on Biotech Business, Copenhagen Business School

Waluszewski, A. (2004), A competing or co-operating cluster or seven decades of combinatory resources? What's behind a prospering biotech valley? *Scandinavian Journal of Management*. V. 20, (1-2): 125-150

www.astrazeneca.se, extracted in 2007

www.pfizer.se, extracted in 2007

www.swedenbio.org, extracted in 2007

Zucker, L. G., Darby, M. R., & Armstrong, J. S. (2002), Commercializing knowledge: University science, knowledge capture, and firm performance in biotechnology. *Management Science*. V. 48, (1): 138-153