

ALEXANDER STYHRE

FINANCING LIFE SCIENCE INNOVATION

Venture Capital, Corporate
Governance and
Commercialization



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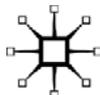
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Financing Life Science Innovation

**Venture Capital, Corporate Governance
and Commercialization**

Alexander Styhre
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palgrave
macmillan



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Softcover reprint of the hardcover 1st edition 2015 978-1-137-39246-6

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First published 2015 by
PALGRAVE MACMILLAN

Palgrave Macmillan in the UK is an imprint of Macmillan Publishers Limited, registered in England, company number 785998, of Houndmills, Basingstoke, Hampshire RG21 6XS.

Palgrave Macmillan in the US is a division of St Martin's Press LLC, 175 Fifth Avenue, New York, NY 10010.

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ISBN 978-1-349-48335-8 ISBN 978-1-137-39248-0 (eBook)

DOI 10.1057/9781137392480

This book is printed on paper suitable for recycling and made from fully managed and sustained forest sources. Logging, pulping and manufacturing processes are expected to conform to the environmental regulations of the country of origin.

A catalogue record for this book is available from the British Library.

A catalog record for this book is available from the Library of Congress.

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Preface and Acknowledgments

According to Leonardo Da Vinci (in *A Treatise on Painting*, first published posthumously in 1651), “noses are of ten different sorts.” Such claims of limited variation (which make it possible to cognitively apprehend and recall) are reassuring when one works on problems of seemingly unlimited complexity. Much academic work, following Aristotle, is concerned with constructing taxonomies and classificatory systems, such as Leonardo’s ten noses, but in some cases such schemes seem to come up short when they encounter the vast multiplicity of forms in actual life.

This book addresses the issue of innovation, in itself already a study beset by complexity, and more specifically, innovation in the life sciences, a domain where the biological systems of highly differentiated species such as human beings are explored, mapped, and ultimately manipulated. Basic life science research and the innovation of health care therapies and medical technologies is an area of research that, at least for me, is overdetermined by factors that require consideration: the underlying scientific research findings, the entrepreneurial spirit of the executives and co-workers in individual start-up firms, the structure and access to venture capital, the institutionalized forms of corporate governance in countries and regions, the legal and regulatory frameworks within which enterprising activities are located, and so forth. It would have been so much easier if there were elementary rules of thumb to make use of (“Ten noses, no more no less! Mark my words!”) when examining this domain of venturing and innovation, but that is really not the case here. Instead, the more you look, the more you tend to see in terms of differences and variation.

For instance, in life science innovation, one can draw a line of demarcation between, say, pharmaceuticals, following a specific European Union directive, tissue engineering, regulated by another directive, and medical technologies. Also, within these different categories, there are substantial differences in the underlying research work. For instance, while cardiovascular medicine has been treated as having been remarkably successful in mapping biological pathways in the human cardiovascular system and in identifying small-molecule drugs that regulate the circulatory system, research in, for example, neurodegenerative medicine has been much more difficult to map in such cause-effect diagrams.

Meanwhile, disorders in the central nervous system (CNS) such as Parkinson's and Alzheimer's, seem to be far more complex than cardiovascular disorders. One of the quite immediate effects of this limited theoretical understanding of the CNS field is that venture capitalists tend to regard pharmaceutical therapies in the CNS as constituting a financial graveyard, and they are often quite unwilling to carry the risks involved in pursuing such research work. Cancer therapy is another therapeutic area that suffers from this lack of a full understanding of the underlying biological pathways and etiology of the disease.

In summary then, there are numerous factors to consider when examining life science innovation and adhering to a standardized academic procedure; researchers studying innovation therefore carve out a small domain that they study and theorize *as if* it was an isolated element and not one component in a larger system of activities and resources. As a consequence, there are sociologists and others in the discipline of science and technology studies (STS) who are informed about advances in specific scholarly fields and disciplines, there are innovation management researchers who specialize in studying the organization of innovative milieus including industries, clusters, joint ventures, or individual organizations or research teams, and there are finance market researchers examining how firms and industries acquire and secure financial capital for their innovation work. This academic division of labor is both a curse and a blessing: a curse in that it adopts a reductionist approach that undermines an integrated view of all these activities taking place within the individual firm, and a blessing in terms of gradually providing more detailed understanding of the challenges involved in producing new health care therapies.

Studying life science innovation therefore involves moving back and forth between different literatures and discourses and individually creating a patchwork of theories and studies that help construct an operative framework for analysis. This academic research approach – a form of advanced tinkering with things that are deemed useful or merely interesting – is also, I imagine, quite similar to the entrepreneurial process. For life science entrepreneurs, perhaps with a background in laboratory research work, producing an intriguing research finding that can possibly be of therapeutic value, and thereafter embarking on an entrepreneurial process including many steps and many challenges both small and large to handle, is also exposed to this mind-boggling complexity. Only with the help of experienced and skilled innovation agency counselors, business incubator advisors, and venture capital investors can these ideas developed in the research labs be transformed into marketable therapies

and new clinical practices. However, this path is crooked, and the entrepreneur will encounter many difficulties and setbacks.

During the last 15 years that I have been involved in research in the field of life science innovation, I have published six research monographs addressing various aspects of innovation of clinical relevance to the health care sector. The present volume leaves the issue of scientific work per se largely to one side. Instead it focuses on the more conventional managerial and economic aspects of life science ventures, namely the issues of the supply of capital and corporate governance practices intimately related to financial investment. In this book, the focus has to some extent shifted from *within* the firm (the activities taking place to refine and clinically verify the new therapy) to *outside* the firm, to examine how venture capitalist and innovation system representatives regard access to capital and how they assess the level of innovation in the Swedish life science sector in the present period.

The first thing to notice when approaching this quite small but relatively heterogeneous community is that the world presented in the scholarly literature, dominated by North American and British researchers, is so much more better ordered and structured than the actual one. Academic research is, again, the attempt by truthful Aristotelians to turn continuous realities into a world of fixed and discrete categories, mutually excluding and neatly separated and ordered within an intelligible structure. Academic research work rarely recognizes, or is theoretically capable of apprehending, the turmoil and messiness of everyday life, especially not in so-called dynamic and fast-paced milieus, and consequently these features of the actual world are treated as deficiencies that need to be overcome, preferably by rigorous analytical procedures. In short, actual life science venturing is a domain characterized by limited information, uncertainty, bounded rationality, fuzzy models of the underlying biological pathways being explored, complex – and at times almost impenetrable – legal and regulatory frameworks, fickle market actors and market conditions, political interests, and different degrees of willingness to take risks. All this messiness of life science venturing is, on the other hand, counteracted by skilled and professional knowledge workers having long-term experience from working in this field, their joint willingness to exploit interesting and promising research findings, a strong commitment to making the world a better place through new therapies and health care innovations, and the ambition to negotiate practical solutions to joint problems. That is, life science innovation is arguably one of the most intellectually and organizationally demanding activities being studied by management researchers – the complexity

involved in exploring the human biological system is the key argument here – but there are also people out there who invest their heart and soul in advancing health care innovations. They are all animated by the entrepreneurial spirit and want to “do good.”

As the empirical material suggests, doing good is always easier said than done, and there are numerous solutions to the various challenges being proposed by professionals. If there is one single lesson that I hope readers absorb while reading this book, it is that there is no such thing as pure, rent-seeking capital put to work in life science venturing, but the capital provided by venture capital firms, among others, is always already accompanied by other social interests and professional know-how. The *rentier* view of capital investment – that the owners of capital lazily take the backseat and await their return on investment – is of limited relevance to life science venturing. Instead, capital is the vehicle that enables an extended collaborative relationship over time. At the same time, there are irreducibly strong financial interests in life science venturing – the dream of major financial benefits at the end of the rainbow – but that form of capital belongs to another order. As suggested by the economic sociologist Vivianne Zelizer in a series of publications (e.g., Zelizer, 1989, 2011), there are in fact many different forms of money in use in society. My proposition is that the venture capital put to work to fuel the entrepreneurial function of competitive capitalism is practice-oriented and social, while the reward allocated to successful venturing (e.g., in the case of the firm being acquired by a major corporation) is abstract, separate from previous joint activities, and anchored in the financial capital markets. Different categories of capital are thus mobilized and generated in the life science venturing process. This view converges with that of Sunder Rajan (2012: 19) who emphasizes that the dry and formal term “the economy” comprises not just the totality of “quantitative measures of productivity or profit,” but also denotes “regimes of value,” both “material and symbolic.” The very use of venture capital in life science ventures operates within such regimes of value, while the financial capital generated by a successful exit is amenable to “quantitative measures of productivity or profit.” The fault of both finance theory scholars and scholars working in the science and technology studies tradition is the failure to see this decisive distinction between these two forms of capital and to assume that capital is always one single unified resource, an abstract measure of worth that does little more than enable transactions to be continued and therefore keeps the venture going. Such a reified view of finance capital only accounts for its quantitative elements. Venture capital is thus to some

extent animated by social interests and commitment; it is, in the most positive sense of the term, “working capital.”

I thank Virginia Thorp at Palgrave Macmillan for commissioning this volume. I would also like to say how grateful I am for all the help provided by the professional and very busy people who shared some of their precious time with me. Gustav Öberg, former chairman of the Swedish Venture Capital Association, was very helpful in pointing out key actors in the life science venture capital sector whom I would benefit from talking to. Finally, I would like to thank my colleagues at the School of Business, Economics, and Law, University of Gothenburg, for inspiring discussions and exchanges over the years. The empirical material reported in this volume was collected in a research program funded by the Swedish Research Council [No. 421–23012–775].

Introduction: Competitive Capitalism and the Role of Capital Investment

Introduction

In Joseph Schumpeter's account, arguably the most persistent set of economic propositions on entrepreneurship and its role in economic growth, the entrepreneur is of necessity a *net debtor* prior to the generation of revenues: "[As] innovation, being discontinuous and involving considerable change and being, in competitive capitalism, typically embodied in new firms, requires large expenditure previous to the emergence of any revenue, credit becomes an essential element of the process...saving usually lags behind requirements" (1991a: 66). One of the principal challenges for the economic system, especially if the economy is enacted as self-regulating and self-monitoring, as in the Austrian school of economics tradition of thinking, is how to match the supply of capital and entrepreneurial demands for funding of enterprises. Supporting this proposition, research reported by Brown, Fazzari and Petersen (2009) suggests that the boom of research and development (R&D) in the American economy in the 1994–2004 period can be explained on basis of the inflow of capital in the high-tech industry: "The financial coefficients are large enough that the financial cycles for young high-tech firms along can explain about 75% of the *aggregate* R&D boom and subsequent decline" (152). For instance, during the dot-com boom of the 1998–2000 period, young firms in the United States increased their net stock issues by nearly 265%, indicating the role of capital as the principal driver of innovation. Brown, Fazzari and Petersen (2009: 181) consequently suggest that "finance, financial development, and the institutional structure of financial markets are important factors driving economic growth."

In Schumpeter's view, "economic progress" is based on the ability to put "productive resources to uses hitherto untried in practice," and he reserves the term "innovation" to denote the outcome from such activities. Needless to say, innovations are always accomplished in a milieu beset by difficulties and resistance, and consequently "successful innovation," Schumpeter says, is not a feat "of intellect but of will": "To overcome these difficulties incident to change of practice is the function characteristic of the entrepreneur" (Schumpeter, 1991a: 65–66).

It is no exaggeration to say that Schumpeter's view of the entrepreneur as the juggernaut of competitive capitalism, as both a destroyer and builder of worlds, has been one of the most evocative figures in economic theory and in political rhetoric and discourse over the last decades. In the Western economies, fuelled by the growth of the manufacturing industry in the post-World War II years – today in many cases shipped off to low-cost regions – and eventually propelled by the development of knowledge-intensive service and technology sectors, the entrepreneur has been given the role of being an almost mythological figure capable of accomplishing the most astonishing things on basis of his or her ideas, ambition, diligence, and stamina. However, although there has been a series of most remarkable accomplishments of entrepreneurs and company builders in the history of capitalism, the underside of entrepreneurialism is that many entrepreneurs inevitably fail in their ambition to create a venture that survives and thrives. The narrative of entrepreneurship frequently ignores its backyard and overlooks failures and losses generated in entrepreneurial fields. As always, the prerogative to tell the official story falls within the jurisdiction of the victors.

One of the principal challenges for entrepreneurs and other actors involved in promoting entrepreneurialism is how to attract and acquire the capital investments needed to bring an idea to the market. In technology-based industries, there are many difficulties involved, especially regarding the possibilities for attracting clients and end-users, but at least the technology can be controlled and gradually modified and refined to suit its application. In the life science, there is a much more significant element of genuine uncertainty (as opposed to *risk*, that is, the calculated statistical possibility of failing, see Knight, 1921) as the biological system (most often that of laboratory animals and only eventually the human body) – the material substratum in which the new innovation operates – is not fully known and understood by life science researchers. As a consequence, the clinical trials that serve to test the efficacy of the new therapy all too frequently demonstrate that therapies either fail to provide significantly better clinical effects, or increase other, undesired

risks such as so-called adverse events (injuries or even deaths of patients). Technology-based ventures may fail to develop a product that is capable of competing with prior technologies, and in such cases, the company may further develop its technology or develop applications for other markets or market segments. In contrast, life science companies may invest years of academic basic research and long periods of development and clinical testing only to learn, in some cases virtually overnight, that years – perhaps decades – of work have not paid off well as the therapies are not demonstrating adequate levels of efficacy or safety. In such cases, unfavourable clinical data undermine the economic value of all the efforts and investments made to date. At the same time, regardless of these risks and astronomical costs for developing new drugs, the life science industry and pharmaceutical companies demonstrate a remarkable level of profitability, almost twice that of the industry average (Lexcin, 2006).

In the eyes of capital investors, there is on the one hand substantial uncertainty in this field of innovation, while on the other hand, there is the promise of substantial economic return-on-investment in the case of a successful introduction of a new therapy, or, more likely, if a major corporation in the field places a bid on the start-up company prior to the market introduction of the therapy. This makes the notion of *risk-aversion* highly relevant for the study of the entrepreneurship in the field of the life sciences. Risk-aversion is a term that assumes that all agents demonstrate a certain “utility function” for risk exposure and risk-taking; some individuals are willing to take high degrees of risk because they have the capital needed to be able to take such risks – that is, their “way of life” is not threatened by a calculated capital loss – or have superior understanding and know-how of the field and can therefore predict the actual risks better than other agents, or the agent has an utility function that differs from other actors, and consequently, they are willing to endure periods of higher risk and uncertainty. Extrapolating such “microeconomic models” to macroeconomic structures, it may be postulated that for instance the access to venture capital for entrepreneurs may differ over periods of time and the economic cycle. During certain periods of time, such as the first half of the 1980s in the United States and in the late 1990s in both the United States and in Europe, there has been good supply of venture capital (Gompers and Lerner, 2001), while after, for example, the financial crisis of 2008, there is a much higher degree of risk aversion among venture capitalists. This ebb and flow of venture capital is cumbersome for equally entrepreneurs, economic advisors, and policymakers as there is a need for a renewal of industry to be able

to handle social challenges (e.g., sustainability issues and the supply of work opportunities). In the life sciences, there is a significant and stable demand for new therapies or technologies that make health care better, safer, and cheaper, and the global population of more than seven billion people ensures by its sheer volume that there will be a predictable demand for health care products and therapies. The snag is again the difficulties in predicting and anticipating how the biological system responds to and accommodates the substances or materials it encounters, leading to the question of who is to carry the risks of life science ventures?

This is an issue heavily debated among industry representatives, economists, and policymakers, and in many cases there are strong ideological beliefs at play regarding, for example, the role of the state vis-à-vis unregulated market transactions. For instance, Lerner rejects state-governed initiatives to allocate and invest venture capital and points at numerous failed or ill-conceived initiatives to create new science-based, high-growth industries. For instance, Lerner reports, "Venture economists' calculations suggest that from the beginning of the industry through the end of 2007, the average European venture fund has had an annual return of minus 4 percent: hardly a number to warm investors!" (2009: 123) By and large, Lerner suggests, government initiatives are bound to fail and instead policymakers should focus on easing the burden of taxation in the field of venturing, reduce "legal hurdles" for entrepreneurship, and ensure that there are stock markets that are willing to invest in entrepreneurial companies (ibid. 224). Lerner's suggestions sound very much like a conventional recipe for an unregulated competitive capitalist regime of accumulation, including a combination of a withdrawal of state initiatives to pave the way for private equity and the state's active creation of an infrastructure for lowering the costs of venturing. In this view, the state should play an active role but only to the extent that it "sets the table" for private investors.

While this program sounds reasonable, it fails to address a number of empirical conditions being observed and reported in the literature. First, Lerner overlooks the fact that not only do governmental initiatives to invest in ventures tend to fail – venture capital firms writes off roughly 75 percent of their investments (Hochberg, Ljungqvist and Lu, 2007) – making such investments a most risky business for *all* actors, not only governmental agencies and funds. Secondly, even in cases where there is no strong presence of public funds, there is limited interest, especially after 2008, to invest in companies entering the clinical verification of their therapies or products. Steven G. Burrill, himself working

in the life science venture capital industry, accounts for the recent access to venture capital in the United States: “[In 2011] the industry raised more than \$91.1 billion through public and private transactions, a 25.8 percent increase over 2010... [But] in reality, a relatively modest portion of the total global financing into the sector are going to fund innovation” (2012: 5). This 25.8 percent increase conceals, Burrill suggests, that much of this capital include reinvestments already made and that a “great concentration of the funding is going to just a handful of firms” (ibid.). Rather than being in sufficient supply, “early-stage companies have found raising capital increasingly difficult as many life science venture firms have shifted their focus to less risky investment of later stage deals” (ibid.). By and large, venture capital firms demonstrate a new risk-aversion utility function, and increasingly ensure that there are good exit opportunities available after a period of active ownership:

Ventures investors are no longer willing or able to fund companies with an indefinite exit. Instead, they are waiting later to fund companies, building exits into their investments from the start, and looking to innovative technologies other than therapeutics that can address medical and healthcare system needs, but provide a more predictable path to revenue. (ibid.)

In addition, venture capital firms are not keen on building companies but rather seek to generate value in products or therapies by demonstrating the market opportunities for larger corporations in the health care or biotechnology sector: “Venture investors are focused on building products rather than companies, funding the development of drugs to a proof of concept stage at which point they can license them to a pharmaceutical company” (ibid.). In Burrill’s account, the private venture capital market has withdrawn from the early and risky stages, and today they primarily target companies in more mature stages where there are clear opportunities for exits, and where the value of the company resides not so much in its ability to entrench market shares or grow organically, but in the therapy’s fit with the product portfolio of major and cash-rich corporations having the marketing and sales channels needed to bring the new therapies into the clinics. Entrepreneurship thus shifts from the creation of companies to the creation of *biovalue*.

The scenario Lerner and Burrill sketch is somewhat daunting for both entrepreneurs and policymakers. If the state does the job of providing venture capital and accompanying corporate governance and management skills poorly, as Lerner (2009) suggests, and if venture capital

investors have abandoned the early stages and clinical trial stages, who should then pay for the new life science innovations? Who should carry the risks involved? Needless to say, there is no simple answer to these questions, but the theoretical framework developed by Joseph Schumpeter certainly applies: New innovations and new ventures demand capital investment, and capital investment always of necessity implies risk-taking. One of the structural difficulties involved is the distinction between what may be called *industrial capitalism* and *rentier capitalism*. Industrial capitalism based on the development of new products, technologies, services, and infrastructures on basis of a combination of enterprising and managerial skills and the long-term commitment from capital owners. This is – to make use of a Marxist term – a *regime of accumulation* that is generally credited for much of the advancement of the modern, technological society emerging after the industrial revolution beginning in England by the end of the eighteenth century. In addition, rentier capitalism is associated with the generation of wealth on basis of an existing stock of capital that is invested in relatively safe rent-generating finance market products. The capital of the rentier is not invested in risky ventures and entrepreneurial activities; it is reproduced and grown within the domain of the financial markets and existing low-to-modest risk investment opportunities. Critics claim that what has been called the financialization of the economy (to be further discussed in Chapter 1) is the return and dominance of the rentier economy (Lapavitsas, 2012; Deutschmann, 2011; Palma, 2009); rather than feeding excess capital into entrepreneurial activities and new industries as prescribed by neoclassical models and enabling further economic growth, capital income is reinvested in the finance industry, making the finance industry account for an increasingly large share of the accumulated profit in advanced economies (Krippner, 2011, 2005; Tomaskovic-Devey and Lin, 2011). Such a criticism needs, however, to be complemented by figures demonstrating how many public resources have been invested in life science research during the last decades (Lazonick and Tulum, 2011). There is still concern about an increasing reliance on public funding in the field of innovation and a relative decline of private corporations' share of innovative products (Block and Keller, 2009; Berman, 2012). After initial investment in basic research in the university system, these new research findings and ideas need to be brought to the markets to become, for instance, product packages or therapies that are clinically and commercially verified. In the field of life science research, to a much higher extent than in the case of information and communication technology and computer science, for

example, the step from the lab bench to the clinic is not a trivial matter but demands much capital investment, scientific, clinical, and commercial know-how, and legal, regulatory, and managerial skills.

This leaves us with lingering questions about how to match entrepreneurial activities and investment opportunities in the field of life science research. For the private venture capital investor, the immense uncertainties of any life science venture needs to be weighted against the possible yield and return on other investment opportunities, and apparently most of the venture capital owners have reached the conclusion that they are not willing to carry the risks involved in the development stage of life science ventures. It would be unfair to speak of market failure in this setting, as there is possibly a much higher supply of venture capital investment today in the age of academic entrepreneurship (Berman, 2012) than there was a few decades ago. Ahn and Meeks stress that the access to advanced life science research technologies and tools lowers the costs for producing what are seemingly intriguing research findings that in turn could lend themselves to further clinical research and possibly clinical applications:

Fuelled by the expanded access to research tools and biological insights from initiatives such as the human genome project, the excitement of creating new companies has resulted in large numbers of small, undercapitalized start-ups focused on discovery of novel drug targets but lacking resources needed to convert these targets into drug candidates and to validate them in the clinic. (2009: 23)

In addition, the perceived shortage of supply of venture capital is arguably endemic in a milieu where there is a strong emphasis on enterprising activities and where many actors dream of creating their own Genentech, Amgen, or Cetus. In the life sciences, exploring the mind-boggling complexity of biological organisms and systems, there are also ample opportunities for finding intriguing correlations between, for example, genomic sequences or proteins and so forth, findings that may constitute academically sound conjectures but that would demand a significant additional amount of research work before a more detailed theoretical model could be constructed on the basis of empirical data. In addition, the more widespread use of biocomputation technologies and systems biology methods in the life sciences (Styhre, 2011) – seeking to structure vast data sets generated in, for example, genomics or proteomics studies – always produces statistically significant relationships. Whether these mathematically proved relations have practical and

clinical significance (Ziliak and McCloskey, 2008) remains an empirical question to be answered, though.

Still, the question of life science enterprising venture capital funding remains a pressing concern. Most countries invest a significant amount of tax money in basic life science research, but there is not an output of new therapies on par with such commitments. The almost exponential growth of life science know-how since the 1970s has not been translated into comparable breakthroughs in terms of radically different therapies and health care practice, but a vast number of minor but significant contributions have been made. The question of venture capital investment in these most difficult and uncertain territories remains a key concern in economic theory.

The knight of faith of entrepreneurship

In the discourse on entrepreneurship, the entrepreneur is a figure who works against all odds and overcomes all obstacles in his or her pursuit of the creation of a new venture. In Max Weber's terms, the entrepreneur relies more on his or her charisma and enthusiasm than on a calculative rationality, and therefore, the entrepreneur represents a rationality that deviates from the regular norms of the contemporary economy. This makes the entrepreneur an enigmatic figure, complicated to study *ex ante* or in the making, but subject to extensive romanticism as the creator of new worlds. In order to fully understand both the life world of the entrepreneur and its status as a quasi-religious element in the otherwise rationalist economic system, one can turn to the philosophy of religion to acquire a proper vocabulary for apprehending that which extends outside of the realm of reason and logic.

In Søren Kierkegaard's theological writing, the *knight of faith* is the individual who places greater value on faith than on knowledge. In the tradition of Western thought, characterized by the Socratic pursuit of wisdom and knowledge, all subjectivity is "stripped away" as objective truth is sought (Kierkegaard, 1992: 131). Subjectivity, the essence of faith, needs to be subsumed under the authority of objective knowledge. However, for Kierkegaard (1985: 170), the concept of doubt can never be overcome by "objective thinking," as doubt presupposes "interest" or "consciousness," two terms bound up with subjectivity that are already from the outset excluded from objective knowledge and wisdom. Doubt and faith are closely associated, and as there can never be any conclusive firsthand facts given regarding religious beliefs, Kierkegaard advocates *passion* as a key element of the religious experience. This

is the key to his *religious stage*: the understanding that faith is something that defies objective knowledge and its ready-made conceptual framework. Consequently, the concept of *reflection* is for Kierkegaard a term that denotes how the human intellect packages everything into “sterile abstractions which could not be experienced ‘completely and personally’” (Golomb, 1991: 66). In structuring human experience into such abstractions, the human intellect “rationalizes away all avenues to authenticity” (ibid.). Kierkegaard’s authentic religious experience, grounded in passion and pathos, is therefore what cannot be spoken about *propositionally*; it is what must remain mute. On the one hand, we have the Socratic project to learn to know the world through imposing rational categories and abstractions onto the world perceived and examined; on the other hand, we have the religious experience of authenticity and passion that must remain unspoken. In the former case, the subject is gradually decomposed; in the latter case, the subject’s authentic experience is affirmed but remains a personal experience and thus escapes reflection qua proper representation. For Kierkegaard, authenticity therefore presupposes a suspension of reason and logic: that is, the Socratic categories of objective knowledge (ibid. 78). The knight of faith is for Kierkegaard the subject that affirms his or her religious experience in its full breadth and understands that religious experience cannot be fully accounted for. As Rorty (2007: 65) remarks, absolute commitment has “nothing to do with the ability to win arguments or convince opponents”; one cannot debate faith, passion, and authentic experience but must recognize the limits of the vocabularies that reason and logic provides us with.

The entrepreneur is the economic actor who overlooks or ignores that the odds speak against him or her. Armed with passion and commitment (see, for example, Chen, Yao and Kotha, 2009), the entrepreneur resists arguments speaking against his or her will and the project pursued. Kierkegaard’s statement, “What we lack today is not reflection but passion” (1985b: 71) could easily be transferred to the contemporary economic domain, where politicians and policymakers put their faith in the entrepreneur to step forward and to enable economic growth and work opportunities. Amidst an otherwise thoroughly rationalized existence, grounded in calculative practices and instrumental rationalities, the knight of faith of entrepreneurship stands tall and is expected to play a significant role for the future (see Boxter and Rarick, 1989). The concern is that this knight of faith and his or her convictions and passions are not easily clad in the vocabulary of reason and logic favoured by politico-economic discourses; to some extent, the entrepreneur remains a

ghost – or perhaps better, the holy spirit – in the economic machinery, a residual factor that cannot be fully pinned down in propositions and abstract categories.

Kierkegaard's philosophy of religion represents perhaps the first major break with the predominant Western tradition of rationalist thinking, beginning with Socrates and Plato and stretching over Descartes and Kant and into our own time. The newer generations of philosophers, following Kierkegaard's analysis of the limits of objective knowledge, included Nietzsche and eventually a series of continental philosophers who all deviated from the Plato-Kant axis of the tradition of Western thought. Kierkegaard suggests that objective knowledge, no matter how successful it has been in advancing science, technology, and political constitutions – all key elements of the contemporary society – must be subject to criticism, as abstractions can never fully accommodate the whole of human experience. One of the consequences of the indisputable triumph of the Socratic idea of separating light from darkness is that irrationality, operationalized as anything that escapes thinking grounded in reason and logic, is today, Rorty proposes, "thought of as a blamable failure to exercise an innate faculty" (2007: 58). Therefore, the inability to adhere to such thinking has become "the secular equivalent of sin." Still, the entire domain of entrepreneurship is based precisely on forms of irrationality, but when it proves to be successful – which it is in only exceptional cases – it is praised as a major social accomplishment.

Speaking of life science venturing, there are key elements of passion and faith involved. As the human biological organism is only mapped and explored on a general level, clinical trials of, for example, new candidate drugs, in many cases reveal unanticipated responses to the active compound. As a consequence, little is known until the data is reported, and therefore there is an irreducible element of faith involved in at least the development of new pharmaceuticals. The view of the entrepreneur as a Kierkegaardian knight of faith thus recognizes both the passion for creation and the faith in one's research work that are the *sine qua non* of life science venturing; the ability to transcend "sterile abstractions" is part of this advanced human endeavour to create new therapies and medical technologies.

Research question and possible contributions

This volume will address the issue of the financing and commercialisation of life science ventures. Rather than blaming either governments or private capital owners for "failing" to provide adequate funding for

life science ventures, the book seeks to explore some of the difficulties involved in bringing scientific research from the researcher's bench to the clinic. The volume will examine the following research questions:

- How do life science companies perceive the access to venture capital beyond the initial start-up phase when the companies need to both clinically and commercially verify their products?
- On what basis do venture capital investors make investment decisions in life science companies, and how do they perceive the entrepreneurial milieu in a Scandinavian and European setting? That is, how are state-governed and regulatory practices influencing their decision to invest in life science venturing?
- What role do various market makers – including incubator directors, venture capital interest organizations, and other relevant actors supporting and promoting life science venturing – enact for themselves, and how do they support the matching of life science entrepreneurs and venture capital investors?

Taken together, this book seeks to provide an analytical framework addressing both what has been called the financialization of the economy since the end of the 1970s and the emergence of a venture capital market, to address the need for corporate governance, and to ensure access to relevant managerial competences when bringing life science innovations to the market. In addition, this research monograph reports empirical data that sheds light on the three categories of life science venture actors listed above. The research monograph thus contributes to a more empirically based discussion about the difficulties involved in capitalizing on the basic life research conducted in the university setting.

Outline of the book

This book includes this introductory chapter and three parts. The first part, entitled “Elements of the Life Science Innovation,” includes two theoretical chapters and a chapter accounting for the methodology of the study. Chapter 2 addresses the literature on financialization of the economy and how that affects the supply of venture capital investment in life science venturing. Chapter 3 turns to the issue of corporate governance and how life science-based start-up firms are in dire need of acquiring leadership and management competence to be able to commercialize basic research findings. The second part of the book,

“Empirical Studies,” reports the empirical material collected in a study of the Swedish life science venturing sector, including interview materials from venture capital investors, innovation system agency representatives, and life science companies’ representatives and entrepreneurs. The third part of the book includes a chapter that presents an analysis of the empirical material and points at some of the theoretical, managerial, and policy-oriented implications of the joint work conducted in this area to bring basic life science research findings to the market and into clinics.

Part I

Elements of Life Science Innovation

1

The Financialization of the Economy

Introduction: the creation of biovalue

“By ventures, I mean privately held entrepreneurial firms with significant external equity investment from professional investors,” Garg (2013: 90) writes. This is an operative definition that will be used in this volume. Today, the life sciences are not only capable of producing new drugs and therapies that benefit patients and their relatives by increasing the quality of life and prolonging the lives of millions; they can also produce various forms of what Mitchell and Waldby refer to as *biovalue*, a composite term that refers to “the yield of both vitality and profitability produced by the biotechnical reformulation of living processes” (2010: 336). When technically manipulating biological materials in a variety of ways, for example, “transformed into cell lines, genetic sequences, or genetically modified organisms” (*ibid.*), biovalue is produced and thereafter translated into economic capital. This connection between biovalue and economic value constitutes what has been called the *bioeconomy*, the wider institutional field wherein life science research acquires its economic and financial worth (Birch and Tyfield, 2013). The term biovalue is useful because it captures how the biological, material substratum being worked on – a genome sequence, a cell line, a biological pathway, or an organ – can be translated into economic worth and become subject to the calculative practices that lie at the very heart of the capitalist regime of accumulation. There is, in other words, a certain “transposition” between the material substratum and the economic capital being apprehended by the term biovalue. Just like biovalue is translated into economic and financial capital, so is financial capital the source of biovalue in the first place. Inherent in this translation of biovalue – life science know-how that serves as the basis for

therapies – into financial capital is what Sunder Rajan (2012) refers to as “systems of valuation,” calculative practices based on statistical and numerical analyses, ethical considerations, shorthand practices, and rules of thumb used by calculating agents. Being able to recognize the financial value in a certain biovalue is not a trivial matter. In the new millennium, numerous life science funds has failed to deliver adequate returns on investment made given the level of risk-taking because of the difficulties involved in calculating biovalues and in anticipating the risks involved in bringing new therapies to the market.

Clark introduces the term *healthscapes*, influenced by Appaduari’s (1996) influential vocabulary, to denote the heterogeneity of what Clarke et al. (2010: 57) refer to as the “medical industrial complex.” The term healthscapes is not a trivial term but includes a great variety of actors and terms:

Healthscapes are ways of grasping, through words, images, and material culture objects, patterned changes that have occurred in the many and varied sites where health and medicine are performed, who is involved, sciences and technologies in use, media coverage, political and economic elements, and changing ideological and cultural framings of health, illness, healthcare, and medicine. (ibid.: 105)

This healthscape includes patients, physicians and other professional health care groups, regulators, authorities, pharmaceutical companies, medical technology firms, politicians, patient interest groups, laboratory animals, cell lines, and experimental organisms, and so forth: that is, all sorts of “humans and non-humans” (in the convenient phrase of actor-network theorists) that constitute the field of health care and life science research. In addition, the healthscape also includes capital owners such as venture capital funds, pension funds, state-governed innovation funds, and so forth: that is, specialized professional groups that invest in biovalue and ensure that it is translated into an adequate return on investment in the form of economic value (i.e., finance capital). In much research, these two worlds are rarely combined or brought together; sociologists, management researchers, and science and technology students are concerned with examining how life science research and clinical practice are translated into new therapies, brought into the health care clinics, and launched in markets. Finance market researchers and venture capital studies target the various practices of venture capital investment and the corporate governance of these investors. Only at sometimes do these two research activities cross their paths. This is a

curious condition as the biovalue being produced in life sciences laboratories at the universities and in both multinational corporations and small and medium-sized companies are capable of generating substantial profits. "The healthcare industry is now 13 percent of the \$10 trillion annual US economy," Clarke et al., report (2010: 57), and many studies has shown that, for example, the pharmaceutical industry has reported substantially higher bottom line performance over time in comparison to other major industries such as the manufacturing and construction industries and retail (Lexchin, 2006).

When you make it in the life sciences, the yield is substantial. The concern is that it is very complicated to predict what life science research projects that will eventually come out as winners. First, it is hard to predict how certain compounds will interact with the human biological system in the full-scale clinical trials, making what seemed to be a promising new chemical entity (NCE) in the laboratory setting very disappointing when tested in a population of patients. Second, from history we can learn that it is not always easy to predict the market potentials for new therapies. For instance, as Lakoff suggests, in the early 1960s, pharmaceutical companies could not easily assess the market potential for a new category of antidepressant drugs:

Pharmaceutical firms were hesitant to develop antidepressant components given what a very limited market...By 2001, annual sales of antidepressants had reached \$1.3 billion in the US. They were the second most prescribed class of drugs, after heart medication, with 7.1 million Americans taking them. (Lakoff, 2007: 58)

However, in the recent decades and the last decades, pharmaceutical companies have learned that therapeutic needs not only exist as some kind of undisputed fact, but market opportunities are also a matter of active market creation (Angell, 2004). Critics have consistently emphasized how pharmaceutical companies not only supply therapies to handle perceived needs but also actively influence how, for example, psychological health (Lakoff, 2007, 2006; Healy, 2002) and sexual performance and interest (Åsberg and Johnson, 2009; Fishman, 2004; Mamo and Fishman, 2001) are perceived and consequently medicalized. As Lakoff (2007: 59) recognizes, pharmaceutical companies are not "social critics" but experts facing "practical problems" under the influence of profit motives, and therefore they are responding to the problem of how to define or create markets like any other industry in the regime of competitive capitalism – that is, through market creation and marketing.

This chapter will address the concept of *financialization*, denoting the increasingly more prominent role played by financial actors in the contemporary economy, and connect that concept to both venture capital and innovation literature. In the next step, financialization is closely associated with the development of both the biotechnology industry and life science venturing at large: that is, the recent interest in exploiting biovalue in what Rose (2007) refers to as the *bioeconomy*, the economic regime of accumulation where the life sciences are regarded as one of the high growth potential industries in the Western economies. In other words, the access to both finance capital and competent venture capital investors, having a detailed understanding of the risks involved in life science venturing, is the *primus motor* of the bioeconomy; in fact, the entire life science industry developed from within the university research system from the mid-1970s is closely co-produced with the financialization of the economy after 1980 (Cooper, 2008). There is, in other words, a very intimate relationship between, on the one hand, the institutional field of life science research and on the other hand an overarching financialization of the economy that deserves to be explored in greater detail in order to understand how biovalue can be transformed into financial capital that in turn can be reinvested in new life science research activities. In the bioeconomy, science and capital are folded into one another.

The concept of financialization

Krippner defines *financialization* as “a pattern of accumulation in which profits accrue primarily through financial channels rather than trade and commodity production” (2005: 174). Krippner also makes a distinction between an “activity-centered view” (e.g., the image of the “post-industrial society”) and the “accumulation-centered view” that stresses “where profits are generated in the economy” (ibid.: 176). Dore similarly defines financialization as “the increasing role of financial motives, financial markets, financial actors and financial institutions in the operation of domestic and operational economies” (2008: 1097–1098). In these two accounts, financialization denotes the increased role of finance actors and finance institutions in the contemporary economy. Krippner emphasizes that the term financialization has taken on a number of meanings in the social science and economic literature, and has at least four discernible meanings: (1) the use of shareholder value corporate governance; (2) the dominance of capital-markets over bank-based finance; (3) the increased power of the rentier class; and (4) the

“explosion of financial trading associated with the proliferation of new financial instruments” (2005: 181). When Krippner and Dore speak of financialization, they mean above all the share of accumulated profits in the economy derived from – as well as benefitting – finance market actors. Over the period beginning around 1980, and the new neoliberal policy stressing a deregulation of the finance markets to increase competition and efficiency, first in the UK and the United States and eventually to a various degree elsewhere, this share has grown dramatically:

[In the U.S.] Financial sector profits as a proportion of all profits in the economy grew slowly between 1848 and 1970, dropped across the 1970s, and increased dramatically after 1980... This trend peaked in 2002 when 45 percent of all taxable profits in the private sector were absorbed by finance sector firms. (Tomaskovic-Devey and Lin, 2011: 539–540)

In the case of Europe, a similar trend is being observed:

Within the EU-27 [the 27 members of the European Union] ... the FIRE [Finance, Insurance and Real Estates] sector contributed to no less than 28.8 percent of GDP in 2010, topping industry (18.5 percent) and every other sub-branch of the service sector. In Germany with its strong industrial sector the FIRE-share of GDP was even above the EU-average (30.4 percent), again topping industry (23.4 percent) significantly. (Deutschmann, 2011: 353)

The driving force for this gradual growth of the finance industry, both in sheer size and in proportion to other industries, has been heavily debated by economists and economic sociologists. From a neoclassical economic theory perspective, part of the growth is derived from growing productivity in the sector based on human capital investment (Tomaskovic-Devey and Lin, 2011: 540). Other commentators have claimed that it is the new neoliberal and neoconservative policies emphasizing the effectiveness of unregulated markets, ultimately based on what economists refer to as the *efficient market hypothesis*, strongly associated with the University of Chicago economics department and with Eugene F. Fama. This effort to deregulate financial markets has opened up for a series of finance market innovations such as collateralized debt obligations (CDO) and credit default swaps (CDS) that have been claimed to play a key role the finance market collapse of 2008 (Stiglitz, 2010; Crotty, 2009; White,

2009). Yet another group of critical scholars has emphasized the financialization of the economy as a political program, steeped by neoliberal and neoconservative political orientations occurring after 1979–1980 in the UK and the United States as Margaret Thatcher was elected prime minister and Ronald Reagan took office in the White House: “What lies behind the phenomenon of financialization is the actual transformation of advanced capitalism into a rentier society, where the private asset holder has become dominant over the entrepreneur. From a sociological view, financialization can be characterized as a hegemonic regime of rentiers over entrepreneurs,” Deutschmann suggests (2011: 382; see also Lapavitsas, 2012).

Following Krippner (2011, 2005), the financialization of the economy was not very likely to be something that could be planned in detail *ex ante*, but is instead the outcome from new policies and political programs with the ambition to handle the high inflation and high unemployment rates in the 1970s, the effects of the two oil crises that caused many problems in the 1970s economies (Stein, 2011), and various macroeconomic and even demographic conditions. It is not very likely that policymakers taking office by the end of the 1970s, like Paul Volcker, the new chairman of the Federal Reserve appointed by President Carter, could fully predict the effects of all the events that led up to the situation in 2002 when the finance industry accounted for a record-high 45 percent of all taxable profits in the private sector in the United States. Neither could they have been able to anticipate the events of 2008 when the risk-exposed American sub-prime housing market and the toxic assets held by finance institutions derived from this market caused the most conspicuous economic crisis in the post-World War II period. Instead, the financialization of the economy needs to be understood as the outcome from various uncoordinated conditions and, importantly, of the “institutional work” (Suddaby and Viale, 2011; Lawrence, Suddaby, and Leca, 2009) of an emerging class of knowledge workers being trained in the newly reawakened discipline of financial economics (Dobbin and Zorn, 2005).

In the 1980s, the effects of financialization were given public attention as a new category of finance actors engaged in so-called leveraged buyouts (LBO). Stearns and Allan identify three factors explaining the LBO wave that swept over the American economy in the mid-1980s: (1) the increase of capital through the inflow of foreign savings in the United States (in turn based on high overseas savings and positive trade balance in, for example, Japan, and an overrated dollar), (2) the deregulation of the finance sector, and (3) the issuing of junk bonds to finance

LBOs, a new finance market innovation. Stearns and Allan stress the role of junk bonds in particular:

Between 1983 and 1989, nonfinancial corporations issued \$160 billion of junk bonds to the public. The sum accounted for more than 35 percent of total public bonds offerings. About two-thirds of these issues were associated with restructurings (i.e., leveraged-buyouts and acquisitions). (Stearns and Allan, 1996: 706)

As this new class of finance industry entrepreneurs earned a reputation for buying undervalued American corporations and divesting them, there was much criticism against such activities (even though economists like Michael C. Jensen at Harvard welcomed such “restructuring” of corporations as they served to reduce what Jensen and agency theorist refer to as *agency costs*). However, the Reagan administration, taking a strong “pro-business” position to distance itself from both the “1960s’ liberals” and the preceding Carter administration, was advised by neoliberal and libertarian economists including Milton Friedman and the future chairman of Federal Reserve, Alan Greenspan, who promulgated a strong *laissez-faire* ideology that signalled that the state would limit its regulatory role. “By changing how antitrust laws would be enforced, it specifically disturbed the institutional arrangements set up to monitor and limit mergers,” Stearns and Allan write (1996: 706). However, when George W.H. Bush took office in 1989, the new administration started to “clean up the excesses tolerated by Reagan’s permissive regulators” (ibid.: 712): major figures in the LBO wave like Michael Milken were sent to jail, an event that indicated that firm belief in deregulated financial markets was not always in the best interest of all constituencies.

In addition to the growth of the finance industry and the emergence of a professional finance market analyst class, recruited from elite American universities such as Princeton and Harvard (Ho, 2009), financialization has also strongly influenced the corporate governance and the top management composition in major corporations. First of all, propelled by agency theory and its flamboyant advocate, Michael C. Jensen, corporations were increasingly concerned with enriching shareholders under the label *shareholder value creation*. Since American corporations were undervalued after the 1970s bear markets, and there was an inflow of capital into the US economy in the early 1980s, CEOs were increasingly concerned about the price of their companies’ stocks. Stock prices too low to book value would make them a target for LBO activities, which in turn would put the CEO’s job at stake. In addition to macroeconomic

changes, new policy, and the enterprising activities of the new finance industry actors, agency theory provided a theoretical argument (to be discussed in detail in the next chapter) in favour of shareholder value creation, based on the proposition that the holders of stock contract for the right to the residual cash flow. Agency theory was part of a general neoliberal and laissez-faire discourse gaining momentum in the 1980s.

The shareholder value ideology and the financialization of the economy had two principal consequences. First, the organizational form of the conglomerate, the major corporation hosting by and large unrelated activities, became “deinstitutionalized” (Davis, Diekmann, and Tinsley, 1994). Rather than top management and board of directors making the decision about where to invest what agency theorists call the “residual cash flow” – the cash that is left when all other costs are covered – this cash should be returned to the shareholders for them to reinvest in industries with a high potential for growth and returns. The conglomerate model, by and large the outcome from corporate law aimed at curbing the growth of trusts and monopolies rather than securing shareholders’ interest’ here as suggested, became unfashionable. The second consequence was that finance-trained and finance market-minded CEOs were recruited to major corporations. Rather than operating through board membership, institutional investors thought it would be better to hire CEOs who directly operated in accordance with their interests. In addition, the chief financial officer (CFO) position was changed from being a relatively marginal and highly technical role in the corporation, primarily aimed at securing the access to capital over the economic cycle, to a more prominent position at the helm of corporation. In many cases, executives trained in the engineering sciences had to give way for a new generation of business school graduates majoring in finance, an event that represented a major shift in corporate governance: the managerial capitalism of, for example, Alfred P. Sloan et al. had to surrender to the finance market capitalism or “investor capitalism (Useem, 1996) of the new regime of capital accumulation. “The financialization processes transferred the power from a managerial elite rooted in companies to an opportunistic alliance between mobile managers and investment funds,” Widmer (2011: 694) concludes from his study of the effects of financialization in Swiss manufacturing companies, traditionally dominated by engineers in managerial positions.

What role this new financialization played for the 2008 finance industry collapse is still being subject to scholarly analysis and debates (e.g., Mirowski, 2013; Blinder, 2013), but it is possible to draw the conclusion that the financialization brought by the new neoliberal policies

implemented after 1980 has played a decisive role, including the free market ideology of leading actors including the Federal Reserve chairman Greenspan. It is beyond the scope of this volume to fully engage with the causes and effects of the financialization of the economy and the 2008 economic shift, but it remains a major event that effectively both contributed with capital to the life science industry and eventually, after September 2008, reduced capital supply.

Financialization-as-practice: the valuation of assets

One important perspective derived from the financialization of the economy is the economic sociology view that stresses the calculative practices in the contemporary economy. While much finance theory in economics operates on basis of standard statistical models and well-established finance theories such as the capital asset pricing model (CAPM), economic sociologists have paid attention to the process of *valuation*: that is, how to “put a price” on what is previously “priceless” – what has not yet been subject to economic and financial evaluation. Since life science is what is in-the-making – not yet ready but holding great potentials for generating future economic rents – this domain of venturing is amenable to such calculative valuation practices. Lamont speaks of valuation as the practice of “giving worth or value” to an asset or resource (2012: 205). In contrast, *evaluation practices* are activities aimed at “assessing how an entity attains a certain type of worth” (ibid.). This is most delicate distinction wherein valuation operates on what is produced *de novo*, for example, a work of modern art, not previously available on the market, and how this piece of art can be inscribed with an economic worth. Muniesa speaks about the “pragmatics of valuation” (2007: 390) to underline that actors make use of a variety of resources and skills when putting a price on an asset, say, a life science company, a compound, a patient’s life, and so forth: that is, any asset that has a certain biovalue that can be translated into an economic value. As economic sociologists are keen on emphasizing, in the contemporary economy, economic actors are primarily making use of monetary valuation when inscribing economic worth into assets. As Carruthers remarks, there is a certain rhetorical value in using monetary value in the articulation of the valuation:

The connection between monetary valuation and quantitative measurement gives the former an image of an objective, neutral, and precise mode of valuation... Ideally, valuation resembles... disinterested mechanical objectivity... but in fact the rules are often too

vague, incomplete, and numerous to prevent interest-driven creative interpretations. (2005: 359)

This failure to conceal the fissures and faults in the monetary evaluations is especially cumbersome when it comes to the valuation of what Fourcade refers to as “peculiar goods,” say, human lives, transplant organs, human reproductive materials such as egg or sperm, nature, and so forth. In such cases, the calculative and valuation practice include moral and ethical concerns that are not possible to express in monetary terms per se:

Economic valuation is so revealing precisely because it is so much more than a process of monetary commensuration: it is, much more powerfully, a process of “definition” or social construction in a substantive sense...which incorporates all kinds of assumptions about social order and socially constructed imaginaries about worth. Economic valuation, in other words, does not stand outside of society: it incorporates in its very making evaluative frames and judgments that can all be traced back to specific politico-institutional configurations and conflicts. (2011: 1769)

The paradox of valuation is that while the monetary worth is enjoying a halo of objectivity and detachment, the reference to monetary terms also inevitably leads to what George Simmel called *Verdinglichung* – a reification – and such reification blocks a qualified and more informed valuation of the asset. A human liver is, for instance, not just *any* asset, but can be a lifesaving organ to be transplanted into the body of a dying patient, and consequently the liver is always valued and exchanged as a sacred object capable of saving a human life. Therefore, valuation practices need to move back and forth between moral and ethical (i.e., subjective or intersubjective) beliefs and norms, and formally agreed practices of monetary or otherwise metric calculations. It is precisely this “double nature” of the valuation of assets that makes this practice intriguing for economic sociologists: it is a domain where the calculative rational actor comes to an end, and where social and cultural norms can no longer be put aside.

In addition to the elementary practice of valuating, economic sociologists also examine the practice to *commensurate*, the activity to value or measure “different objects with a common metric” (Espeland and Stevens, 2008: 408). While valuation is aimed at inscribing “absolute” value into an asset (e.g., a market price), commensurating is aimed at ranking such

assets: that is, the assets achieve a “relative” value. “Commensuration always is a process, often one that requires considerable social and intellectual investments. Before objects can be made commensurate they must be classified in ways that make them comparable,” Espeland and Stevens argue (2008: 408). For instance, if the research of the economics department at MIT acquires a total of 9.67 point on a ten-point grading scale – this is an entirely fictional example – and the University of Chicago economics department acquire 9.62, these are according to this metric two fine and qualified departments. The commensuration of this valuation serve to further discriminate between these two departments, placing the MIT above the University of Chicago. If we assume that there is no department having higher total scores than 9.67 and 9.62, that makes MIT number one on the league table and University of Chicago second. While the actual difference between 9.67 and 9.62 is quite small, accounting for less than a 0.5 percent difference, when being placed in the league table, this small difference is amplified and appears to be much more salient than the underlying metrics indicate. For a lay audience, it may appear as if the MIT faculty vastly outperforms their Chicago colleagues, while in fact this miniscule difference may be explained by statistical errors and measuring problems. That is, the league table, an instrument for commensuration, serves to discriminate more than the valuation does. Such practices of ranking and commensuration at large interest economic sociologists as they are effective tools in the hand of authorities and third parties to govern at distance and for lay audience to get an overview of field they lack the competence to fully monitor or assess. Also, accounting researchers have contributed to the study of such calculative practices, in many cases under the label of *auditing*, a most fashionable term in the new regime of governance. As we will see below, for venture capital firms, the capacity to valueate and commensurate various investment opportunities is a key competence that demands both calculative practices derived from finance theory and other forms of know-how and skills that are not of necessity lending themselves to such numerical calculation. Making investment in the life science industry in order to exploit biovalue demands sophisticated calculative skills, an understanding of the scientific field, industry experience, and clinical practice know-how.

Consequences of financialization: innovation and commercialization in the life sciences

Joseph Schumpeter’s economic theory stresses renewal and development in economic system and consequently the entrepreneur and

his or her innovations play a key role when understanding economic systems and their change over time. Schumpeter's definition of innovation is frequently cited in the economics and management literature: "What we, unscientifically, call economic progress means essentially putting productive resources to uses hitherto untried in practice, and withdrawing them from the uses they have served so far. This is what we call 'innovation'" (1991a: 64). Innovation includes not only "a new commodity" but also the ability to produce "at smaller cost per unit, breaking up the old 'supply schedule' and starting a new one" (ibid.), that is, innovation is occurring in the forms of both product and process. More importantly from a managerial perspective, innovations do not emerge without skilled leadership and effort, and consequently the innovator – that is, the entrepreneur – is an important figure in the economic system:

Successful innovation is...a task *sui generis*. It is feat not of intellect, but of will. It is a special case of the social phenomenon of leadership. Its difficulty consisting in the resistances and uncertainties incident to doing what has not been done before, it is accessible for, and appeals to, only a distinct type which is rare... To overcome these difficulties incidents to change in practice is the function characteristic of the entrepreneur. (ibid.: 65–66)

Schumpeter here carefully distinguishes between the "entrepreneurial function" and the "managerial function," which he terms "distant" (ibid.: 66). At the same time, these two skills need to "meet one another in the same individual" in the "process of innovation." For Schumpeter, the entrepreneur is a Janus-faced figure, on the one hand focused on creating "novel combinations," while simultaneously overseeing the activities involved in their creation.

In addition to the assemblage of entrepreneurial and managerial skills demanded to innovate, Schumpeter stresses the importance of capital investment to produce innovations. In other words, the entrepreneur becomes a debtor who can only eventually generate rents that can pay for the capital invested (Ingham, 2003). Taken together, there are three resources involved in innovation: entrepreneurial skills, managerial competence, and capital investment. None of these three resources can be dispensed with; all must be in place. Mazzucato stresses that the relationship between finance, innovation, and entrepreneurship is not as linear and straightforward as a generalized Schumpeterian framework may suggest. First of all, students

of innovation must recognize that innovation is “deeply uncertain,” Mazzucato suggests: “Investment in innovation is a bet on the future, and most attempts fail” (2013: 852). Firms that engage in innovation work operate under very different conditions, handle various practical and scientific problems, and operate in milieus characterized by specific legal, regulatory and managerial conditions and arrangements. These varieties and differences across firms create different “cost structures” and needs for financial investment (ibid.: 853). For instance, Mazzucato suggests, “science-based sectors” wherein “firms depends largely on publicly funded research” will require a specific type of finance (ibid.). As a consequence, life science innovation is not simply a matter of raising capital from capital owners, but the relationship between entrepreneurs and financiers is more tightly knit and their interests more closely entangled. As a consequence, Mazzucato claims, the problem of perceived endemic shortage of venture capital should not be posed as one of “the big bad banks and dodgy financial institutions (e.g., hedge funds and credit default swaps) versus the (potentially) innovative ‘real economy,’” but must aim to understand how “value creation” (i.e., innovation and its accompanying commercialization) and “value extraction” (the generation of income and finance capital on basis of such innovations) are related (ibid.: 863). In this view, the supply of finance capital and the entrepreneurial function are interrelated and must consequently be examined in such terms. Consequently, as we will examine below, the role of venture capital firms, for example, is not only to provide capital but also to actively locate their partner companies in networks of relations that help these beneficiaries tap into resources that they would not otherwise have access to. Entrepreneurial skills and resources, shared and exchanged in network structures in innovative fields, are thus developed both in the companies and in the venture capital firms.

The financialization of the pharmaceutical industry

The capital needed to develop new pharmaceuticals is enormous, and large pharmaceutical firms spend £1.7 billion annually per firm on R&D (Hopkins et al., 2013: 910). As only a fraction of the new drug development projects finally reach the market – the success rate varies between 1.3 and 19.7 percent, depending on the therapeutic area (ibid.) – only a small number of highly commercially successful drugs cover all the costs of new drug development. One of the effects, critics of Big Pharma such as Angell suggest (see also Petryna, 2006; Busfield, 2006; Fishman, 2004; Braithwaite, 1984), is that while

major pharmaceutical companies are fond of presenting themselves as R&D intense, intellectual, and knowledge-intensive centres outside of the university system, the pharmaceutical industry is in fact “at best” described as an “idea-licencing, pharmaceutical formulating and manufacturing, clinical testing, patenting, and marketing industry” (2004: 73). “The industry actually spends far more on marketing and administration than on R&D,” Angell remarks (*ibid.*: 198). At the same time, the market for pharmaceuticals grows, especially in the United States (Dumit, 2012; Abraham, 2010): “Pharmaceutical-sector growth is estimated at about 8 percent per year ... Americans spend more than \$100 billion on drugs in 2000, double the amount spent in 1990,” Clarke et al. report (2003: 167).

In major multinational pharmaceutical companies holding patents and intellectual property rights for a portfolio of blockbuster drugs, there are opportunities for maintaining quite sophisticated R&D activities, while smaller firms and start-ups have to rely on the finance market to fund their R&D. “Bio-pharma is an industry dependent on the capital market for funding because it is cash hungry until, and if, products in the pipeline become commercially viable and generate positive cash flow from revenues,” Anderson et al. argue (2010: 632). This makes the highly unpredictable and uncertain new drug development process a form of “casino-like” venture where “the chances of success of an early-stage drug are unpredictable and financial loss is the most likely outcome” (*ibid.*: 640). There are both biological and regulatory sources of uncertainty to consider: First, there are incomplete analytical models of the human biological organism making the clinical trials at the moment when the new compound – the active substance of the drug – reveals itself in its full biological complexity and demonstrates in the clinical data whether the compound provides an adequate level of efficacy and safety. In addition, difficulties involved in predicting outcomes on the basis of *in vivo* animal models being used in the pre-clinical phases of the R&D work occasionally lead to disappointing outcomes when what appeared to be a promising new compound on the basis of studies in, for example, mice, fall short in a population of human beings. Second, the Federal Drug Administration approves drugs, and there are no once and for all, clearly defined lines of demarcation between adequate and inadequate efficacy, and consequently, there is always room for individual assessment and even negotiations when new candidate drugs are approved. These two sources of uncertainty need to be considered when finance capital owners invest in new drug development projects: “Bio-pharma is a spectacular bet

on scientific discoveries and is similar, in this respect to oil, gas, and mineral exploration where Federal Drug Administration (FDA) regulatory approval is like striking oil of finding the seam," Anderson et al. propose (*ibid.*: 632). This close co-evolution of new drug development ventures and the finance market makes these start-ups vulnerable to shifts in the risk-taking among venture capital investors (Stucki, 2014). In a study of US and UK venture capital investment in small and medium sized companies in the 2002–2004 period, Mina, Lahr, and Hughes) somewhat unsurprisingly found that larger firms raising capital for R&D projects were more likely to obtain capital than smaller firms. Mina, Lahr, and Hughes suggest that the "greater informational transparency" in larger firms, reducing the "information asymmetries," were explanatory factors for the different outcomes for the various categories of firms (2013: 875). Unfortunately, they suggest that these "asymmetric information problems" tend to be the most severe in firms relying on "intangible capital" such as small start-ups (*ibid.*). Such research findings are not too assuring regarding how capital is invested in high growth potential industries and what politicians are fond of referring to as "smart innovations" (Lazonick and Mazzucato, 2013: 1094). In the present period, it is very difficult to attract venture capital funding for new drug development projects in Sweden, for instance; venture capital investors instead favour medical technologies, biomaterials, or diagnostic tools and methods development that do not demand highly uncertain and unpredictable clinical trials.

The new sites for life science innovation

Schumpeter's seminal work of entrepreneurship and innovation has brought with it a significant amount of research work in management studies that addresses the difficulties involved in producing innovations. While innovation has successfully taken place in increasingly larger multinational corporations in the interwar and post-World War II period, today the practice of innovation has shifted gears. Block and Keller examine published innovation statistics and emphasize that today, innovations are increasingly produced in small and network-based settings, frequently involving research universities, rather than in R&D laboratories and R&D departments in major corporations. "University-based science efforts are now linked to industry...[and] government agencies are playing an increasingly central role in managing and facilitating the process of technological development," Block and Keller write (2009: 463). Measured in terms of patents being filed by Standard & Poor 500 companies, there is a decline in the number of patents, "strongly

suggesting diminished innovative efforts" (ibid.: 470). Instead, the innovation field has shifted its tone, and today there is a larger proportion of R&D scientists employed in smaller units:

In 1971, 7.6% of all R&D scientists and engineers working, or 2,800 individuals were employed by firms by fewer than 10,000 employees. By 2004, this percentage had risen to 32%, while the actual number had grown to 365,000. (ibid.: 470)

Also, Mowery reports statistics that support the view that larger firms are losing their position as principal sites for innovations:

The share of industry-funded R&D investment performed by firms with 25,000 or more employees dropped from nearly 50% in 1984 to less than 40% by 2011...Small firms (500–9,999 employees), however, increased their share of R&D performance from 17% to almost 29%, and the smallest employee size class, firms with fewer than 500 employees, increased their performance share from 7% in 1984 to almost 20% by 2001. (2013: 15)

Block and Keller summarize three basic findings from their review: (1) There is a "declining centrality of the largest corporations to the innovation process in the US"; (2) there is a "growing importance of inter-organizational collaboration and small start-up firms in the innovation process"; (3) The public sector institutions have taken on an "expanded role" as both "participants in and funders of innovation processes" (2009: 475). Block and Keller thus suggest that their data "contradicts the market fundamentalist ideology that celebrates private enterprise and denigrates the public sector" (2009: 476). Much neoclassical economic theory strongly advocates market solutions over "organized" and corporate activities (O'Sullivan, 2000: 7), and many mainstream economists have favoured private initiatives over state-funded research. Block and Keller (2009) show that state-funded and state-governed organizations play a key role in propelling new innovations. In fact, life science research and the biotechnology industry, developed from the middle of the 1970s, beginning perhaps when Stanford University patented the recombinant DNA (rDNA) explored by Stanley Cohen at Stanford and Herbert Boyer at University of California at San Francisco (Mirowski and Van Horn, 2005; Smith Hughes, 2001), is a foremost example of how fruitful collaborations across the private-public boundary can lead to both economic growth and the development of new innovations

and therapies. Sunder Rajan points at some of the factors that jointly contributed to the development of the emerging life science industry in the United States in the 1970s and 1980s:

First, venture capitalists were willing to invest in a technology that had little credibility at the time as a successful business model. Second, the U.S. federal government spent an enormous amount of money on basic biomedical research through the National Institute of Health (NIH) consequent to the declaration of a war on cancer in the early 1970s. Third, the Bayh-Dole Act, a piece of legislation enacted in 1980, facilitated the transfer of technology between academe and industry in the United States, and thereby enabled rapid commercialization of basic research problems. Fourth, a supportive legal climate allowed the protection of intellectual property in biotechnology, marked, for instance, by the landmark U.S. Supreme Court ruling in *Diamond v. Chakrabarty*, in 1980, which allowed patents right on a genetically engineered microorganism that could break down crude-oil spills. (2012: 2–3)

Today, in Elizabeth Berman's enthusiastic acclaim, the universities are becoming "economic engines" on the basis of these institutional changes and new practices. However, as she also stresses, the story of the emerging biotech industry is frequently told as if it all was inevitable and that the breakthrough of rDNA was so great that it "had to be commercialized." On the contrary, she argues, "there were actually substantial barriers to making faculty entrepreneurship a new norm in the biosciences" (2012: 59). One such barrier was the scientists' initial unwillingness to abandon what Sunder Rajan speaks of as the "value system of the sciences" (2012: 6), based on what Robert Merton (1973) speaks of as its "disinterestedness" and "communism" – the idea that scientific results belong to the public and the community, and that scientists should serve mankind and not capital interests. Sunder Rajan (2012) suggests that Stanford University's patenting of rDNA was in fact a moment when this value system started to change, an event that paved the way for a commercial biotechnology industry. While Berman recognizes this shift in the value system in the community of scientists, she emphasizes the access to capital as the decisive barrier to the commercialization of the research work conducted in the universities: "The main barrier was the limited quantity of capital interested in investing in the fledgling industry, in which the path from academic invention to marketable product would clearly take years to traverse" (Berman, 2012: 59). Cultural, legal, financial, and policy changes all contributed to the commercialization of life

science research (Cooper, 2008), but the access to capital has always been a very important factor when understanding the emergence of a life science industry. As numerous studies show, the number of patents filed by universities has grown substantially since the 1960s – “The number of patents issued to universities roughly tripled between the mid-1960s and the mid-1970s,” Berman reports (2012: 95) – as the universities were encouraged to foster entrepreneurialism and to promote what has been called “entrepreneurial professors” (Lam, 2007: 1006), to the point today where various commentators and venture capital market actors believe that there are perhaps too many research findings being subject to start-up ventures. For instance, Block and Keller deplore the tendency that the ambition to commercialize is increasingly overshadowing the university’s original assignment, to conduct basic research: “Programmes designed to accelerate the commercialization of new technologies have been forced into a destructive zero sum battle with programmes that support fundamental research, and scientists in different fields have been pitted against each other to win funding” (2009: 478). In other words, the boundary between basic, academic, and primarily publically funded research has moved forward towards the domain of applied, private business venturing and commercialization. “Entrepreneurial professors” are more prone to stress their entrepreneurial function than their scholarly roles in a milieu concerned with proving the short-term economic value of basic research. Just like Berman (2012), Block and Keller (2009: 478) stress the role of venture capital and the competence needed to allocate capital investment to the most promising domains to fully exploit the potential of research findings: “If capital markets had been structured more effectively, some of that pool of excess savings could have been channeled into financing the US innovation economy in a sustainable fashion and that might also have worked to strengthen the US balance of trade.” That is, there is a need for a skilled handling of venture capital investment that on the one hand can recognize the commercial and clinical potential of basic research findings, while still being able to assess the difficulties involved in taking a research finding from the lab bench to the clinic, from the domain of academic research to the markets. The venture capital markets are supposed to serve this role, and in the next section the venture capital market literature is examined.

The growth of intellectual property rights and patenting

One heavily debated issue pertaining to the financialization of the economy is what has been referred to as the “propertisation” of

intellectual resources. Such propertisation includes all kinds of legal contracts including intellectual property rights (IPRs), patents, and licenses that serve to specify rights to value extraction from underlying resources (Boldrin and Levine, 2004, 2008; Sell, 2003). Mowery speaks of the period 1985–2005 as the “pro-patent era” in the United States: “For much of the 1943–1980 period, federal juridical and antitrust enforcement philosophies were relatively hostile to patentable rights. All this changed significantly during the 1980s, inaugurating what has come to be called the ‘pro-patent era’ in the US IP policy” (2013: 32). Researchers critical of what they refer to as the “over-propertisation of intellectual properties,” point at the two negative effects of such legal rights. First, it affects the global division of labour, diminishing the investment opportunities in countries characterized by lower IP intensity and therefore by a higher cost of investment” (Pagano and Rossi, 2009: 666). For instance, in 1993 only ten countries “accounted for “84 percent of worldwide research and development expenditure and collected more than 90 percent of the cross-border license fees” (Zeller, 2008: 109), figures that signal the dominance of IPR-rich countries and regions. “Companies in the capitalist metropolises received 97 percent of the license payments in 2001. This corresponds to 71 billion USD every year,” Zeller adds (*ibid.*). Second, due to the “negative effects of over-propertisation on the productive utilization of intellectual resources” (Pagano and Rossi, 2009: 666), there are fewer investment opportunities, even in the most IPR-intense countries such as the United States. In Pagano and Rossi’s view, “intellectual monopolies” granted by over-propertisation leads to “investment blockage”: “On one side, the global intellectual property regime has been strengthened and extended. On the other side, research and innovation policies have more or less intentionally decreased the role played by open science in modern economies” (*ibid.*: 670). “There is ample evidence showing that foreign direct investment has been influenced by the strength of IP protection,” they contend (*ibid.*: 673).

Boldrin and Levine question the assumption in intellectual property right legislation that there is “a near-zero marginal cost of reproducing and distributing” new ideas (2004: 329), and its corollary: that unless such ideas are protected by legal rights, there would be no output of new ideas or innovations. For instance, Boldrin and Levine point at the “huge literature” on technology transfer as being indicative of the costs included in sharing know-how (*ibid.*: 333). Historically, for instance in the seminal writings of Schumpeter, intellectual monopolies were treated as “a necessary evil.” Today, however, IPRs are treated as a vehicle

for the innovation economy, the creation of the new on basis of legislation that prevents the sharing and distribution of new ideas. Apparently, the distinction between value creation and value extraction has been blurred and confused.

As the percentage of intangible assets in the Standard & Poor's 500 firms has grown remarkably – from 16.8% in 1975 to 32.4% in 1985, to 68.4% 10 years later, and at the level of 79.7% by 2005 (Pagano and Rossi, 2009) – there is naturally a great deal of interest in a propertisation of such assets. There are two major consequences for patenting policy. First, patentability has been extended to encompass previously excluded technological domains, including software, business methods, and biological inventions (*ibid.*: 670). In some cases, as in the life sciences, it is very complicated to apply the original engineering-based terminology to include also sophisticated biological pathways and mechanisms (Calvert, 2007, 2008; Bonaccorsi, Calvert and Joly, 2011). In this new policy, therapies are patented as if they were engineered mechanical devices, leading to a demarcation problem regarding where the patent rights begin and end. Calvert (2008: 392) examines the field of synthetic biology and remarks that patent law was developed in the context of industrial manufacturing. This legislation forces biology into the “mould of engineering” and expects life science researchers to enact biology as what is constituted by “discrete and substitutable parts” (see, e.g., M'Charek, 2005; Hilgartner, 2005; Parry, 2004). One of the salient effects from the shaping of biological systems into “the form necessary for them to be exchanged in the market economy,” Calvert says (2008: 394), is that we have to change our “understanding of what ‘life’ is in the process.” That is, life is performatively enacted as what lends itself to the various techno-scientific procedures that are developed to explore biological systems, the totality of the “biotechnology, biodiversity, bioprospecting, biosecurity, biotransfer, and molecularized biopolitics” – some (e.g., Braidotti, 2008) would here add the term biopiracy, “the unauthorized and uncompensated expropriation of genetic resources and traditional knowledge” (Sell, 2003: 140) – that constitute the life sciences (Helmreich, 2011: 671–672; see also Cooper, 2008). In short, Helmreich proposes, “‘life’ becomes a trace of the scientific and cultural practices that have asked after it, a shadow of the biological and social theories meant to capture it” (2011: 674).

Second, patenting standards have been “considerably relaxed,” according to Pagano and Rossi (2009: 670), leading to unclear distinctions between, for example, pure information and practically applicable knowledge. These changes has led to what Pagano and Rossi refer to

as the “upstreaming of patentability,” the tendency of IPRs to protect knowledge that are closer to “abstract ideas” rather than practically and clinically applicable know-how. Finally, in the United States, the enforcement of IPR legislation has been strengthened. The immediate effect is the sharp growth in patenting:

The last two decades saw a vast increase in patents. The United States Patent and Trademark Office (USPTO) granted 76,748 patents in 1985, 107,124 in 1991, and 221,437 in 2002. A similar development happened in Europe. There were 42,957 applicants for patents in 1985, 60,148 in 1991 and 110,640 in 2002 at the European Patent Office (EPO)...From 1990 to 2000, the number of patents granted in biotechnology rose 15 percent a year at the USPTO and 10.5 percent at the EPO. (Zeller, 2008: 93–94)

“Between 1967 and 1984, US patent applications grew by roughly 0.3% per year; after 1984, the rate of growth increased to nearly 7% per annum,” Mowery adds (2013: 32), pointing at the growth of patenting in computing and electronics industries as the principal explanation for this intense patenting activity. In Zeller’s view, the principal driver for the “explosive expansion of intellectual property monopolies” is not so much the result of actual “technological breakthrough” (2008: 94). Instead, the far-reaching economic and institutional changes are related to the growing dominance of the finance industry in overseeing and regulating science-based industries (see e.g., Andersson et al., 2010): “Under the pressure by financial investors, biotech companies strive to multiply their intellectual property titles. Property monopolies can contribute to boosting the price at an *initial public offering* (IPO) or a trade of the entire company” (ibid.: 104–105, emphasis in the original). At the same time as private interests and property rights play a central role in this new regime of rent-seeking on basis of scientific know-how and expertise, most national innovation systems in developed, democratic countries rely on public R&D expenditure effectuated by governments and their educational systems, which is not directly profitable in a short-term perspective (ibid.: 101–102). In addition, the universities are today advancing themselves as enterprising and rent-seeking actors that no longer are willing to share the fruits of their labour with private actors without compensation. Between 1963 and 1999, American universities increased their share from 0.3% to 4% of all patents (Mowery, 2013: 37), and in the field of life science, studies show that licensing fees paid by private industry increasingly finance universities’ basic life science

research: “Biomedical patents accounted for more than 66–85% of the gross licensing revenues of [American] academic institutions for much of the 1980s and 1990s” (ibid.: 39). The new patenting regime and the rent-seeking role of the universities in the economy create new challenges, and today, private industry representatives are concerned about the new relations between universities and industry. “Largely as a result of the lack of federal funding for research, American Universities have become extremely aggressive in their attempts to raise funding from large companies,” Dr Stanley Williams, a Hewlett Packard representative, testified in a hearing of the US Senate Commerce Committee’s Subcommittee on Science, Technology, and Space, on 2 April 2005 (cited in Mowery, 2013: 37).

In summary, the role of IPRs remains debated as there is a great paradox built into the legislation that assumes that individual legal right holders can claim the value generated on basis of the collective efforts to produce new knowledge and new ideas. In the era of increased specialization and a sharply growing mass of knowledge to cognitively and practically integrate and apprehend, knowledge production is, practically speaking, demanding a communal view, a shared commitment, and a willingness to share know-how and expertise, but intellectual monopolies erected by the IPR legislation counteract such joint engagement, critics contend. “The regime of intellectual property monopolies in the context of finance-dominated accumulation regime impedes potentials for innovation and favours an enormous squandering of human and material resources,” Zeller argues (2008: 106). Pagano and Rossi speak of “the tragedy of the anticommons” (2009: 673). Sell, who endorses IP rights “in principle” and believes they are both necessary and important, still maintains that “the balance between private rights and public access has shifted too far in favour of private rights at the expense of the public weal” (2003: 28). Under all conditions, the rise of the new and both stricter (in terms of its enforcement) and more liberal intellectual property rights legislation (in terms of the expansion of “patentability”) is co-evolutionary with the financialization of the economy caused by the liberalization of the finance market control and international agreements regarding the transfer of capital between countries and regions. Somewhat paradoxically – or perhaps better, riddled by Mertonian unintended consequences – IPR legislation, which was originally conceived of as protecting new ideas and new knowledge from free-rider exploitation (see Olson, 1965) to let a thousand flowers bloom, instead leads to increased barriers and impediments towards the full exploration of the know-how produced on basis of initial public investment; private

interests and private value extraction from public investment thus overrules all other social interests and benefits. For policymakers and legislators, it is of central importance to carefully and wisely balance the incentives for private investment in ventures with the interests of other constituencies and other objectives. For the time being, it may be that it is time to roll back IPR legislation to lower the barriers for collaborative efforts.

Venture capital investment

The role of venture capital in economic systems

Venture capital is either private or public capital investment in early-stage ventures – that is, capital that serves to support the entrepreneurial function and the development of innovations. The term *venture capital* was first used in public in a *Wall Street Journal* editorial on 13 January 1938, and was already being used at DuPont (Kenney, 2011: 1686). Kortum and Lerner define venture capital accordingly: “Equity or equity-linked investment in young, privately held companies, where the investor is a financial intermediary who is typically active as a director, an advisor or even a manager of the firm” (2000: 676). Hopkins et al. provide the following definition:

VC is “the process of external equity finance by professional investors in a new or young (i.e., early stage) company to create new assets for the primary purpose of reaping substantial economic gains through a market flotation [initial public offering (IPO)] or trade sale.” (BCVA-NESTA, cited in Hopkins et al., 2013: 907)

As numerous studies have emphasized, the access to venture capital grew remarkably in the first half of the 1980s in the United States: “In 1984, in excess of \$4.5 billion of new capital was committed to the industry, an amount of over six times greater than the amount committed in 1980,” Gorman and Sahlman report (1989: 231). Deli and Santhanakrishnan add that the venture capital market in the United States grown from (in constant 2005 dollars) \$740 million in 1980 to its peak of \$118 billion in 2000 (2010: 558). “Funds flowing into the venture capital industry increased dramatically during the late 1970s and early 1980s,” Kortum and Lerner write (2000: 676). Despite this growth in venture capital investment, sceptical commentators such as Leyshon and Thrift suggest that venture capital has been “the object of almost obsessive attention” among both scholars and policymakers (2007: 102). In fact, Leyshon

and Thrift propose, regardless of this “massive amounts of attention,” venture capital remains a “small concern” in most countries and economies (ibid.: 101). Regardless of such criticism, in life science venturing, venture capital still plays a key role in translating basic research findings into new therapies and medical technologies.

Gompers and Lerner account for some of the structural changes in industry during the 1990s, paving the way for a professional venture capital market:

Established mainline corporations that had relied on central R&D laboratories for new product ideas during most of the century were exploring alternatives, including joint ventures, acquisitions, and university-based collaborations. Managers and academics alike had realized that management difficulties led to corporations extracting only a small amount of the value from centralized R&D facilities. Many of the best ideas languished unused or were commercialized in new firms founded by defecting employees. A number of fast-growing technology firms such as Cisco Systems, which relied on acquisitions rather than internal R&D for the bulk of their new ideas, make it apparent that outside venture capital might be a practical alternative – even a superior alternative – to an internal, centralized R&D process. (2001: 150)

In addition, the willingness to invest in high-risk venturing is related to both the sheer supply of capital in an economy and the emergence of intellectual property rights that can protect the investors’ claims on the residual cash flow. “Venture capital is associated with a substantial increase in patenting,” Kortum and Lerner notice (2000: 674). It is no trivial matter to determine the causal relations between venture capital and patenting as they are essentially co-produced, bound up with individual firm’s patenting strategies (Danguy, de Rassenfosse, and van Pottelsberghe de la Potterie, 2014). It is, however, plausible that the supply of venture capital served to further hasten academic researchers’ patenting activities. “Patenting declined from the early 1970s to the mid-1980s, and then rose sharply,” Kortum and Lerner write (2000: 678), indicating that patenting was an effect of the inflow of venture capital. Kogut, Urso, and Walker (2007: 1197) represent a more sceptical view of the causality venture capital-patenting activity but remark that their research findings are consistent with Kortum and Lerner’s finding that venture capital investment “promotes innovation” (2000) (see section below).

Most research on venture capital is based on the premises that the access to venture capital is indicative of the healthiness of the economy, that there is an appetite for risk-taking, and that stable legal and political relations are in place, which in turn may encourage further innovations. Kortum and Lerner argue that venture funding has a “strong positive impact on innovation,” and that “a dollar of venture capital appears to be about three times more potent in stimulating patenting than a dollar of traditional R&D” (2000: 675). The argument that venture capital would be allegedly “more effective” than traditional R&D spending is, however, problematic, as it really commensurate different types of capital investment with different objectives. Rather than pit venture capital against basic R&D investment, these two complementary sources of investment serve the economic system at different stages. “An expanded supply of venture capital raises employment and aggregate income in a region,” Samila and Sorenson conclude in their study (2011: 347), echoing Kortum and Lerner’s affirmative view of venture capital. The question of whether venture capital is the cause or the effect of a vital economic system can be disputed – the effects seems more plausible given the risk involved in at least life science venture capital investment – but venture capital plays a central role in commercializing basic academic research. As suggested by Block and Keller (2009), for example, “upstream” public investment in basic research work in the life sciences and “downstream” private venture capital investment are essentially complementary forms of capital supply. The two sources of capital serve to both explore and exploit life science research work.

A quite substantial literature examines whether venture capital firms “make a difference” not only on the level of the aggregated economy but also on the firm level. Sapienza (1992) reviews the literature and finds quite strong evidence of venture capital firms contributing to their partner firms, not least in terms of broadening the contact network for start-up firms. His own data also supports the thesis that venture capital firms add value to the companies they invest in. Daily et al. (2002: 400) suggest that formally speaking, venture capital firms serve the role as a financial intermediary in markets where lenders and borrowers can only get together at a certain cost. These costs derive from various information imbalances and moral hazard problems, and venture capital firms have the capacity to lower these transaction costs. Such a formal view of venture capital firms, stressing the role of information shortage and various agency costs, unfortunately ignores the practical, hands-on accomplishments of venture capital firms. Steier and Greenwood’s empirical study of a start-up firm points at the venture capital firms’ role

as inviting the start-up into a community that in various ways provides the entrepreneurs with support, information, and know-how:

Venture capitalists provide access to important networks which the start-up entrepreneurs would otherwise find difficult, if not impossible, to penetrate. Access to these networks significantly increases the possibility of successful development because they provide information, resources, and market outlets. These “weak ties” ... are invaluable to the entrepreneurial firm. (1995: 348)

Contrary to the view of Daily et al. (2002), which emphasizes a calculative and financial understanding of the venture capital firm as what is capable of reducing costs and/or overcoming information imbalances, Steier and Greenwood underline qualitative analysis and judgment as pivotal venture capital investor skills: “It is tempting to believe that venture financing is the product of informed judgment based upon reasoned analysis. In fact, the particular case examined here indicates that the process of funding is neither fully reasoned nor divorced from wider context” (ibid.). Like Mazzucato (2013), Steier and Greenwood stress the inherent uncertainty in all entrepreneurial and innovative activities and the more behavioural and practical role of venture capital investors in supporting entrepreneurs:

One of the underestimated requirements of the entrepreneur is constant reinforcement of his/her ability to succeed. The early stages of the new venture are fraught with frustrations, hold-ups and setbacks. In many ways, supportive venture capitalists can provide emotional as well as business support which independent entrepreneurs require. (ibid.: 352)

In many cases, the entrepreneur has embarked on his or her first journey towards a successful innovation project, while for the venture capital investor, this is a run-of-the-mill, everyday procedure occurring in a number of adjacent companies that are financed by the venture capital firm. Venture capital firms have thus accumulated significant enterprising know-how and maintain extensive contact networks that benefit their partner companies.

Venture capital firm practices

Venture capital investment demands a very stable and predictable environment to effectively serve its role to promote enterprising activities

and innovation. In fact, as Samila and Sorenson suggest, innovation require an “entire ecosystem to support it,” a system wherein government, educational institutions, and industry play “complementary roles” (2010: 1349). In Gorman and Sahlman’s study, reported in the late 1980s, when venture capital investment was a relatively immature subset of the finance industry, venture capital investment was portrayed as a “a non-hierarchically organized profession,” wherein most of the actors had “less than six years’ experience” (1989: 231). The combination with inexperienced investors and the technology and market risks involved in all entrepreneurial activities make venture capital investment a risky business. Despite receiving venture capital investment, Gorman and Sahlman say that “venture-backed companies have extremely limited resources, so unexpected snags can quickly exhaust available resources of cash and people” (*ibid.*: 238).

In such a milieu, the role of the top management team cannot be underrated. “Start-ups come in three parts: ideas, financing, and people. The forces that shape the pace and intensity of business activity include the nature and speed of innovation, stock of human capital, and structure and incentives of capital markets,” Ahn and Meeks argue (2009: 29). As a consequence, before investing, “venture capitalists must not only assess the quality of an idea but also if the team of people pursuing it” (Samila and Sorenson, 2010: 1351). In their study, Gorman and Sahlman found that venture capitalists tended to attribute failures to the “shortcomings in senior management” (1989: 238). In a sample of 96 “troubled companies,” venture capital investors claimed in 91 cases that senior management was a “contributing factor,” and in 62 cases (approximately 65% of the cases), management was regarded as “the most important contributing factor” (*ibid.*: 238–239). At the same time, as Sapienza and Gupta (1994) demonstrate, in cases where there are agency risks and “task uncertainty” – and that is always the case in life science innovation – the contacts between venture capital investors and the CEO are tighter. Such more closely knit relations between venture capital investors and CEOs reduce the risk of failure.

Chen, Yao and Kotha suggest that entrepreneurs need to demonstrate “passion” and commitment to their venture in order to convince venture capitalist investors to contribute their money, time, and effort. Passion is, they argue, a “strong indicator” of the entrepreneur’s motivation, his or her proclivity to handle and overcome difficulties, and his or her ability to “influence, persuade, and lead people” working in the venture (2009: 199–200). Chen, Yao and Kotha refer to three important factors that trigger the investors’ “gut feelings”: “(1) The

personality and background of the entrepreneurs proposing a venture; (2) the characteristics of the management team; and (3) the ‘interpersonal chemistry’ between the entrepreneurs and the VCs” (ibid.: 200). All these three factors include elements of “entrepreneurial passion,” defined as “an entrepreneur’s intense affective state accompanied by cognitive and behavioral manifestations of high personal value” (ibid.: 201). This operationalization includes one “affective aspect,” passion, and one “cognitive aspect,” preparedness, that can, Chen, Yao and Kotha assert, be assessed as separate components. “Passion is expressed through facial expressions, bodily movement tone of voice, and other nonverbal cues, whereas preparedness is manifested in the verbal content and substance of a presentation,” Chen, Yao and Kotha explain (ibid.: 209). Reporting experimental data including 126 MBA students at an American university – a study design that arguably has lower validity than a study of actual venture capital investment decisions – Chen, Yao and Kotha suggest that the ability to give a passionate and prepared impression helped raising venture capital (see also Flynn and Staw, 2003).

Regardless of all precautions taken by venture capital investors, the failure rate is, by definition and by historical record, high in venture capital investment: “The average fund writes off 75.3% of its investments. This implies that VC funds earn their capital gains from a small subset of their portfolio companies, namely those that exist via an IPO or a sale to another company (M&A)” (Hochberg, Ljungqvist and Lu, 2007: 262). In order to reduce the risks and to anticipate certain challenges and difficulties, venture capital firms have developed elaborate investment procedures where the investment proposal is examined in detail and from various angles, often involving commentaries from external experts and advisors. Zacharakis and Shepherd examine what they refer to as the *pre-investment process*, and identify five distinct phases: (1) *deal origination*, (2) *deal screening*, (3) *deal evaluation*, (4) *deal structuring*, and (5) *post-investment* (2007: 177). The entire pre-investment process is explained in the following terms:

Preinvestment activities refer to all venture capital tasks up to the and including the signing of an investment contract: soliciting new venture proposals for submission to the venture capital firm, determining whether these proposals meet the firm’s broad screening criteria, conducting due diligence (more extensive research to determine the likely success of the venture), and then negotiating and structuring a relationship with the entrepreneur. (ibid.)

Time constraints prevent venture capital investors from studying each proposal in too much detail, but they do “make initial screening decisions” that are based upon “sparse information and necessarily rely on shortcuts, or heuristics, to increase the speed of decision making, according to Kirsch, Goldfarb, and Gera (2009: 487). Their study found that the business planning documents that the entrepreneurs are expected to present to venture capital investors do not, in fact, play a decisive role for the venture capital investors; they search for valid information elsewhere and through their own channels and networks, and consequently, perhaps to the chagrin of incubator advisors and entrepreneurship training experts who commonly emphasize such documentation, the business planning documents “may serve a limited ceremonial role” (ibid.: 488):

The true skill of the venture capitalist is his or her ability to look past the presentation of the plan and other strategic actions intended to outwit the investors’ assessment process. If each venture capitalist uses only idiosyncratic criteria to evaluate potential targets, any parsimonious theory will necessarily be wrong. (ibid.)

The business planning documents may help the entrepreneurs to co-align their interests and ambitions, or help this community narrate a story that engages various stakeholders, but seasoned venture capital investors are likely to assess the commercial potential of the underlying idea independently of such documents. That is, venture capital investors are likely to find the “unflattering qualities of the ventures” that are not put on display in the formal documents, or not even fully known by the entrepreneurs themselves (ibid.: 490).

In addition to the mere capital supply needed to keep the enterprise going, venture capital investors take on a broader role (discussed in more detail as corporate governance in the next chapter) to secure their interests – that is, to help and support the enterprise in various ways. Venture capital investors help to connect entrepreneurs with “business-minded individuals” and “advise the companies in which they invest” (Samila and Sorenson, 2010: 1350). Moreover, venture capital investors “provide legal, financial, and strategic advice, and help to connect entrepreneurs to talent, buyers and suppliers,” and in many cases they even “connect entrepreneurs in whom they choose not to invest.” That is, venture capital investors serve to introduce and integrate the entrepreneurs in an economic ecosystem and into a larger community that in various ways both can help and support the entrepreneur and to inspire

further work. Studies of the San Francisco Bay Area's Silicon Valley (Shih, 2006; Ferrary and Granovetter, 2009; Barley and Kunda; 2004; Ferrary, 2003; Saxenian, 1994) for example, have frequently emphasized the fertile ecosystem including not only savvy IT folks but also legal counsellors, lawyers, venture capitalist, and distributors who all actively participate in the Northern California information technology cluster. In other words, receiving venture capital investment from a skilled and experienced venture capital firm is not only a matter of receiving the vital supply of capital – the lifeblood of competitive capitalism – but also becoming a protégé of a venture capital firm or, more likely, a syndicate of venture capital firms, eager to secure rents from its investment. Capital is always more than just the capital *qua* money; it is what upholds, reproduces, maintains, and further develops an entire economic and social ecosystem.

Syndicated investment

Venture capital investors and entrepreneurs enter partnerships that are not operating in a very comfortable and calm domain but are characterized by several major challenges, and therefore it is important that venture capital investors trust the entrepreneurs on whom they bestow their capital. Consequently, Hochberg, Ljungqvist and Lu (2007: 252) found that many venture capital firms “show a preference for networks rather than arm’s length, spot-market transactions”; that is, they want to work closely with the companies, their top management team and the board of directors they invest in, and they also prefer to syndicate their investment with other competent venture capital firms to spread the risks. One specific feature of the venture capital market is therefore that it is, unlike most other markets, collaborative at its heart. Venture capital firms investors in most cases syndicate their investment with one or more other professional venture firms to spread the risks and to take advantage of extended contact networks to recruit qualified individuals to key positions in the firm and to the board (Ferrary, 2010; Kogut, Urso and Walker, 2007; Wright and Lockett, 2003). Kogut, Urso and Walker even define the venture capital market as a “chain of investors and brokers who often do not know the start and the end of the chain, but who surely know their adjacent links” (2007: 1181). This image of the venture capital market strongly stresses its network characteristics and the ability of venture capital investors to engage in joint investment projects at a relatively low cost. The principal mechanism for lowering the costs in syndicated investment is thus the mutual trust between the investors. “Syndicates are a mechanism by which individual

VC firms can overcome their human capital constraints,” Deli and Santhanakrishnan propose (2010: 558). Say Gompers and Lerner,

A venture capitalist who originates a deal will often look to bring in other venture capital firms. This syndication serves multiple purposes. By syndicating investments, each venture capital firm can invest in more projects and largely diversify away firm-specific risk. Involving other venture firms also provides as a second (and third and fourth opinion on the investment opportunity), which limits the danger that bad deals will get funded. (2001: 156)

Sorenson and Stuart suggest that “the likelihood that a venture capitalist invests in new venture (‘target’) declines sharply with the distance between venture capitalists and target” (2001: 1547) by the joint investment. As a consequence, venture capital firms not only supply capital to life science ventures but also help to locate the firm within a complex network of contacts and exchanges that benefits the venture and increases its chances of surviving, for example, the development stage: “VC firms bundle human capital with financial capital when making an investment” (Deli and Santhanakrishnan, 2010: 560). In serving this “double role” as capital supplier and knowledge broker, venture capital firms, Sorenson and Stuart write, “have been critical catalysts in the development of many new high-technology industries” (2001: 1549). More specifically, venture capital investors need to tackle two key issues: “First, venture capitalists must acquire information about the existence and characteristics of investment opportunities. Second, they must assess the quality of these opportunities” (ibid.: 1550).

Deli and Santhanakrishnan formalize this line of reasoning to the hypotheses that (1) “Syndicates arise when the required human capital and financial capital investments would be too costly for any one VC firm to supply,” and (2) syndicates arise when “there is greater uncertainty about firm value” (2010: 560). Deli and Santhanakrishnan refer to the former hypothesis as the *constrained capital hypothesis* and the latter as the *certification hypothesis*. Based on a quantitative study of venture capital investment, Deli and Santhanakrishnan provide evidence supporting the two hypotheses and demonstrate that syndication is “most likely for investment in firms at the earliest state of development and for firms at the last stage of development” (ibid.: 558). In the early stages, there is a great need for human capital investment, and in the latter stage, there is an uncertainty about firm value, two conditions favouring syndicated venture capital investment.

When private venture capital is not available: the role junior stock markets

For companies that fail to attract venture capital from private venture capital firms, there is today one opportunity left: to list the company on one of the “junior” or “new” stock markets that have been created in many European countries to promote a vital venture capital market (Revest and Sapio, 2012). As Deeg remarks, for instance, after the peak in the 1998–2000 period, there was a dramatic drop in IPOs, and not until 2005 the level of IPOs were back at the late 1990’s levels (2009: 565). Such data indicate a general withdrawal of venture capital after the Internet bubble at the turn of the millennium. Studies of junior stock markets demonstrate varying results, but there are generally negative outcomes (Carpentier, L’Her and Suret, 2010: 403). In addition, as individual, local markets represent idiosyncratic institutional, financial and cultural conditions, different countries have “little to learn from each other” (Revest and Sapio, 2012: 199). That is, one successful market for start-up firms may be complicated to replicate elsewhere on the basis of the same principles. Audretsch and Elston studied the *Neuer Markt*, the German junior stock market, and found that firms listed on there grow faster than companies listed in regular stock exchanges, but noticed that “nearly a third of the *Neuer Markt* firms have been voluntarily or non-voluntarily de-listed” (2006: 21). “This 30% failure rate, while not unusual for firms in emerging technology sectors,” Audretsch and Elston write, “has prompted concerns in Germany that new equity markets may not be the best solution for creating new firm growth and innovation” (ibid.: 21).

In contrast, Carpentier, L’Her and Suret’s study of the Canadian junior market TSXV reveals that the time to success is longer in the public venture market, but that in the conventional private VC market, the “success rate” of the TSXV is “four times the estimated rate for traditional VCs”:

During the June 1995–June 2005 period, the VC industry reported a dismal net annual return of -3%, while the new listings index of the public VC market posted an 11.96% annual return. Moreover, screening rules applied at the initial listing time would have allowed such an investor to earn an average annual return of 24.45%. (2010: 404)

Revest and Sapio’s 2013 study of the UK Alternative Investment Market (AIM) is less assuring regarding the effectiveness of junior stock markets. Revest and Sapio say that AIM, created in 1995, boasts “impressive

growth in capitalization" (954). The analysis of AIM-listed companies shows that firms grow in terms of the number of employees but that such organic growth is not accompanied by a comparable growth in financial performance: "AIM has selected companies with higher-than-average growth in operating revenues and assets, and has nurtured the growth of employees of its listed companies; but such growth has not translated into superior value added growth, causing AIM-listed companies to underperform in productivity terms" (ibid.: 955). In comparison to companies listed on the London Stock Exchange (LSE), AIM companies are "less likely to make acquisitions, they produce lower dividends, and they are more likely to be cancelled after an IPO," Revest and Sapio write (ibid.: 958).

Gleadle and Haslam's 2010 study of a medical diagnostics company, Medco, demonstrates some of the challenges for companies listed in junior markets such as AIM. In Medco, managers constantly constructed compelling narratives about how R&D investment translates into financial output: that is, short-term financial objectives were always prioritized. In addition, managers and directors with the competence to convince the shareholders that they pursued adequate strategies demanded economic compensations that led to significant costs for Medco and similar AIM-listed companies: "Directors' fees and bonuses for this group accounted for one third of losses [of bio-pharma start-up firms] again suggesting that in small to medium start-up companies the emoluments and bonuses of directors constitute a substantial financial commitment out of profit and loss" (62). By and large, Medco became part of a financialised market, wherein short-term financial performance was always placed in the first room. In Gleadle and Haslam's account, whether junior markets are in fact capable of enabling economic growth in small and medium-sized companies is questionable, especially when they demand additional and long-term investment in R&D.

As Revest and Sapio argue, "unbridled trust in the ability of stock markets to stimulate real performance is hard to reconcile with the effects of financialization" (2013: 954). Revest and Sapio address the same concern and speak directly to policymakers:

Policy-makers should compare the actual impact of such markets on the real economy with the (public) costs their creation involves. If we accept the idea of a proactive state in the field of entrepreneurship and innovation, supporting measures should be effective and directed not only toward the most promising companies...but also

towards the institutions that, unlike the AIM, are better suited to enhance the real performance of SMEs. (2013: 969)

In summary, junior markets represent one attempt to create dynamic venture capital markets, but with the exception of the Canadian TSXV stock exchange, there are few examples of highly efficient public venture capital markets. “The European stock exchanges dedicated to high-tech companies have failed to deliver support to technology-based small firms,” Revest and Sapio conclude in their analysis of the performance of four major European junior stock exchanges (AIM, Neuer Markt, The Nouveau Marché in France, and Nuovo Mercato in Italy) (2012: 194, original emphasis omitted). Taken together, private venture capital investment structured around a syndicate of a limited number of highly skilled venture capital firms appear to perform more favourably than operating in a public venture capital market.

Post-investment practices

After the venture capital investment is finished, a new phase, what De Clercq and Manigart (2007) names the “venture capital post-investment process” starts. Many of these activities are covered in the next chapter by what is addressed as corporate governance activities, to actively establish a management function in the firm including the recruitment of a CEO and to recruit a board of directors monitoring the management team’s activities to secure the investors interests. In addition, the venture capital investors must determine the strategy for how to secure an economic value of the venture by the end of the investment period, commonly ten years. As Daily et al. show, firm performance could be defined in many ways, and economic value could be acquired through various strategies. Daily et al. speak of at least four different measures of financial performance, including (1) accounting and market-based measures of financial performance, (2) “the performance of the firm at the initial public offering (IPO),” (3) the growth of the firm in terms of market share, turnover, or number of employees, and (4) the “survival of the firm” (2002: 389–390). The concern is that these different measures of firm performance may be opposing goals (e.g., the growth of the firm versus financial performance).

Given how venture capital investors believe the firm acquires a market value and an economic value, they make the decision on what strategy to pursue through the board of directors, on which each investor partner commonly holds a seat. “Venture capitalists can significantly impact firm performance,” Daily et al. say (*ibid.*: 391). For

instance, in life science ventures, having massive initial costs to provide adequate clinical data and costs for market and sales to introduce new therapies while thereafter acquiring substantial economic value if and when a therapy is widely used in health care organizations, it is rarely the financial performance that determines the economic value of the venture. Instead, market share or the recognition of the therapy in clinical community with normative or decision making authority are better predictors for the economic value of the new therapy and the firm that controls the intellectual property rights. In other words, after the investment period, a life science firm may employ few people and report modest economic performance, but if it holds the intellectual property rights to a clinically verified new therapy that has been positively reviewed and recognized by leading practitioners, the venture may have a significant economic value. That is, venture capital firm strategies are based on the *discounted economic value* of the new therapy and the returns the new therapy can generate for a future owner. Life science venture capital investment is thus ultimately based on expectations, a key feature of the contemporary economy (Beckert, 2013; Borup et al., 2006; Brown and Michael, 2003), and not the least in technology-based innovation (Rosenberg, 1976; Selin, 2007) and in life science (Hedgecoe, 2010; Hedgecoe and Martin, 2003). By and large, life science ventures acquire an economic value and a market value not so much through organic growth or by reporting sound financial performance but through pointing at the potential future income from a particular new therapy. The board of directors must still determine how to be able to demonstrate the economic value and the biovalue of the new therapy within the stipulated ten years investment horizon. In many cases, such strategies focus some form of clinical verification and recognition of the therapy.

The access to venture capital in life science venturing

It is important to recognize that venture capital investment in the life sciences differs from venture capital investment in, for example, technology-based industries. While, for example, information technology ventures include technology risks and market risks: that is, according to Knight (1921), calculable risk that can be assessed and handled in various ways, in the life sciences, there is in addition significant uncertainty – “non-calculable risk” – which derives from the limited understanding of the immense complexities of the (primarily human) biological system being explored. When developing a new drug, for example, it is complicated to estimate the efficacy or the safety of the drug in pre-clinical

models, mostly based on in vitro models such as cell lines, yeast cells, or in vivo models based on animals models, and in many cases there is a need for quite costly clinical trials, at times separated into three distinct phases, before the new compound can be supported by adequate data. If there are unforeseen so-called adverse events, including injuries or even deaths of patients, the compound prove to be unsafe, practically speaking, overnight. In many cases, when therapies prove to be both safe and effective, they may still provide too little additional therapeutic value for the patient, and consequently regulatory authorities may not approve it. Only after clinical trials have been conducted can the biovalue of the new compound – the active molecule in the new candidate drug – be fully assessed. The upside of this most difficult venture is that if the new drug is being successfully launched in the market, the economic return can be astronomical. The one percent or so of all candidate drugs that makes it to the market are thus capable of paying for *all other* failed projects. Ahn and Meeks present some useful statistics regarding the innovation rate in the pharmaceutical industry: “[Since 1982] the biopharmaceutical industry has had 254 drugs approved for 385 indications with over \$70bn in sales in 2006. In addition, more than 300 drugs are currently in clinical development targeting more than 200 diseases” (2009: 21).

“The average drug takes over \$1.0bn and 12 years to go from laboratory to approval,” Ahn and Meeks add (*ibid.*). In addition, all candidate drugs that make it to the clinical trials – still being quite far away from a registered drug – amount to a mere 11 percent. This failure rate also effectively translates into the overall financial performance of the industry, which is not too assuring when the major pharmaceutical companies are excluded from the calculation: “Out of nearly 350 publically traded biopharmaceutical companies, fewer than 10 reached sustainable profitability,” Ahn and Meeks report (*ibid.*: 22).

Regardless of such daunting figures, this dream of “making it big time” in combination with therapeutic needs and scientific curiosity are what fuels entrepreneurship and venture capital investment in the life sciences. As a consequence, in most venture capital funds, life science investments are located in the “risky” domains of the entire stock invested. Hochberg, Ljungqvist and Lu (2007: 261) found that of all the funds studied in the United States, 9.2% specialized in “medical, health, life sciences,” while 6% specialized in biotechnology. In addition, out of 16,315 companies in a Venture Economics Database, 10,9% were in “medical, health, life sciences,” while 4,9% were in biotechnology (Hochberg, Ljungqvist and Lu, 2007: 263). In other words, out of the

total stock of venture capital, between 10 and 15 percent are committed to life science ventures and commercialization.

Like so many other commentators on the life science research field, Ahn and Meeks stress that the strong emphasis on academic entrepreneurship in combination with “Big Science” programs such as the human genome project (HUGO) has resulted in a “large numbers of small, undercapitalized start-ups focused on discovery of novel drug targets but lacking resources needed to convert these targets into drug candidates and to validate them in the clinic” (2009: 23). In both the literature and among venture capital investors, this strong growth in the supply of companies that are derived from academic research work and that are not yet ready to introduce new therapies on the market is deplorable, as it creates a body of “zombie companies” in the industry, “the living dead” – “venture-backed companies that have failed to meet expectations but that nonetheless squeeze out a stable, independent existence” (Gorman and Sahlman, 1989: 231). These companies consume both research skills and human resources, and should preferably be either divested or return to the academic settings from which they once originated. These unsuccessful and failed companies, once based on intriguing academic research findings and encouragement from incubator advisors and others, have gradually lost their momentum but disillusioned entrepreneurs are not yet willing to kill their darlings as they have been assured at an earlier stage that their ideas are promising. These companies have entered what has been referred to as “the valley of death” and have failed to cross this barren land. In many cases, such zombie companies are not only emerging on the basis of premature academic research findings, or inadequate findings that eventually prove to have limited therapeutic or clinical value, but also because inexperienced or incompetent venture capital investors make estimations of the yield to be discounted from their life science investment that are too positive. “Returns on venture capital funds declined in the mid-1980s, apparently because of overinvestment in various industries and the entry of inexperienced venture capitalists,” Gompers and Lerner write (2001: 149), implying that the venture capital investment side of the equation also needs to carry some of the guilt for such failures.

Another explanatory factor can be the sheer mass of capital investment in life science research over the last four decades. “Life sciences now account for more than 60% of all academic R&D expenditure [in the United States],” Cockburn and Stern report (2010: 3). The vast majority of this support for academic R&D comes from the budgets of the public agencies such as National Institute of Health (NIH) and the

National Science Foundation (NSF) in the United States. The creation of an enterprising class of life science professionals has also contributed to a new attitude in the academic setting:

Innovation in life science innovation is grounded in the development of a large and specialized R&D workforce. Over time, universities have expanded and developed graduate and post-graduate training programs, particularly within academic medical centers, allowing each new generation of researchers to develop the specialized human capital required to innovate at the life science frontier. (Cockburn and Stern, 2010: 5)

This boosting of the field of basic life science research in combination with the strong normative pressure on academic researchers to engage in entrepreneurial activities and to patent research findings, in combination with the “systemic risk” involved when exploring not yet fully known biological systems, have jointly caused an endemic perceived lack of venture capital. The life sciences are surrounded by a halo of urgency – everybody wants to cure cancer or neurodegenerative diseases such as Alzheimer’s – and this perceived lack of capital is frequently addressed and reflected upon in both the research literature and among the actors of the field. Whether this perceived shortage of venture capital is inhibiting new therapies and clinical practices from being developed, or if an increased supply of venture capital would merely overvalue already unqualified research projects and start-ups, is not easily determined, but all combinations of these two endpoints on the continuum are possible.

Summary and conclusion

This chapter has advanced the argument that life science venturing coincides with what has been called the financialization of the economy, beginning in the end of the 1970s. Financialization includes seemingly opposing elements of liberalization of markets and active policy-making lowering the barriers for capital investment and trade and the expansion of intellectual property rights. In this new economic regime, increasingly relying on a finance theory vocabulary and finance market control of corporations and managerial activities, there are new possibilities for acquiring venture capital investment for new life science start-up firms. In this new regime, practices of valuation and capital investment have been developed, and there are today a venture capital market and venture

capital investment firms that play a vital role in assessing, funding, supporting, and developing life science start-up firms. The second part of the chapter reviewed the literature on venture capital firms, and there was a distinction made between pre-investment and post-investment activities. Despite the significant expansion of credit in the last two decades, there is still a global endemic shortage of venture capital for life science ventures, and the principal explanation is that there are significant risk and uncertainty involved in life science ventures, formally operationalized as the degree to which venture capital investors write off “failed” investments – that is, investments with low or none economic returns, today being at roughly a 75 percent level for the entire stock of venture capital invested. It is reasonable to believe that this proportion is even higher in the field of life science.

In addition to being the supplier of much-needed capital funds, venture capital investors play an active and very central role in securing life science start-up firms’ acquisition of qualified managers, directors, sales and marketing competence, and sales and marketing managers. In the next chapter, the issue of corporate governance will be addressed, including a review of the literature pertaining to the role of governance competence in life science ventures.

2

Corporate Governance and the Supply of Commercial Human Capital

Introduction

As was discussed in Chapter 1, venture capital firms do not only supply capital to start-up firms and companies that are in the development phase; they also actively participate in the governance of the firms in which they have invested. Some venture capital investors, such as major institutional investors (pension funds, etc.) at times delegate this work to smaller and more targeted venture capital funds specializing in, for example, life science investment. In their day-to-day work, venture capital investors either work through the board of directors, holding one or more seats in the firm's board, or through participating in the recruitment of CEOs and other top management executives who are regarded as being critical for the commercialisation of the innovation. Speaking in theoretical terms, all issues pertaining to the management and control of firms and the how the interest of various stakeholders is balanced are labelled *corporate governance*. Corporate governance is addressed in a quite extensive literature – including corporate law literature, economic theory, and management studies – and includes a variety of perspectives and views, including more formal theoretical statements and historical studies of how corporate governance practices have developed over time and how such practices in many cases are the outgrowth of political ambitions to balance various social interests and to anticipate and handle risks. In this chapter, this literature, during the last few decades dominated by an agency theory perspective – “agency theory has colored the air we breathe,” Dobbin and Jung claim (2010: 32) – will be reviewed and critically examined. The chapter demonstrates

that the historical record of corporate law, especially in the case of the United States (which dominates the literature even if there is a fair share of comparative studies where other economies' corporate governance practices are examined), is a complex and very non-linear development of regulations and practices to avoid opportunistic behaviour and monopoly situations. After the early 1980s, there is a strong finance theory perspective taken on corporate governance that stresses the shareholder as the foremost stakeholder of the corporation. Recently, however, both law scholars and management researchers have called for a theoretical renewal of the research on corporate governance, and perhaps we will see more alternative perspectives on corporate governance in the future.

Defining corporate governance

In the literature, there are at least three alternative views of corporate governance: (1) the *corporate law view*, stressing the legislation regulating the relationship between the various stakeholders of the firms, (2) the *economic sociology view*, emphasizing corporate governance as the totality of the social and economic relations involved in securing widely accepted and legitimate rules for how economic activities are conducted and monitored, and (3) the *neoclassic economic theory view*, putting much emphasis on the effectiveness of the various corporate governance practices but also on entire corporate governance systems being developed in different countries and regions. In many ways, these three views address the same problems and the various practices derived therefrom, but the views are located in different theoretical perspectives and with different objectives. In this chapter, all three categories of works are included and referenced, but the economic sociology perspective, which takes a wider and more historical view on corporate governance, informs the review of the literature.

O'Sullivan (2000) argues that corporate governance is "concerned with the institutions that influence how business corporations allocate resources and returns," and defines it accordingly: "A *system of corporate governance shapes and makes investment decisions in corporations, what types of investments they make, and how returns from investments are distributed*" (O'Sullivan, 2000: 1, emphasis in the original). This definition strongly stresses the financial elements of corporate governance practice and therefore to some extent pushes aside other aspects. Fligstein offers a substantially wider definition of corporate governance: "*Governance structure* refers to the general rules in a society that define relations of

competition, cooperation, and market-specific definitions of how firms should be organized” (1996: 658). In a more recent paper, Fligstein and Choo identify three elements of such a governance structure, including (1) *company law*, which “defines the legal vehicles by which property rights are organized”; (2) *finance market regulations*, which specify how “firms obtain capital for their operations, and in doing so it specifies firms’ relationships to banks, other financial institutions, and public equity and debt markets”; and (3) *labour law*, which “defines how labor contracts will operate in a particular society” (2005: 63). In this tripartite model, corporate law specifies how property rights are defined and enforced, finance market regulations serve to ensure that effective capital markets can both supply capital to firms and reallocate capital to high-growth industries, while labour law defines the rights and obligations of the various actors in the economic system. In the economic sociology perspective, all three regulatory elements need to be in place and to operate effectively, including regulatory control of, for example, the labour and financial markets. The financial crisis of 2008 was, for instance, the immediate effect of too-lax regulatory control of the financial institutions that held some of their assets – eventually to be rebranded *toxic assets* when the sub-prime home mortgage market collapsed – in what were called off-balance sheet vehicles, serving to increase the risks taken by the banks and financial institutions to unprecedented levels (Blinder, 2013; Helleiner, 2011; Sinn, 2010; Crotty, 2009; Arnold, 2009). Some economists, especially representatives of the so-called Chicago school of economics tradition, would claim that both corporate law and labour law are for the most part complicating economic transactions, as freely operating financial markets would do the job for jurists and labour market participants to effectively regulate not only financial transactions but also other social relations. While such a proposition has not been supported by adequate empirical evidence, it has served as a strong theme in the corporate governance literature over the last three decades. The strong belief in unregulated markets as a solution to a variety of economic issues was not subject to detailed criticism until the finance market meltdown in 2008, where dedicated followers of what has been called the “efficient market hypothesis” (EMH) such as Federal Reserve chairman Alan Greenspan had to admit that they underrated the risks in the finance industry (Stiglitz, 2009; Fox, 2009). Greenspan and other proponents of free market had put too much hope that supposedly efficient markets would be capable of monitoring and regulating themselves as had been promised by a cadre of leading economists, some of them Nobel prize laureates in economic sciences.

Regardless of these events in 2008 and the following sobering but equally painful phase, corporate governance theory remains preoccupied with the issue of how to distribute decision rights to various stakeholders and how to determine who is eligible for what agency theorists call the “free cash flow” of corporations – the capital that remains when all costs for the production are covered. Needless to say, as the capitalist economic system is highly dynamic and has changed over time as new technologies are introduced and trade agreements and other forms of regulations have been enacted and implemented, there is a need for a historical perspective on corporate governance.

Historical accounts of corporate governance legislation and practices

Joseph Schumpeter remarks that in Adam Smith’s economic theory, the very bedrock for neoclassical economics, there is a conspicuous neglect of all kinds of managerial practice in the economic system. This is not a peripheral or moot issue but is rather to be understood as being of pivotal importance for neoclassic economic theory and its most recent branch finance economics, and, ipso facto, for corporate governance theory. Schumpeter’s argument needs to be explained in some detail. He says,

Adam Smith repeatedly talked about the employer – the master, the merchant, and the undertaker – but the leading or directing activity as a distinctive function played a surprisingly small role in his analytic scheme of the economic process. His reader is bound to get an impression to the effect that this process runs on by itself. Natural law preconceptions led Adam Smith to emphasize the role of labor to the exclusion of the productive function of designing the plan according to this labor is being applied. (1991b: 254–255)

In Smith’s work, the activity of translating raw materials into commodities, and marketing and selling them is thus not worthy of any particular investigation: “What a businessman does in the system of Adam Smith is, therefore, to provide real capital and nothing more,” Schumpeter writes (*ibid.*: 255).

Neoclassic economic theory has inherited this neglect of what occurs *inside* of the manufacture or corporation. Economists are interested in either macroeconomic phenomenon such as trade balances, the degree of foreign direct investment, or other aggregated economic activities, or they

are at pains to develop microeconomic theories that explain aggregated economic activities. Microeconomic theory has been widely criticized by various social sciences for maintaining the reductionist and economicist model of *homo oeconomicus*, a rational choice theory model of man, regardless of empirical data and experimental results that undermine the credibility of such a model. Economists in turn claim that the rational choice model is a theoretical construct and a heuristic that helps them formulate more differentiated analytical models. Somewhat surprisingly, regardless of such assertions that the rational choice model is just a tool in the hands of the economic theorist, there are extensive policy recommendations made on the basis of such heuristics. Under all conditions, economists are interested in aggregated behaviour or in the elementary processes centered on individual decision making; the intermediary level – the domain where human beings interact and jointly create, for example, new innovations, the principal source of economic growth in Schumpeter's economic theory – is of limited interest for economists. Instead, rather than exploring such social relations, for example, by opening the black box of the corporation – the object of research in management studies – to explore how individuals collaborate and share ideas and know-how, economists eliminate this level of analysis almost entirely and go straight to the market. The market is, for many mainstream and orthodox neoclassic economists, a sacred domain that constitutes the nexus between their microeconomic models and the macroeconomic structures explored. This favoured tripartite model of economic theory composed of the three layers of microeconomic behaviour/market transactions/macroeconomic patterns unfortunately tend to exclude the organization as a legitimate object of analysis, O'Sullivan suggests: "Trained, as virtually all American economists are, to believe that the market is always superior to organizations in the efficient allocation of resources, these economists were ideologically predisposed against corporations' – that is, managerial – control over the allocation of resources and returns in the economy" (2000: 7). In other words, in this view, there is relatively little that professional managers inside the corporation can do better than finance traders operating in the market, a key axiom for example, for agency theory being rarely if ever questioned by mainstream and orthodox economists.

One of the key consequences of this neglect of the corporation is that the issue of innovation is marginalized economic theory, a malaise that again has its origin in the writings of Adam Smith:

The subordination of the process of innovation, and of production more generally, to the theory of market exchange is... not exclusive to

financial economics but forms part of a more general trend in mainstream economic thought. The predominant attitude among neoclassical economics is to favour the sanctity of exchange over production. (ibid.: 51)

Therefore, in order to fully understand how the corporate governance literature has come to stress finance/market-based control of the corporation over traditional managerial control, it is important to recognize both the path dependencies of economic theory and to point at the history of corporate law and its enforcement to fully see how various regional and local corporate governance practices were not originally instituted to secure optimal efficiency but to resolve a number of social issues and disputes. Turning a blind eye to such a historical record undermines a comprehensive understanding of contemporary corporate governance practice and fails to recognize the accomplishments of previous generations in creating the economic system of competitive capitalism. Much orthodox economic theory represents a Whig history view of competitive capitalism in assuming that previous accomplishments were originally and consciously aimed at creating the contemporary market-based economy. The history of human societies is therefore like pieces of a puzzle that neatly fit together to finally provide a full and splendid overview of human accomplishments, with no excessive pieces being left on the side. Rarely, if ever, many commentators would oppose, does history unfold in such a perfected and seamless fashion.

The role of the state to create markets and possibilities for capital investment

From an economic history or economic sociology perspective, God did not create the economic system of competitive capitalism during his first six days of operation. Instead, competitive capitalism is a human accomplishment, a manmade system demonstrating certain path dependencies and lock-in effects, and therefore cannot be fully understood unless the analyst takes an historical perspective. Recent research on corporate governance (e.g., Johnson, 2010; Roy, 1997; Djelic, 2001; Roe, 2003; Gourevitch and Shinn, 2005) suggests that rather than being rooted in an economics perspective emphasizing the efficiency of economic transactions, present governance systems are derived from politics and legal concerns directed to other issues. In the neoliberal literature and in neoclassical economic theory, the state and the government are by and large portrayed as necessary evils – even though in practice, such economic programs seek to make the state its ally and

instrument in its ambition to deregulate markets – but such a critical view of the state ignores its role as a crucial market-maker, establishing markets and economic actors such as corporations in the first place. Roy refers to this former perspective as *efficiency theory*, a theoretical framework that assumes that “private enterprise, disciplined by an unforgiving market, is inherently more efficient than government decision making” (1997: 75). Roy’s study of the development of the American governance system tells another story, wherein the privately owned corporation could be developed only *after* the state has discounted most of the risks and established a legal and regulatory framework that secured the interest of the capital owners and investors:

The most private of our economic structures, the large business arose as a quasi-government agency. Some of its particular features, such as limited liability, perpetual life, and parcellized ownership, were established not so much because they were efficient but to compensate for the inefficient tasks corporations were assigned, like building canals, turnpikes, and bridges, were markets would not support them... The corporation was after all a delegation of sovereign powers to serve the public interest, thus the corporation did not grow by an evolutionary process by which an organizational form was perfected to its maximum efficiency. (ibid.: 76)

The idea that such a massive institutionalization process could move straightforwardly to the point where its efficiency could be assessed, or even discussed in such terms, is ignorant of the work needed to “set the scene” for private capital expansion in the first place. Rather, the issue was to create the conditions necessary to enable such capital expansion *at all*: “The changes created by corporate law were not necessarily conducive to greater efficiency, technological development, or managerial effectiveness. The explanations of the corporate revolution that focuses on technological adaptation, managerial efficiency, or economic power miss part of the story,” Roy argues (ibid.: 174). This historical myopia of much economic theory is telling, as it assumes that markets are “naturally occurring phenomena” (Harcourt, 2011) that demands little effort or regulatory oversight to operate.¹

According to Harcourt (2011), Adam Smith’s economic theory was strongly influenced by the French physiocrats, presenting what their leading representative, the physiologist François Quesnay, called the *tableau économique*, a comprehensive model of the economic system and the circulation of capital and commodities. When presenting “the

first complete analysis of the static economic process" (Schumpeter, 1991a: 59), Quesnay was influenced by the relatively recent findings of the British physiologist William Harvey, capable of mapping the human cardiovascular system in detail. Smith translated Quesnay's work and that of another influential French economist, Anne-Robert Jacques Turgot, to English. As a trained physician, Quesnay modelled the economic system on the human biological organism with which he was familiar, and consequently the physiocrats introduced the term "natural orders" in economic theory. However, as classic economic theory became neoclassic economic theory by the end of the nineteenth century, a term that paid homage primarily to Smith's contribution, the idea of the natural order of the economic system was displaced by the idea of the market and its accompanying term, "market efficiency." "The language of natural order has been replaced by a more technical and scientific theory of market efficiency, but the parallel to the earlier Physiocrats remain striking," Harcourt argues (2011: 149). For Roy and other students of the historical development of corporate law and governance systems, there is nothing "natural" about markets; on the contrary, for markets to operate, they demand substantial regulatory control and oversight executed by the state or international organizations such as the World Bank, the International Monetary Fund, or the European Central Bank: "The market itself is an institution that must be explained just as thoroughly as hierarchies. Institutions are not residual, but are the basic foundations of society. Any sociological explanation of macro level phenomena should include institutional factors," Roy summarizes (1997: 170). Such an institutional perspective demand new vocabulary: economists construe the state involvement, Lazonick and Mazzucato argue, as "fixing 'market failures,'" but it would be more adequate to describe the state's role as "opportunity creation" that benefits various constituencies (2013: 1100).

Based on these premises – that governance systems are derived from historical activities wherein various local and regional economic challenges and issues have been addressed, handled, and more or less effectively solved or moderated by relevant actors – there is a literature on comparative corporate governance practices that examines the differences between leading economies such as the United States, the UK, France, Germany, and Japan. While this literature point at the diversity of the various systems of governance, there is perhaps an agreement today that there is "no one best way" to secure an effective governance system, but instead there are many local solutions to specific concerns that work to various degrees: "The literature now agrees that there is a

variation in systems of corporate governance across societies and that most of this difference reflects national political, social, and cultural trajectories that have created and continuously shaped the laws that define corporate governance" (Fligstein and Choo, 2005: 62). That is, economic growth, at least in developed countries, Fligstein and Choo suggest, is more likely to come about because there are "stable political institutions" in place rather than some quite specific "configurations of laws and institutions" (ibid.: 67). That is, economic growth is the effect of a combination of conditions including, (1) stable governments that do not seek rents too much (i.e., in the form of state officials susceptible to corruption, bribes, and extortion), (2) laws and regulations that solve or mediate class struggle, and (3) laws that enable the accumulation of private wealth, including tax legislation that promote enterprising activities as well as well-defined property rights (ibid.: 67–68). In addition, all economies struggle with the issue of how to balance the access of capital to entrepreneurial activities and capital accumulation. In an economy starved of venture capital, there can be no thriving entrepreneurial class; on the other hand, in an economy with excess venture capital supply, enterprising activities with limited market opportunities and long-term possibilities for generating stable cash flows and profit may be overvalued and lead to bubbles such as the notorious information technology bubble by the turn of the millennium. That is, the problem first addressed by Schumpeter of how to match people who have money to invest with people who need capital investment to build their firms remain a key economic issue and a governance problem.

In the next section, the historical view of governance systems will be compared with the economy theory model, emphasizing not so much the diachronic emergence of existing systems as the synchronic efficiency of present corporate governance regimes.

The economic theory view of corporate governance

The economic theory view of corporate governance starts from the concerns addressed by Adolf A. Berle and Gardiner C. Means in the early 1930s – that is, how to ensure that hired professional managers (the agents) are in fact acting in accordance with the best interests of the capital owners (the principals). While previous theories on corporate governance and capitalist accumulation more or less assumed that these two categories of actors in the capitalist economic system, the managers and the capital owners, shared a socioeconomic and cultural background and were both committed to capital circulation and accumulation, Berle

and Means rendered this assumption an empirical question. The distinction between salaried managers and capital owners is central in the economic theory of corporate governance.

Shleifer and Vishny (1997: 737) write, "Corporate governance deals with the ways in which supplies of finance to corporations assure themselves of getting a return on their investment." For Hermalin (2013: 734), "Corporate governance is the means by which the externalities that controlling parties generate are regulated." La Porta et al. (2000: 4), finally, argue, "Corporate governance is, to a large extent, a set of mechanisms through which outside investors protect themselves against expropriation by the insiders." These authors also emphasize that corporate law plays a decisive role in shaping regional and national systems of corporate governance: "Much of the differences in corporate governance systems around the world stems from the differences in the nature of legal obligations that managers have to the financiers, as well as the differences in how courts interpret and enforce these obligations," Shleifer and Vishny (1997: 750) write. "The legal approach to corporate governance holds that the key mechanism is the protection of outside investors – whether shareholder and creditors – through the legal system, meaning both laws and their enforcement," La Porta et al. add (2000: 4). Such differences in legislation opens up for comparative studies regarding alleged differences in "effectiveness." For instance, La Porta et al. report from their research that "the data show that countries with poor investor protection typically exhibit more concentrated control of firms than do countries with good investor protection" (ibid.:14) More importantly, La Porta et al. report findings that render the Berle and Means' 1934 question insignificant, as there are other, more acute concerns regarding governance effectiveness: that is, the different interests of various groups of investors and influence on managerial decisions. "In large corporations of most countries, the fundamental agency problem is not the Berle and Means conflict between outside investors and managers," they write, "but rather that between outside investors and controlling shareholders who have nearly full control of the managers" (ibid.: 15).

As Shleifer and Vishny remark, "corporate governance is typically exercised by large investors" (1997: 739). Only larger investors have the clout, competence, and voting rights to actively influence how decisions are made. Therefore, La Porta et al. argue that one of the principal objectives for governments is to ensure that there are regulations prescribing how different categories of capital investors should advance their joint interests. La Porta et al. also emphasize that the regulation

of debt is of key importance in an economy as “countries that protect creditors better have larger credit markets” (2000: 15). Taken together, La Porta et al. suggest, clear and widely recognized regulations of financial markets serve to “accelerate growth” through three mechanisms. First, regulations can “enhance savings,” which adds to the stock of capital in an economy. Second, these savings can be channelled “into real investment and thereby foster capital accumulation.” Third, “to the extent that financiers exercise control over the investment decisions of the entrepreneurs, financial development allows capital to flow toward the more productive uses, and thus improves the efficiency of resources allocation” (ibid.: 16). In a dynamic and growing economy, there is also, contrary to common sense economic thinking, a relatively high share of debt: “On average, countries with bigger stock markets also have higher ratios of private debt to gross domestic product (GDP), contrary to the view that debt and equity finance are substitutes for one another” (ibid.: 18). As, for example, Schumpeter stresses, enterprising demands capital investments to actualize promising enterprising ideas, and therefore growth economies demonstrate higher degrees of debt than stagnating economies do. Such capital investment is enabled only on the basis of clear rules and regulations being enacted, instituted, and enforced by the state. “Empirically, strong investor protection is associated with effective corporate governance, as reflected in valuable and broad financial markets, dispersed ownership of shares, and efficient allocation of capital across firms,” La Porta et al. summarize (ibid.: 24). More importantly, especially given the last few years’ imbalances in the financial markets and the excessive risk-taking, La Porta et al. suggest that governments cannot surrender the monitoring and regulation of finance markets to the financiers themselves or to market intermediaries such as privately owned credit rating agencies: “An important implication of this approach is that leaving financial markets alone is not a good way to encourage them. Financial markets need some protection of outside investors, whether by courts, government agencies, or market participants themselves” (ibid.). Therefore, for the financial markets to operate effectively, there is a need for a strong state that regulate and enforce legislation to avoid opportunistic behaviour.

Porta et al.’s research findings are important because they undermine the relationship between the capital owners and the managers as being the single most critical relations in corporate governance, an axiom in the corporate governance literature that draw on agency theory. “The overwhelming emphasis in governance research has been on the efficacy of the various mechanisms available to protect shareholders from

self-interested whims of executives,” Dalton and Cannella argue (2003: 371), indicating the narrow and dismissive view of top management and CEOs and the board of directors in agency theory. In the next section, the main arguments of the agency theory view will be addressed in order to demonstrate how agency theory has overemphasized one single relation in the economic system, that of capital investors and executives and what Dobbin and Jung refer to as the sole objective of “money making,” (2010: 36) while ignoring virtually all other relations and sources of opportunism in the firm and in the economic system.

The orthodox economic theory view disqualifying both organizations and managers as a credible alternative for effective use of resources in an economy has in this case been not only developed into a full-fledged economic framework but also managed to become the dominating perspective in the corporate governance literature. Such hegemony is unfortunate, as agency theory, which arguably looks parsimonious and elegant in its reliance of a few basic propositions, has by and large failed to be supported by empirical evidence. Instead, the ideology of the rationality inherent to market transactions, frequently advanced under the label the efficient market hypothesis (EMH), has persuaded agency theorists to put their faith in finance market control.

Agency theory and corporate governance practice

Michael C. Jensen, for many years part of the Harvard Business School faculty and prior to that at Rochester University’s economics department – one of the strongholds of orthodox economic theory criticizing the role of government in the economic system (Fourcade and Khurana, 2013; Chabrak, 2012) – is the most prominent advocate of agency theory. The agency theory framework, starting with Berle and Means’ idea, this separation between capital owners – for example, the owners of stock, the so-called *the principals*, and the professional managers and other staff (e.g., experts and R&D personnel), the *agents* – suggests that capital owners invest their capital in company stock and therefore expects managers to act in accordance with their best interest. If managers demonstrate an unwillingness to act in accordance with such expectations, they incur so-called agency costs on the principals. When agency costs increase – that is, when the managers act opportunistically in accordance with their own – not the capital owners’ – interests – the so-called free cash flow or residual cash flow being generated by the corporation is reduced – that is, the capital owners receive less return on their investment as such capital is spent on internal organizational activities. By and large, agency theory

is fully committed to understanding how agency costs could be kept at a minimum to benefit the capital owners, and, by implication, a more effective use of capital in the economy. This corollary from the reduction of agency costs has been disputed. What is at stake here, then, is free cash flow, which Jensen defines accordingly:

Free cash flow is cash in excess of that required to fund all projects that have positive net present values when discounted at the relevant cost of capital. Conflicts of interest between shareholders and managers over payout policies are especially severe when the organization generates substantial free cash flow. The problem is how to motivate managers to disgorge the cash rather than investing it at below the cost of capital or wasting it on organizational inefficiencies. (1986: 323)

The single most important assumption in agency theory is that professional executives act self-interestedly and therefore tend to make a suboptimal use of the free cash flow generated, unless they are closely monitored by the principals, in practice meaning the board of directors. There are innumerable passages in Jensen's work that dismiss executives as being clumsy, ignorant, and incompetent investors of the free cash flow, and he frequently used morally charged terms such as "waste" to denote the outcomes from managerial decision making. "Managers with unused borrowing power and large free cash flows are more likely to undertake low-benefit or even value-destroying mergers," Jensen proposes (*ibid.*: 328).

In the early 1980s, when the American stock market was undervalued, and there was an inflow of foreign capital into the United States, accompanied by a deregulation of the financial markets, so-called hostile takeovers became a new phenomenon in the US finance market. Entrepreneurs could raise money to buy undervalued stock-listed corporations – in many cases, conglomerates that were the outcome from the anti-trust legislation that had guided corporate law in the United States for decades – and divest them, selling them off piece-by-piece. Such financial raids outraged many commentators and policymakers, but in 1993, Jensen acclaims such operations and regards them as being indicative of the finance market's ability to outperform incumbent managers' use of financial resources. In this new milieu, two categories of firms were especially susceptible to such hostile takeovers: They were "firms with poor management that have done poorly prior to the merger, and firms that have done exceptionally well and have large free cash flow which

they refuse to pay to shareholders” (ibid.: 329). “Jensen described the hostile takeover not as a form of disruptive speculation, but as a restraint on managerial malfeasance,” according to Dobbin and Jung (2010: 42).

Jensen’s agency theory view strongly stresses that managers and executives should only think of the shareholders’ interest to make the most effective contribution to the economy. All other relations and constituencies that arguable influence the firm’s capacity to generate the desired free cash flow can be ignored as long as the firm follow the legislation – which again, must be noticed, free-market activists claim, should be minimized in order to not intervene into supposedly self-regulating markets – and consequently Jensen is hostile to all alternative views, including what has been called *stakeholder theory*, which portrays the firm as being embedded in a series of relations and interactions with surrounding organizations and authorities, and therefore executives need to carefully balance various interests. Rather than just being concerned with generating shareholder value, stakeholder theorists claim that the firm has several constituencies that need to be recognized. Such a view of the firms is rejected *tout court* by Jensen), who suggests that stakeholder theory is

fundamentally flawed because it violates the proposition that any organization must have a single-values objective as a precursor to purposeful or rational behavior...Firms that adopt stakeholder theory will be handicapped in the competition for survival because, as a basis for action, stakeholders politicizes the corporation, and leaves its managers empowered to exercise their own preferences in spending the firm’s resources. (2002: 237)

In order to operate effectively – that is, to maximize the free cash flow to be distributed to capital owners that in turn (agency theorists postulates) reinvest free cash in new ventures – there cannot be conflicting goals and objectives, Jensen insists: “Multiple objectives is no objective” (ibid.: 238). Instead, “maximizing the total market value of the firm...is one objective function that will resolve the tradeoff problem among multiple constituencies” (ibid.: 239). Jensen here introduces the grandiose phrase “enlightened value maximization” to denote this maximization of market value to solely enrich the constituency of shareholders. Despite his preferences for such noble terms, Jensen cannot avoid the temptation to reject executives’ performance as a major obstacle for an effective economic system:

With no criteria for performance, managers cannot be evaluated in any principled way. Therefore, stakeholder theory plays into the

hands of self-interested managers allowing them to pursue their own interests at the expense of society and the firm's financial claimants. It allows managers and directors to invest their favorite projects that destroy firm-value whatever they are (the environment, art, cities, medical research) without having to justify the value destruction. (ibid.: 242)

Jensen's strong belief in free market economic thinking and his commitment to the efficient market hypothesis – two key elements in the so-called Chicago school of economics represented by economists such as Milton Friedman, Eugene Fama, and George Stigler, which further expanded its base to Rochester University and elsewhere in the 1970s (Chabrak, 2012; Smith, 2007) – is of key importance in understanding this version of corporate governance. Hart summarizes this argument: "Shareholders elect the board to act on their behalf, and the board in turn monitors top management and ratifies major decisions" (1995: 681). Since this relation is supposedly effective or at least provides a final check on managerial opportunism, there is no real need for the government to intervene, Hart claims. "There is in fact a strong argument that a market economy can achieve greater corporate governance without government intervention. The argument is a familiar 'Chicago' one," Hart argues (ibid.: 686). The "Chicago argument" runs as follows:

[Company founders] have an incentive to choose selection procedures for the board of directors, the mix of executives and nonexecutives directors, the structure of audit and remuneration committees, disclosure rules concerning takeovers, etc.... They therefore have the incentive to choose corporate governance rules that maximize total surplus. (ibid.)

As the government's intervention is here by definition what bias market transactions – and market transactions are both believed to be efficient by the Chicagoans – any ambition to regulate markets induces additional agency costs: "According to the Chicago view, then, there is no need for statutory corporate governance rules. In fact statutory rules are almost certain to be counterproductive since they will limit the founders' ability to tailor corporate governance to their own individual circumstances" (ibid.).

This sounds like a beautiful idea: that markets are capable of executing a final check on managerial opportunism not only in the interests of the capital owners but for the efficiency of the economy at large. This

proposition therefore demands to roll back the state and to cut down on regulations – corporate law has historically been the most prominent instrument for government to ensure the transparency that La Porta et al. say is critical for a dynamic economy – and put the control in the hands of the capital owners themselves.

In practice, this line of reasoning ends with a strong emphasis on the role of independent outside directors on the board of directors: “A major prescription of agency theory...is that effective boards will be largely comprised of independent, outside directors” (Dalton et al., 1999: 679). Luckily, this chain of reasoning, based on a series of assumptions (Managers and governments are unable to make competent decisions; only capital owners knows what’s best for the economy, etc.) end up in a proposition that is capable of lending itself to empirical investigation. This proposition that companies with independent board of directors outperform other companies will be further addressed below.

In summary, agency theory has served the role as the dominating theory in corporate governance studies since the publication in 1976 of Jensen and Meckling’s seminal paper (Dalton and Cannella, 2003). Much of this theory is based on a set of assumptions that can be tested empirically. In addition, many of its assumptions have been subject to criticism as they have been highly speculative from alternative perspectives, for instance, the assumption that the role of the firm is to maximize shareholder value. That statement is based on preferences and beliefs rather than the starting point for the corporate law being enacted since last decades of the nineteenth century. In other words, many of the axioms and propositions that constitute the bedrock of agency theory are in fact based on a preferred role of the corporation rather than some neutral view of it. As we will see, there is a divergence between abstract armchair thinking models and actual finance market control, and as one form of “opportunistic behaviour” is being curbed (e.g., the tendency to reinvest the free cash flow in conglomerates structures including co-called “unrelated diversification”), another tend to take its place (e.g., stock buyback programs to boost the stock price being the basis for CEO compensation, or excessive executive compensation).

Critique of agency theory

The economics view

La Porta et al. advance the argument that the relationship between capital owners and executives – the *raison d’être* of agency theory – are

in fact of minor importance in the field of corporate governance: “The perhaps main implication of this evidence for the study of corporate governance are the relative irrelevance of the Berle and Means corporation in most countries in the world and the centrality of family control” (2000: 15). Agency theory’s almost obsessive preoccupation with the influence of allegedly incompetent and self-interested executives wasting the fruits of the hard labour of capital owners are not shared by other economists, nor do these propositions stand up very well when tested empirically. In Shleifer and Vishny’s account, the corporate governance model proposed by agency theorists – that of shareholder value maximization as the only legitimate objective – is riddled with difficulties. First, the contracts that the managers and investors sign “cannot require too much interpretation if they are to be enforced by outside courts” (1997: 737). No matter how much external investors try to secure low agency costs through contracting, there is always room for interpretation on the part of the executives, given their authority to act in accordance with the interests of the capital owners. Secondly, investors tend to be too slow to be able to execute adequate control of executives. Inside actors such as practicing managers are always more informed than outside investors – if that wasn’t the case, there would be no market for executive competence – and therefore an expanded control of the corporate governance activities may be more costly than the original agency costs: “In the cases where financing requires collection of funds from many investors, these investors themselves are often small and too poorly informed to exercise even the control rights that they actually have” (*ibid.*). Management scholars such as Dalton and Cannella stress the rhetorical qualities – its simplicity and polemics – rather than the empirical accuracy of agency theory:

The popularity of agency theory in governance research is likely due to two factors. First, it is an extremely simple theory, in which large corporations are reduced to two participants – managers and shareholders – and the interests of each are assumed to be both clear and consistent. Second, the notion of humans as self-interested and generally unwilling to sacrifice personal interests for the interest of the other is both of age old and widespread. (2003: 372)

Especially the latter element – the overly negative image of executives and their performance and ability to make informed decisions – is popular among economists trained to think of the market as a “naturally” occurring locus for economic exchanges and transactions. In a

corollary to this axiom, organizations and the executives that populate them are ex hypothesi market failures, as higher transaction costs motivates the emergence of hierarchies. Agency theory is thus based on neoclassical assumptions that the market is a primordial economic site for transactions. "In nearly all modern governance research governance mechanisms are conceptualized as deterrents to managerial self-interest" Dalton and Cannella notice (*ibid.*). In addition, Dalton and Cannella argue that agency theory assumes that low-performing corporations are of necessity managed by incompetent executives, and only high performing managers are lucky to have recruited qualified managers (*ibid.*: 378). Such a reductionist line of reasoning is not very credible, as good managers may do a fantastic job keeping companies and even industries up and running despite all their difficulties and challenges. "If (as agency theory implies) the only good managers are those associated with high-performing firms, it is unclear why any of those good managers would unwillingly leave a high-performing firm to take over one threatened by bankruptcy," Dalton and Cannella ask (*ibid.*). On the other hand, Jensen actively encourages companies to divest once they end up in such precarious situations, no matter what economic and social value or work opportunities firms and industries provide, a stance that follows Jensen's commitment to capital-owner interest. Competent managers providing a small return-on-investment in troubled and stagnating industries are, in this view, a waste of human capital and, worse still, of capital resources. Needless to say, a broader view of the firm in an economic system would suggest otherwise.

Dalton and Cannella, unimpressed by the agency theory framework and its ability to promote a vital and dynamic economic system, claim that there is a need for "alternative theoretical perspectives" on corporate governance (*ibid.*: 379). Also, more mainstream economists tend to disqualify the single focus on shareholder rights and privileges:

The legitimacy of shareholder complaints about their lack of control is limited – no one compelled them to purchase equity, and they are, in expectations at least, compensated for the risks they bear. Consequently, one should be cautious about extolling the virtues of increasing shareholder control, especially if imposed via regulatory fiat. (Hermalin, 2013: 755)

When moving to the economic sociology and the corporate law literature, such criticism is even more scathing. In this view, agency theory, regardless of its success and influence in instituting shareholder value

programs in listed companies, is riddled by ideologies and, worse still, remains unsupported by empirical evidence.

The economic sociology critique

Economic sociologists recognize the role of Berle and Means' seminal 1934 work in advancing a robust analytical framework for corporate governance. However, in contrast to agency theory's staunch rejection of the legitimate claim of any other stakeholder than the owners of stock, Mizruchi stresses the wider perspective of the firm: "Berle and Means' concern about the separation of ownership from control was not simply about managers' lack of accountability for investors. It was also a concern about managers' lack of accountability to society in general" (2004: 581). That is, economic sociologists do not think that the proposition that executives act self-interestedly is wrong per se, but they believe such claims needs to be tested empirically rather than just assumed, and if that would be the case, it is not self-evident that it is only the interest of one single group (the shareholders) that needs to be protected, but also constituencies such as employees, creditors such as banks, suppliers, and customers that have stakes in the focal firm. As demonstrated above, Jensen rejects all such claims. The difficulty involved here is, Mizruchi argues, that the organizational process of managerial decision-making is addressed by and through economic theory – a theory that has only been marginally concerned with exploring what happens inside of organizations:

Agency theory is in many respects a critique of managerialism. It proponents acknowledge the difficulties that emerge with the dispersal of stockholding and the rise of management, but they want to address them within the framework of more conventional economic theory. (ibid.: 586)

By and large, economic sociologists do not regard economists' tendency to reduce complex social relations and social processes to linear and dual exchanges and contracting favourably; neither do they share the assumption that markets are naturally occurring systems, nor the even more tenuous claim that such market are of necessity efficient. Fligstein and Choo, argue that agency theorists regard history, culture, and politics as being "irrelevant for the issue of how to get the right (i.e., efficient) mix of investments made in a particular economy" (2005: 66). In addition, agency theorists claim that societies that "do pursue goals other than shareholder wealth" through their corporate governance system, and

that ignore the problem of agency costs are “doomed to underperformance because their capital markets will not be deep enough to allow the most profitable (efficient) investment for owners” (ibid.). Such implications from the agency theory framework, repeated over and over, cannot be supported by empirical evidence from various highly competitive capitalist economies including those of Germany and Japan, two of the favoured benchmark economies for American scholars of all hues and disciplines. Fligstein and Choo here speak about the “the empirical failure of agency theory.” First of all, Fligstein and Choo claim, corporate governance legislation and practices did not start from the intention to benefit only finance market actors but to create a legal and institutional framework wherein private enterprising could be developed and secured. Profit maximization benefitting the owners of capital was therefore balanced against all other possible political and social interests and objectives. In its ambition to provide a general and universally applicable model for corporate governance, agency theorists lose their historical and socioeconomic oversight and become preoccupied with details (ibid.). Second, there are evidence of many economies that have, Fligstein and Choo write, “experienced comparable economic growth” without converging toward the US form of corporate governance (ibid.: 66–67). Such evidence suggests that “there is no set of best practices of corporate governance but rather many set of best practices, and that the relationship linking these institutions to good societal outcomes like economic growth is more complex than agency theory would allow” (ibid.).

For Dobbin and Jung, the sole focus on shareholder enrichment in agency theory has contributed to the increased instability of the financial and economic system. As this shareholder value version of corporate governance emphasizes and rewards risk-taking, while eliminating any punishment for ignoring downside risks, executives have learned that risk-taking is rewarded:

The new compensation system encouraged executives to take risks, but because the system was implemented to reward executives for increasing stock prices in the near term, but not to punish them for declines, it encouraged reckless risk-taking. Knowing they could only win, executives could afford to do deal that offered huge potential for profits and losses alike, knowing that for them, there was only an upside. (2010: 37)

In addition, contrary to what Jensen claims, shareholders do not really represent a wide variety of actors ranging from the professional investor

community to “the man on the street” – the fabled “common man capitalist” advanced by Prime Minister Thatcher as the backbone of the “society-less” economy – but rather a small community of capital fund managers. This new situation institutionalized not only risk-taking but also short-sightedness in executive decision making:

Fund managers controlled over 60% of the shares in the average firm in our sample by 2005, up from 20% in 1970, and so they increasingly determined stock price. Executive interests were thus not aligned with the long-term interest of shareholders so much as with the short-term interest of institutional fund managers. (ibid.: 38)

This new order effectively undermined the carefully balanced corporate governance system embedded in corporate law, institutional relations, and considerations regarding long-term economic growth and stability as the control of corporations were laid in the hands of a small community of finance market actors.

In a more extensive critique of agency theory, Erturk et al. say that agency theory and the corporate governance literature based on “orthodox finance theory” is “uninformative and naïve” as they reduce a complex issue to a singular perspective. More specifically, they claim, agency theory as such was “always theoretically incredible,” and eventually it also became “empirically discredited” (2004: 687). A theory that is neither consistent, nor proved to be supported by empirical evidence, has a hard time subsisting over time unless it is charged with ideological beliefs and fits nicely into political agendas being pursued for the time being. The influence of ideology perhaps explain why agency theory and the governance program it proposed, that of shareholder value maximization, was hugely successful in the 1990s:

This narrative was not compelling because it appeared to be theoretically rigorous or empirically plausible. Rather, narrative power came from its capacity to create an intelligible world through strong, simple assumptions about what is wrong and the appropriate solutions. On the problem, it asserts the centrality of a shareholder/manager agency problem. (ibid.)

Corporate law scholars add to the criticism regarding the accuracy of agency theory, suggesting that the agency theory view of corporate control renders corporate law ineffective while still being unable to account for how corporate law has been developed historically and how it is enforced in practice.

The corporate law scholars critique

Roe argues that “managerial agency costs” come in “two flavours.” First in the form of managers “stealing” from corporations, an activity that corporate law and forms of auditing seek to control and counteract. Second, managerial agency costs appear in the form of “shirking” as the managers are “pursuing goals other than shareholder value” (2003: 163). In Roe’s view, this second category of managerial agency costs, “corporate law largely leaves alone.” “The standard that corporate law applies to managerial decision is, realistically, no liability at all for mistakes, absent fraud or conflict of interest. *But this is where the big costs to shareholders of having managerial agents lie, exactly where the core of corporate law falls into an abyss of silence*” (ibid.: 172, emphasis in the original).

In Roe’s view, corporate crime has been targeted in, for example, anti-trust legislation by the turn of the twentieth century to counteract capital concentration and the formation of monopolies, and in insider trade legislation in finance markets in the 1980s. But the category of “shirking” – echoing Jensen’s favoured term, “waste,” when addressing managerial performance – is more complicated to handle through legislation and to actively enforce. However, other legal scholars such as Bratton and Wachter are critical of agency theorists’ negligence of corporate law and its historical roots:

Corporate law always performed a balancing act with management discretion and shareholder power. The balance, however, has always privileged the directors and their appointed managers in business policymaking because they are better informed than the shareholders and thus better positioned to take responsibility for both monitoring and managing the firms and its externalities. (2010: 659)

In addition, Bratton and Wachter claim that “shareholder proponents” tend to depict agency costs as “a static, historical constant,” not varying over time and being determined by legislation and regulatory frameworks (ibid.: 660). In contrast, agency theorists assume that shareholder empowerment, effectively operationalized into the maximization of shareholder value and agency cost reduction are interrelated: “Agency-cost reduction and shareholder empowerment move in lockstep in this picture – you do not get one without the other” (ibid.: 675). This central idea in the agency theory framework – creating shareholder value of necessity reduces agency costs – implies, Bratton and Wachter notice, that “the corporate governance systems leave big money on the table, in the ordinary course, a proposition that to us is counterintuitive” (ibid.)

That is, under all conditions where there is no strong shareholder value policy guiding managerial work, agency costs rise. Regardless of the all the accounting procedures, auditing, legal control, and managerial compensation system and performance-reward systems, agency costs are claimed to be substantial. Bratton and Wachter simply do not believe such claims can be substantiated:

This holds that managers will systematically fail to maximize value in predictable ways. They will favor conservative, low-leverage capital structures, misinvest excess cash in suboptimal projects, fail to reduce excess operating costs, and resist premium sales of control. All these missed opportunities amount to agency costs that could be reduced if the law provided for greater shareholder input. (ibid.: 676)

In addition, new legislation and regulatory control have been proven to increase the accuracy of market prices: “The information gaps between those inside and outside of the corporation have narrowed, due in part to stricter mandatory disclosure requirements and in part to more liquid markets and larger sector of information intermediaries” (ibid.: 668). Such market communication and legal control of stock-listed companies are again excluded from the agency theory model. In addition to legal and regulatory changes – by definition inducing agency costs in the Chicago economic theory tradition – there are practices (examined in greater detail below) such as stock repurchases that strongly affect the shareholder value through increased stock valuations without affecting the substantial value of the firm.² Such cases indicate that there is in fact no convergence between lower agency costs and shareholder value: In fact, as shareholder value increases, so does the agency costs when executives and board of directors decides to repurchase its own stock rather than investing in, for example, R&D activities that would secure future income. If nothing else, for proponents of the efficient market hypothesis, stock repurchases are puzzling phenomena, even anomalies, as the market by definition cannot value assets inadequately.

Ireland offers an entirely different critique, centring on the straightforward claim that shareholders do not have the right to the free cash flow or the residual cash flow in addition to what is already claimed by the existing corporate legislation (see also Stout, 2012). Such claims are merely statements, Ireland argues, suggesting that the interests of the capital owners were already from the beginning given a role in corporate law. “The triumph of corporate legal form was more a product of the growing political power and needs of *rentier* investors than it was economic imperatives,” Ireland says (2010: 838). In Ireland’s view, quite

in opposition to agency theory, this rentier class should carry a *larger share* of the risks than they do at present:

At present, corporate shareholders (including parent companies) enjoy the best possible of all possible legal worlds. On the one hand they are, for some purposes, treated as ‘completely separate’ from the companies in which they hold shares and draw dividends, in that they are not personally responsible for the latter’s debt or liabilities (or behaviour). On the other hand the companies in which they hold shares must be run exclusively in their interests: for these purposes the interests of ‘the company’ (formally a separate entity) are synonymous with those of the shareholders. (ibid.: 848)

In securing all the interests of the rentier class, corporate law enjoys a situation where they are protected from legal responsibilities, while still being able to claim the right to the free cash flow (Djelic and Bothello, 2013). In Ireland’s view, such “no-obligation, no-responsibility, no-liability nature of corporate shares” (Ireland, 2010: 845) leads to various forms of opportunistic behaviour – not on the part of the executives and other agents hired by the principals, but by the finance market actors:

By the early 1990s, the principle of shareholder primacy had been restored with a vengeance. Corporate managers today are much more accountable than they were – to the *rentier* shareholders with whom they are now much more closely entwined...The consequences have been only too clear: a massive increase in speculative financial exchanges, regular financial crises, numerous corporate scandals, falling growth rates, a reduction in the rates of productivity growth and soaring executive remuneration. (2010: 852)

Needless to say, these claims would be disqualified by agency theorists, but both Bratton and Wachter (2010) and Ireland (2010) point at the assumptions and unsubstantiated claims made by agency theorists, all leading to the prescribed program that companies should engage in the one-sided pursuit to enrich capital owners.

Empirical studies of shareholder value creation and executive

The influence of independent directors

A substantial body of research in management studies has tested the empirical relevance of the propositions of agency theory, to ensure that

the authority to make decisions on where to invest the free cash flow is moved from top management to shareholders, from the organizational hierarchy to the actors of the financial markets. First of all, agency theorists argue that external board members play a key role in curbing managerial opportunism, but a series of studies show that there is a weak or even negative correlation between firm performance and the presence of board members recruited from, for example, investment funds. Dalton et al., found no correlation between board of director size and performance. Bhagat and Black examined the literature on the relationship between an “independent board of directors” as prescribed by agency theorists and performance but found no strong relationship:

We find evidence that low-profitability firms respond to their business troubles by following conventional wisdom and increasing the proportion of independent directors on their boards. There is no evidence, however, that this strategy works. Firms with more independent boards (proxied by the fraction of independent directors minus the fraction of inside directors) do not achieve improved profitability, and there are hints in our data that they perform worse than other firms. This evidence suggests that the conventional wisdom on the importance of board independence lacks empirical support. (2002: 233)

In Bhagat and Black’s sample of studies, four studies in the United States found no evidence of improved performance in companies with independent board of directors. Studies conducted in Australia, Singapore, and the UK support these results. Four studies report *worse* performance in firms with a dependent board of directors (ibid.: 236). In their own study, including a sample of 934 firms in 1991 and 205 randomly sampled boards in 1988 (ibid.: 240), they found a “reasonably strong *inverse* correlation between firm performance in the recent past and board independence” (ibid.: 263). Bhagat and Black conclude, “There is no evidence that greater board independence leads to improved firm performance; if anything, there are hints that greater board independence may impair firm performance.” An exception to this finding was independent directors who “hold significant stock positions,” may add value under certain conditions. In the other cases, independent directors did not. In other words, the agency theory prescription for reducing agency costs, the presence of independent directors, is unsubstantiated by empirical data. In contrast, as opposed to what agency theory predicts, empirical evidence suggests that directors recruited from the

corporation, having adequate know-how and expertise of the firm and the industry, outperform boards relying on independent directors.

Executive behaviour and board effectiveness

In addition to studies of the composition of the board of directors, there is a body of studies examining how top management engage in activities that influence the valuation of the company's stock prices. Such studies provide evidence of the difficulties involved in institutionalizing finance market control of managers as proposed by agency theory. Westphal and Clement studied how CEOs take action to counteract the risks of "negative analyst appraisals," that is, unfavourable valuations of the stock issued by market intermediaries. Their results show that "executives initiate or escalate social exchange with powerful analysts to neutralize the effects of negative or controversial information about their firms on analyst stock recommendation" (2008: 887–888). These "social exchanges" include the finance market analysts' access to executives and directors. In the case of lowered market ratings and warnings of lower performance of the company, finance market analysis were excluded from what Westphal and Clement speak of as "executive favor rendering":

Executive favor rendering significantly reduced the propensity for analysts to downgrade a firm's stock in response to the announcement of relatively low earnings or diversifying acquisitions. Thus, it appears that analysts tend to reciprocate executive favors by maintaining their stock recommendations for the executive's firm despite the release of negative or controversial information about the firm. (ibid.: 888)

In other words, these results indicate that finance market analysts who downgraded the company's stock "elicit negative reciprocity from the firm's executives" in the form of "diminished favor rendering" and "reduced personal access to top executives at the downgraded firm" (ibid.: 888–889). As finance market analysts are aware of the risks involved in the loss of such favours and access to executives, they were, Westphal and Clement suggest, "less likely to subsequently downgrade the firm in response to the disclosure of relatively low earnings or a diversifying acquisition" (ibid.: 889). The effect of these close-knit relations between executives, board of directors, and the supposedly independent finance market analysts was that the market reporting and commenting was biased by joint interests not of necessity beneficial for the third

party – that is, finance market actors relying on credible, competent, and above all, independent market ratings:

Security analysts, by issuing negative recommendations in response to poor firm performance or strategic actions that appear to serve management interest at the expense of shareholders, can direct capital and other resources away from underperforming firms and self-interested managers towards more productive users... An implication of our findings is that microsocial factors in manager-analyst relationships, by reducing the objectivity of security analysts' stock recommendation, may ultimately compromise corporate control and financial market efficiency. (ibid.: 890)

In addition, Westphal and Graebner found that under the influence of negative analyst appraisals in “the form of less optimistic earnings forecasts and less positive stock recommendations,” executives are able to “increase dimensions of board independence that were visible to external constituents without actually increasing their boards' tendency to control management” (2010: 34–35). Again, the agency theory view – that independent boards of directors are capable of reducing agency costs and thus to increase shareholder value – are rendered insignificant as executives and external finance market analysts jointly undermine the possible beneficial effects of an independent board of directors. Westphal and Graebner speak of such activities as a form of “impression management,” wherein there is an operative distinction between perceived and actual changes:

These results support our contention that corporate leaders can successfully manage the impression of external constituents about the governance of their firms by engaging in communications that frames board behavior in terms of central normative prescription of the agency logic of governance, while making visible changes in board composition that *appear* to lend credence to their claims, but that are decoupled from actual board behavior. (ibid.: 35)

The two studies reported by Westphal and Clement and Westphal and Graebner thus suggest that executives are capable of effectively manipulating finance market analysts to receive a more favourable rating than they would otherwise. In other words, executives are not acting in a way that withholds the free cash flow from the shareholders but still act opportunistically, at times unethically, to secure the shareholder value

that they have been hired to deliver. Whether this shift in opportunistic behaviour from the accumulation of resources in the company (if that proposition would prove to be true) to shareholders enrichment as encouraged by agency theorists remains unclear.

In addition to these studies that address the interface between executives, board of directors, and the external and independent finance market analysts, there are a few studies of how CEOs are handling independent directors to secure their own interests and positions: that is, independent board member are not fully capable of executing the final check on executive opportunism as postulated by agency theorists. Westphal and Bednar found that when institutional ownership is relatively high, CEOs are likely to “engage in persuasion and ingratiation tactics” to deter these representatives of institutional investors from using their voting power to reduce the CEO’s capacity to act in accordance with his or her interests (2008: 62). Such behaviour is, Westphal and Bednar claim, “generally effective in influencing institutional owners” (ibid.: 52). Moreover, Westphal and Bednar found that the presence of independent directors increased what they refer to as “pluralistic ignorance” in the board of directors. This term denotes a situation in which “virtually all members of a group privately reject group norms, [practices, or policies, or have concerns about them] but believe that virtually all other group members accept them” (2005: 264). When directors know and trust each another, when there are friendship ties among independent board of directors, and “the demographic homogeneity of the board is relatively high” (ibid.: 286), there is a lower risk of pluralistic ignorance: that is, the board of director’s work benefit from homogeneity and close-knit ties. This all-too-human view of the board of directors suggests that there are difficulties involved when there is not yet full-trust relationship between board members regardless of the accuracy of such beliefs: “Our findings suggest that directors often hesitate to express their concerns about the viability of corporate strategy in board meetings, not because they lack independence from management but because they systematically underestimate the extent to which fellow directors share their concerns” (ibid.: 286–287). The agency theory view suggests that an independent board of directors increases the quality of the corporate governance, but Westphal and Bednar’s study suggest that heterogeneity complicates the board of directors’ work.

Stock repurchases and shareholder value

Another factor that affects the relationship between the principal (the shareholders) and the agents (the executives) is the use of stock

repurchase programs. Stock repurchase is a disputed practice, and there are at least five different explanations presented in the literature for why companies decide to buy its own stock (Dittmar, 2000). In addition, stock repurchase is a relatively new phenomenon, strongly associated with the financialization of the economy and the emphasis on shareholder value maximization embedded in an agency theory perspective. "It was not until the early 1980s that US corporations began adopting share repurchase programs in large numbers," according to Grullon and Ikenberry (2000: 31). In 1982, the Securities and Exchange Commission (SEC) adopted the new Rule 10b-18 that served to reduce the "ambiguities" regarding stock repurchases derived from anti-trust legislation (*ibid.*: 34), and thereafter companies were equipped with a new tool to allocate their free cash flow. In the period 1972–1983, the total corporate payouts in share repurchase programs amounted to less than 4.5 percent of total earnings; in the period from 1984 to 1998, the same ratio exceeded 25 percent: "In the five-year period between 1995 and 1999, US corporations announced intentions to repurchase roughly \$750 billion worth of stock. Moreover, in 1998 – and for the first time in history – US corporations distributed more cash to investors through share repurchases than through cash dividends" (*ibid.*: 31).

Grullon and Ikenberry also observe that stock repurchasing activity is negatively correlated with dividends: "The average dividend payout-ratio [in the United States] fell from 22.3% in 1974 to 13.8% in 1998, while the average purchase payout ratio increased from 3.7% to 13.6% during the same period" (*ibid.*: 34). Such data indicate that the more credible explanation for the interest in firms repurchasing stocks is what Dittmar calls the "management incentives hypothesis," which she herself finds no support for. That is, CEOs and executives may be compensated on the basis of their ability to raise the value of the company's shares, and the "most common reason" for stock repurchases cited by corporate executives and stock analysts is that such programs boost the earnings per share ratio (*ibid.*: 48). If the earnings per share ratio would be the principal key performance indicator for efficient managerial decision-making, then it is tempting for CEO and executives to "eliminate dividends entirely" (*ibid.*: 34) and use the available free cash to repurchase the company's stocks. As Grullon and Ikenberry notice, there has been few indications of companies taking such actions, yet "if the corporation is compelled to pay out capital to shareholders for whatever reason, managers who are heavily compensated through options may feel more inclined to choose a share repurchase over a cash dividend" (*ibid.*). In other words, the use of stock repurchase programs provides CEOs and

executives with a “valuable, and relatively inexpensive, option to repurchase stock” (ibid.: 46); for the shareholders, their “return” comes as higher priced shares, and for the CEOs and executives, their performance is signalled through the key performance indicators assessed by the finance markets.

Dittmar wrestles with the evidence that it is primarily large firms that engage in stock repurchases. Large firms are heavily traded in the stock markets and are therefore less likely to be misvalued by financial analysts. She lists five reasons for companies to repurchases including (1) the *excess capital hypothesis*, suggesting there is capital available that cannot be effectively invested without overrating certain assets, (2) the *undervaluation hypothesis*, making the assumption that insiders (e.g., CEOs and executives) repurchase stock because they believe finance analysts undervalue the shares, (3) the *optimal leverage ratio hypothesis*, suggesting that companies want a certain ratio between its capital holdings and debt and therefore choose to make use of the free cash flow, (4) the *management incentives hypothesis*, portraying stock repurchases as being primarily a matter of an effect of (poorly designed) management incentive system and performance-reward systems, and, finally, (5) the *takeover deterrence hypothesis*, suggesting that CEOs and executives are concerned to uphold stock prices to avoid hostile takeovers. Regardless of the explanation favoured, repurchasing stock is a method to distribute “excess capital” to shareholders (2000: 333). Dittmar’s own findings is somewhat disappointing, as the data reported fails to discriminate between the five hypothesis and provides support for all but the management incentives hypothesis:

Repurchasing firms have greater excess capital and lower leverage than non-repurchasing firms and may be undervalued by investors... these statistics support the excess capital, the optimal leverage, the undervaluation, and the takeover deterrence hypotheses. Since the motives are not mutually exclusive and multiple motives are significant, it is possible that firms repurchase stock for several reasons. (ibid.: 348)

In other words, no matter why companies choose to repurchase their own stock (rather than investing capital in other forms of productive capital and training of the workforce), the outcome is equally the same: shareholder value is maximized given the company’s performance. The question is then whether this is good for the economy, for stakeholders other than the shareholders, and for the shareholder themselves.

According to the proponents of agency theory, stock repurchases is a curious operation inasmuch as it clearly violates the efficient market hypothesis, as it is based on the proposition that finance markets misvalue stocks, making its rationale questionable. On the other hand, the operation serves the purpose of enriching the shareholders and is therefore consistent with the theory of the free cash flow, assuming that residual capital serves the economy best when being distributed to capital owners rather than remaining under the control of CEOs and executives. Other commentators are not as impressed by stock repurchase programs. Lazonick questions the favoured official explanation for stock repurchases, the claim that the shares of the companies' that corporate executives manage are undervalued (2010: 696). This claim is based on the assumptions that finance markets are at the same time efficient in certain cases (i.e., in the case of shareholders making better investment decisions than inside executives) and inefficient in other cases (i.e., when pricing companies', especially large companies', shares). Such mixed emotions about the functioning of finance markets in particular and all markets more generally are clearly violating the axiomatic beliefs in the superior effectiveness of market transactions in neoclassical economic theory. Regardless of these more esoteric theoretical implications, leading to enormous inconsistencies between economic theory and the various economic activities observable in finance markets,³ Lazonick believes that "the trillions spent on buybacks in the past decades could have helped stabilize the economy" (Lazonick, 2010: 696), if that stock of free cash flow would have been allocated and invested differently. For instance, the American automotive industry has been in decline since the 1970s, while for instance the German automotive industry has thrived and managed to establish many of its brands (e.g., Mercedes, BMW, Audi) in the premium segment of the automotive market. Rather than investing in human capital and new production facilities, the American automotive industry has been forced to send its executives to Washington to ask for federal economic support and other subsidies, in many cases under embarrassing terms. It is not apparent that stock repurchasing programs and shareholder value maximization, which are advocated by proponents of agency theory and free cash flow theory, have benefitted, for example, the American automotive industry, once the pride of the nation. Instead, advocates of agency theory have arrogantly dismissed certain industries as being stagnant and in decline, and have rejected managerial attempts to turn around such industries as a wasteful and irresponsible squandering of capital (see e.g., Jensen, 1993: 845), while the very same industries have thrived

in other economies adhering to other corporate governance models. The tendency in primarily the American economy – that the finance sector accounts for increasingly higher share of total profits – suggests that the financialization of the economy has encouraged an attitude where the importance of other forms of capital investment have been overlooked as increasingly higher shares of the accumulated capital have been laid in the hands of finance market analysts and finance institutions. This Midas touch of the finance markets where “everything turns into gold,” while less is invested outside of the sphere of strict financial operations, may prove to be detrimental to long-term economic growth in an economy (Blinder, 2013; Sinn, 2010).

In summary, empirical studies demonstrate that CEOs execute pressures on market analysts to withhold unfavourable market information, that companies buy back their own stock to manipulate what the board of directors regard as an “undervalued stock,” a practice that undermines the credibility of finance market-based control, and that independent board of directors does not perform better (and, possibly, performs worse) than boards relying on internally recruited directors. This empirical evidence undermines the agency theory view and its proposed governance policies, as there is no empirical support for the accuracy of the practices prescribed. Finance market control and shareholder value enrichment is not an effective solution to agency costs. Rather than being the solution to agency problems, the finance market control advocated by Jensen (1993, *passim*) leads to new forms of opportunistic behaviour.

Corporate governance in life science start-ups

Much of the literature on corporate governance addresses concerns in major, stock-listed companies that are in a mature stage where there can be a productive discussion regarding the use of the free cash flow generated in the operations. In the case of life science ventures, the corporate governance practices look vastly different. There are no easily measured agency costs as the entire industry remains riddled by substantial uncertainty and even assessed risks, and there is not yet any free cash flow being generated. What the investors can fruitfully exploit is instead the research findings and the underlying business ideas that can be translated into biovalue if they prove their clinical and therapeutic value. In other words, venture capital investors face an entirely different situation than the one being sketched and problematized by agency theorists. Daily et al. argues that studies of board composition in ventures are

“mixed.” Still, the data “suggests that board of directors’ composition and size and important for firm financial performance and that board composition is associated with the market’s response at the time of IPO” (2002: 399). As many life science ventures, especially the successful ones having a high market value, are not subject to IPOs but remain privately owned, such findings are of limited practical relevance. Garg agrees with Daily et al. that boards of directors are “a primary governance mechanism of ventures” as the boards are in the position to monitor the behaviour of the executives (2013: 90):

I define monitoring as the activities of the board and its individual directors that track the significant behaviors of executives, the outcomes of their actions, and the performance of the venture in order to ensure that corrective action is taken as needed...Monitoring is particularly critical in ventures because of the inherent instability of ventures and markets that call for a frequent change of direction. (ibid.)

This view is consistent with the agency theory view of corporate governance. However, Garg claims that in contrast to the agency theory view and its emphasis on monitoring and reducing agency costs, in ventures there is less concern regarding opportunism on part of the agents, the entrepreneurs and executives. Instead, Garg claims that there are risks of “principal costs” as independent directors recruited by the venture capital investors may have interests in the start-up firm that deviates from that of the syndicate of venture capital investors. In short, the agency theory model is inapplicable in ventures.

Arthurs and Busenitz share this view, pointing at the close collaboration and shared commitment to the venture across the principal-agent divide:

First, the goals of the VC [venture capitalist] and entrepreneurs will likely become aligned thereby mitigating the potential agency problem. Second, after deciding to invest in the new venture, the VC is likely to change from being a wary investor to a willing collaborator...Third, the founding entrepreneur remains a substantial legal owner, albeit at a reduced percentage, while maintaining strong individual-specific investment in the venture he or she has founded. (2003: 153)

In other words, the “agency theory logic,” Arthurs and Busenitz propose, “does not recognize that those involved with an entrepreneurial venture

are almost always primarily concerned with its upside potential" (ibid.).

In the corporate governance model (further discussed in Chapter 4, where the empirical material is presented) of life science venturing, the corporate law issues, including intellectual property rights (IPRs) such as patents and licenses are carefully examined. In many cases, these IPRs are in order and are oftentimes "binary" in nature: they are in place or they are not. If they are not, these issues need to be sorted out and the underlying research findings need to be properly protected against the exploitation of other actors. In the case of Sweden, the upstream innovation systems, supporting start-ups and academic research projects in the early stages are handling these issues quite effectively. Venture capital investors rarely address any concerns regarding this component of corporate governance activities.

What is more important is the human capital and human resources component of corporate governance. Given the immense complexity of the human biological organism and all the uncertainty and risk involved in life science venturing, there is a need for a strong entrepreneurial spirit in the team that will work to bring the research idea from the lab bench into the clinics. Life science venture capital investors therefore primarily execute their rights to monitor their investments through the recruitment of CEOs and members of the board of directors. The CEO and the board of directors thus need to have both the competence and the experience and decision-making authority to effectively navigate these uncharted territories, and therefore the recruitment of such competencies is one of the principal activities of venture capital investors.

The corporate governance activities in these firms are therefore not focused on how free cash should be distributed but on the much more complex issues of first, how to create biovalue on the basis of available know-how and experience, and second, how to translate such biovalue into economic value. This means that there are essentially two phases in life science venturing: the phase where the biological and therapeutic value of, for example, a molecule or a new medical technology, is demonstrated and documented in minute detail, and the succeeding phase where such biovalues are transferred to, for example, a major pharmaceutical or medical technology firm that have the resources (e.g., the marketing competence and distribution channels) needed to fully exploit the full market potential of the new innovation. Speaking in March's (1991) terms, the former phase targets "the exploration" and the latter phase "the exploitation" of the original life science research finding. The two phases demands their own competencies and skills

and certain corporate governance competencies hosted by experienced venture capital firms.

Corporate governance in essence: contracting for the rights to value extraction in life science venturing

The specific agency theory model of corporate governance is irrelevant for life science corporate governance, but the question of who has the right and has contracted for the value extraction from successful life science ventures remains a key concern. Innovation is by definition uncertain, and it also demands collaboration (i.e., specific forms of organization) between individuals and organizations. In common sense thinking and in political rhetoric, innovation is a greater good and represents a form of “smart economic growth,” but as Lazonick and Mazzucato remark, it is seemingly paradoxical: as innovation and entrepreneurship is commonly portrayed as the key to economic prosperity in political rhetoric, innovation also leads to increased economic inequality: “One of the decades in which growth was the ‘smartest’ (innovation led) – the 1990s – was a decade in which inequality continued to rise” (2013: 1094). Apparently, the corporate governance model used in high-growth and innovative fields rewards certain actors more than others, and the legal contracts being signed by various parts are not primarily concerned with economic equality. In many cases, economic inequality is regarded by both policymakers and theorists as a necessary evil (*bien pensant* neoclassic economists treat such outcomes as mere evidence of more or less successful human capital investments being rewarded differently by the market), but it is of interest to examine how contracts between venture stakeholders are designed (see e.g., Neff, 2012). For instance, the state and the government is expected to finance basic research through the national or regional innovation system, and innovation commonly leads to work opportunities and tax income – that is, indirect benefits, rather than direct income. Similarly, salaried co-workers in ventures rarely share the economic values extracted from the ventures wherein they may have spent significant periods of their professional lives.

Lazonick and Mazzucato define innovation quite dryly in neoclassical economic terms as “the generation of higher quality products at lower unit cost at prevailing factor prices” (2013: 1094). In addition, they suggest that “there has been an increasing separation between those economic actors who take the risks of investing in innovation and those who reap the rewards from innovation,” and therefore deplore that there has been relatively limited scholarly interest for how “value is created and

how value is extracted in modern-day capitalism” (ibid.). In their view, the deregulation of financial markets and changes in corporate law has enabled investors and “top corporate executives” to “secure ownership of assets just before major innovation-related gains are capitalized into them” (ibid.: 1106). As a consequence, they continue “a set of socially devised institutions related to corporate governance, stock markets, and income taxation have permitted this concentration of value extraction in a few hands” (ibid.: 1108). In other words, what right do the contracts signed by various stakeholders of ventures specify in term of “value extraction” once the innovation generates a positive cash flow? The state is here commonly given the role of financing basic research in the life sciences, and in political circles and in the public debate, this role can be justified on the basis of ideas regarding, for example, health care innovation as being a “common good.” A more pressing issue is how the entrepreneurs and the founders, and, to a limited extent, co-workers in ventures, should be given the right to share the economic value generated in the venture when innovations are successfully launched on the market, or in the case of the venture being acquired by a major corporation, seeing a market potential for its know-how and innovations-in-the-making. To date, there is no solution to this problem, but as the data reported in Part II of this volume shows, venture capital investors, firm representatives, and representatives of the innovation system are concerned about, for instance, the founder’s gradual loss of ownership rights as new capital is raised. As Lazonick and Mazzucato propose, value creation and value extraction are two sides of the venture that needs to be addressed as a legitimate corporate governance problem.

Summary and conclusion

This chapter has reviewed the literature on corporate governance and has emphasized the distinction between the theoretical framework of primarily agency theory – undoubtedly the most influential theory on corporate governance during the last four decades – and its limited ability to explain practices in organizations – that is, its empirical failure to bridge the gap between prescriptions and actual practices and outcomes. In the case of life science venturing, much of the corporate governance literature is irrelevant or at least of marginal importance as there are not yet any residual cash flow that can be distributed or invested in productive capital, and the substantial uncertainty and risks in the early phases of venturing also render many of the issues of agency costs and managerial opportunism a moot question of little importance for the day-to-day

work in life science start-up companies. Still, the corporate governance literature is of relevance for life science venture capital investment as the entrepreneurial skills and competencies needed to bring innovations to the market are oftentimes secured by the active work of venture capital investors having the experience and the contacts needed. However, the mainstream corporate governance models widely cited in the literature are in many cases misleading, as they address issues and concerns that are not yet on the agenda in life science start-up companies still in the early stages of the innovation process.

3

The Methodology of the Study

Introduction

In this chapter, the methodology of the study will be presented. The chapter examines the Swedish venture capital market and discuss the innovation system that include a combination of state-governed, regional, and university-based institutions and actors, all contributing to the advancement of entrepreneurial ideas and activities. Thereafter, the design of the study is presented, and the data collection practices and data analysis procedures are accounted for.

Basic life science research is today a major field including many disciplines, and in the United States, financiers such as the National Institute of Health (NIH), the National Science Foundation (NSF), and other agencies ensure that more than 60 percent of all academic R&D expenditure benefits the life sciences (Cockburn and Stern, 2010: 3).¹ As Mirowski remark, the relative decline in R&D productivity in pharmaceutical industry, and the inability to run biotechnology companies “in the black” has not reduced the willingness to invest more in the biopharmaceutical sector since the end of the 1990s:

NIH funding doubled from 1999 (\$13 billion) to 2004 (\$26.9 billion); private cash infusion from venture capitalists and other sources funneled to biotechs have expanded massively in both Europe and the United States since 2000...and industry spending also increased dramatically from \$16 billion in 1993 to \$40 billion in 2004...Nonetheless, almost every measure of valuable research output in pharmaceuticals have continued skidding on a downward trend, which dates back to the 1990s. (2011: 209)

Despite this decline in new therapies, the health care market constitutes a significant share of the Western economies. In the United States, the health care industry now accounts for 13 percent of the \$10 trillion annual U.S economy (Clarke et al., 2010: 57).

In comparison to the United States, Sweden spend substantially more on R&D than the United States (Lerner and Tåg, 2013: 174) but has unfortunately, regardless of the public spending, been less successful in creating new viable companies and in registering new patents. This inability to capitalize on the money invested in basic research work has been portrayed as a European malaise of great concern for both national government and the European commission.

The institutional field of life science venturing

The “varieties of capitalism” argument: public equity markets in Europe

Many students of different capitalist economic systems (La Porta et al., 2010; Lazonick, 2010; Panitch and Gindin, 2012; Streek, 2012; Tabb, 2012) have stressed how the market for public equity and venture capital in particular (defined as private equity that is not invested in leveraged buyouts, in 2006 representing 26 percent of all private equity investment in Europe, [Deeg, 2009: 568]) differs across regions and countries. Differences in the institutional environment and the degrees of legal protections of owners and investors, for example, are factors possibly capable of explaining the varying degree of venture capital supply in different countries. Venture capital is generally accounts for a relatively small share of the capital invested in an economy – in Europe, “venture capital invested in early-stage financing represented less than 0.01 percent of GDP for the EU-15” by the mid-1990s, but “levelled off between 2001 and 2005 at around 10 billion euro per annum” (ibid.: 566) – but it is still treated as being decisive for the entrepreneurial function of competitive capitalism. Bedu and Montalban examine the relationship between the size of private equity markets and legal, institutional, and regulatory differences between countries. The data reveals large differences between countries and regions. For instance, France, the Netherlands, and Spain offer “fiscal incentives for PE [Private Equity] investments and research and development (R&D) expenditure” (2014: 34), while Germany and the Scandinavian countries do not. In comparison to Anglo-American law, France, German and Scandinavian law offers lower levels of “investor protection” and “law enforcement” (ibid.) commonly associated with higher levels of

private equity investment, yet Bedu and Montalban (ibid.: 39) notice that that “social-democratic economies economies” (e.g., in the Scandinavian countries) offers a “highly educated labour force, flexible labour markets and deregulated products markets with favour innovation” (ibid.). This in turn encourage venture capital investment. It is therefore very complicated to prescribe “one best way” to organize the institutional environment, as there seem to be many different combinations that help promoting private equity and venture capital markets. There is no evidence of the Anglo-American model of liberal market economies being more efficient than the coordinated market economies of Germany and the Scandinavian countries, for example,(ibid.: 38). Instead, the data reported indicate the somewhat circular argument that, “the richer a country is, the more likely it is to adopt PE-friendly institutional configurations, which are also financialization-friendly institutions” (ibid.: 63). Countries that have already established a legal and institutional milieu favourable to enterprising activities are also capable of creating larger markets for venture capital markets. In practice, this means that “English origin countries” with liberal market economies and “Nordic origin countries” with social-democratic economies offer the “most favourable institutional configurations for the development of PE” (ibid.: 62). The latter category of venture capital markets is based on “large stock markets” and “high public R&D expenditure” (ibid.).

While these results are not very surprising – legal and political stability and predictability create good conditions for venture capital investment – it is perhaps more interesting to learn what Bedu and Montalban found *did not* make a difference when creating venture capital markets. Despite playing a key role in the social-democratic economies as a financier of public R&D, the role of the state in promoting venture capital markets “remain unclear,” Bedu and Montalban (ibid.) write. More specifically, (1) a favourable fiscal environment for companies financed by venture capital has *no effect*, and (2) favourable fiscal R&D incentives for companies have a *negative* effects (ibid.: 64, emphasis in original). That is, the state creating incentives for venture capital investment through fiscal policies have limited effects or even counteract these objectives. In summary, therefore, there seem to be a variety of legal and institutional resources to play with and combine, all in their own particular way creating the stability and predictability needed to create investor protection and large stock markets, but the state should not actively intervene in these market processes through, for example, fiscal policies but primarily create a favourable legal, regulatory and institutional environment.

The Swedish venture capital market

Lerner and Tåg explain how the Swedish venture capital market has developed from being very limited in the early 1990s until today. In the second half of the 1990s, after Sweden had endured one of its most severe banking crises in the post-World War II period, an awakened interest in capital markets led to a substantial expansion of the venture capital market. Until the burst of the Internet bubble in 2000, the number of active venture capital firms reached 160 by 2000. Only during the 1998–2000 period, “almost three times as many venture capital market funds were founded and these were triple in size, on average, in comparison to the period 1983–1997,” Lerner and Tåg (2013: 167) say. However, the Internet boom was in many ways a decisive moment for the Swedish venture capital market. By 2006, only 80 venture capital firms were left. In the period from 2001 to 2008 and during the finance market crisis, the Swedish venture capital sector recovered slowly, but after 2008, it is again back on a lower level than in the end of the 1990s. Many of the funds that were raised during the Internet boom failed to deliver adequate returns and were therefore unsuccessful in raising new money. In addition, journalists learned about the new venture capital investment activities that state-controlled funds (e.g., pension funds) also participated in, and in cases where such money were invested unsuccessfully, substantial negative publicity was likely to follow. At the same time, pension funds that were invested in high-risk high-growth sectors in the economy (e.g., life science) such as the pension funds including the seven so-called *Allmänna Pensionsfonderna*, (often referred to with the acronym AP followed by a figure, e.g., AP5) were relatively successful in making high-risk investments. For instance, AP6 generated a “3.4% real annual return between 1996 and 2010” (Lerner and Tåg, 2013: 170) in its venture capital branch. In the period after 2008, there is a small but relatively stable venture capital market, but the major state-controlled funds remain relatively passive, as the investment managers are aware of the risks involved in venturing. Especially in the life sciences, in many cases including costly clinical trials that may reveal the unanticipated effects of a therapy, only a handful of venture capital investors are active today.

Despite suffering many setbacks since the late 1990s, Sweden still has the second largest venture capital market in the world and is second only to the United States. Sweden is also, for the period from 2003 to 2007, the second largest net importer of venture capital in the world, with the largest net exporter being the United States. (ibid.: 168). In other words,

Table 1 The number venture capital investment in ventures and the amount of venture capital investment in the Swedish venture capital market.

Year/Metrics of Capital Invested	No. of Venture Investment	Accumulated Capital in Venture Investment (MSEK)
2007	601	3,916
2008	551	4,789
2009	480	3,057
2010	564	2,696
2011	502	2,354
2012	510	1,939
2013*	502	1,652

*The figures for 2013 is extrapolated from the first and second quarters of 2013.

Source: SVCA Analys av Riskskapital Marknaden, Andra Kvartalet 2013 [Analysis of the venture capital market, Quarter 2, URL: <http://www.svca.se>, accessed 4 October 2013].

Swedish industry has been quite successful in attracting venture capital. At the same time, since the early 1990s, Sweden has spent “substantially more on R&D” than the United States – the difference being around 1 percentage point in terms of GDP – with its peak in difference in 2001 (*ibid.*: 174, Figure 6). Some of the metrics of the Swedish venture capital market is presented in Table 1 below.

The average number of investments for the 2007–2012 period was approximately 543, whereof the annual number of new investments has been stable around 40 for the 2007–2013 period (Diagram 5, SVCA Analys av Riskskapital Marknaden, Andra Kvartalet 2013, p. 6). The average annual venture capital investment for the 2007–2012 period is approximately 3,124 million Swedish crowns. The statistics also reveal that the global financial crisis did not hit venture capital investment during 2008, but only after that year, when there was a decline in investment in high-risk ventures. If one examines the metrics for buyout investment – venture capital investment in mature firms – one can notice that the access to venture capital is much higher as the risks are lower (see Table 2 below).

The average annual buyout investment for the 2007–2012 period was 20,630 MSEK. This amounts to a factor 6.6 of the average annual venture capital investment for the same period. In other words, the supply of venture capital in high-risk ventures is less than one sixth of the buyout market. The average investment was 5,75 MSEK per venture, while in buyout investment, the same metric amounts to 166 MSEK, an investment 29 times as high as the average venture investment.

Table 2 The number of venture capital investments in buyouts and the amount of venture capital investment in the Swedish buyouts market.

Year/Metrics of Capital invested	No. of Buyout investments	Accumulated capital in buyout investments (MSEK)
2007	128	24,727
2008	120	17,899
2009	145	9,568
2010	156	23,970
2011	109	28,238
2012	89	19,381
2013*	72	5,122

*The figures for 2013 is extrapolated from the first and second quarters of 2013.

Source: SVCA Analys av Riskskapital Marknaden, Andra Kvartalet 2013 [Analysis of the venture capital market, Quarter 2, URL: <http://www.svca.se>, accessed 4 October 2013].

Taxes and regulations

Venture capital investor interest organizations frequently point to the Swedish tax system as an impediment for the development of the industry. Unlike the United States, Sweden follows a dual tax system that distinguishes between capital income and labour income (Lerner and Tåg, 2013: 170), making labour income more highly taxed than capital income. In addition, more technical details such as the widely debated “3:12 rule,” distinguishing between “active business income” and “passive business income,” and where the latter income is taxed to 30 percent while active business income is taxed to 41 percent is often portrayed as an unnecessary complication for the entrepreneurs (*ibid.*: 171). As Tåg and Lerner emphasize, the access to venture capital is over-determined by a variety of factors, including the legal environment, the finance market development, the design of the tax system, labour market regulations, and public spending on research. In addition, the “risk utility function” of capital owners – for example, the willingness to expose themselves to financial risks – also affects the supply of venture capital in an economy. Taken together, the Swedish economy has been based on the governance principle that the interests of various stakeholders should be given attention and that the state should play an active role, while at the same time enabling the emergence of a market for private venture capital investment.

Regulatory issues and practices play a key role in the access to venture capital, especially in life science venturing; in many cases, they are

handled by international and transnational organizations such as the European Union. Phillips et al. suggest that the absence of a solid regulatory framework inhibits the development of suitable supply networks, and consequently novel markets cannot fully exploit their potential. In short, “the regulatory environment contributes towards the shaping of innovative products/services” (2011: 224). For instance, the EU regulatory framework regarding the development of tissue engineered products (TEPs) is one example of how political oversight and decisions enables market creations as “the rules of the game” are specified. At the same time, complementary regulatory frameworks may be overlapping, leading to a situation where, for instance, developers of TEPs that include pharmaceutical, metabolic, or immunological components have to follow the pharmaceutical directive. In such cases, it may be quite complicated for both entrepreneurs and regulators to determine what directive to follow. Still, under any condition, Phillips et al. suggest, regulatory frameworks are central to the development of new fields of venturing in, for example, the life sciences.

The structure of the Swedish venture capital market

The Swedish venture capital market can be separated into different phases, including pre-seed, seed, and venturing phase investment. In addition, there is a variety of actors involved, including state agencies, private venture capital investors (so-called business angels), state-governed venture capital investors, and private venture capital firms.

The pre-seed phase includes all the activities involved in starting the venture and creating the legal form it will make use of. In many cases, state agencies and incubators located adjacent to the major universities are actively supporting the entrepreneurs during the start-up phase. The pre-seed funding is quite small, including a couple of hundred thousand Swedish crowns, but still makes a substantial difference at this stage. When the start-ups reach the seed phase, they have moved a bit further, have created an organization around the business idea, and have, in some cases, interacted with potential end-users. The start-up may be located at an incubator, and may need further investment to develop the business idea. Also in this stage, state agencies, the incubators, and funds associated with the incubators are of key importance. The capital invested is still relatively limited, but they are of vital importance for the start-up firm. State agency and incubator representatives are fond of referring to the seed investment phase as a period wherein the start-up “qualifies” for private, large-scale venture capital investment. In practice, there is the well-known phenomenon of the “valley of death” between the

seed phase and the venturing phase, a phase wherein the start-up is not yet able to present a finished product or service and therefore have no customers or a positive cash-flow, but still is in need for capital investment to conduct clinical trials, for example, or to develop prototypes of medical technologies. In this phase, the state agencies and incubators do not control the amount of capital needed to bring the start-up to the next phase, and the private venture capital investors do not supply capital, as the product is still underdeveloped and too far away from the market. There are substantial discussions regarding how to handle this “capital gap” in venture capital markets, and there are some quite complicated issues to resolve to balance risks and opportunities. If the state takes on an increased role as the supplier of capital in this stage, there is always the risk of an overvaluation of the market opportunities of the ventures. That would lead to excessive risk-taking and a potential squandering of tax-money that brings little economic growth. In addition, as ventures are primarily privately owned, the investment of tax-money into private enterprises would either be a transfer of public resources to the private sector, or, on the other hand, if legal contracts are used to determine the rights of the various stakeholders, undermine the founders’ ownership share of the company. The latter concern is possible to handle through various forms of legal contracts, but the state’s role as what carries the risks for private capital owners (both the founders and the future venture capital investors) is more complicated to deal with politically. In other words, state agencies and the incubators have been quite successful in taking entrepreneurs and their start-ups through the pre-seed and seed phases, but rather than “qualifying” these start-ups for full-scale private venture capital investments, many ventures enter the phase where they are not yet attractive investment objects for venture capital firms, yet are “too big” and “too late” for additional support from state agencies and incubators. In some cases, various forms of stock exchange introductions – not a very attractive alternative – is the only solution to the capital supply problem facing the ventures. Stock exchange introductions signals that the venture is not yet ready for the market and that venture capital investors are not yet ready to take a position in the firm. In addition, the ownership structure of the venture becomes more complicated to handle for future venture capital investors.

Types of venture capital investors

In Sweden, there are a number of actors operating in the venture capital market. First of all, Sweden, which has a strong tradition of an active state support for industry and regulation of industrial relations, has developed

a quite intricate innovation system, including state innovation agencies and regional and university-based incubators. The university system, as part of the state administration – even though a few universities are legally foundations – also in some cases hosts entrepreneurship schools on bachelor and master degree levels. The Swedish entrepreneurship and venturing policy has since the 1990s been very focused on the supply-side of enterprising; state agencies and incubators have been very determined to increase the supply of entrepreneurs – that is, to transform, for example, academic researchers into enterprising capitalists to be able to fully exploit the economic opportunities of the basic research work conducted in the universities. As a consequence, the last two decades has been a period of frantic activities in the entrepreneurship domain, not the least on the university department level, where basically all major universities has hired entrepreneurship researchers and started education programs, theoretical as well as practical.

In addition to the state agencies and incubators, there are wealthy individuals, so-called business angels, who invest in ventures in various stages. The common role of the business angel is to supply capital in the pre-seed and the seed phases, thus complementing the state agencies and incubators that also supply capital in these stages. In the United States, where there are more active business angels and more people with private fortunes to invest, business angels are also active in the venturing phase, demanding larger amounts of capital. Finally, there are the private or state-controlled venture capital investors in Sweden. In the field of life science venturing, there is only a handful of companies and funds that are active investors, and there are a few funds in Denmark. (Scandinavia is commonly treated as one market in life science venturing.) First, there are private venture capital firms that run ten-year funds on the basis of capital they have raised from, for example, investment banks or pension funds. There is also evidence of venture capital firms that have acquired their entire stock of capital from previous successful ventures – that is, capital generated when companies are sold. These firms employ a few partners, and the sums of capital they invest are substantially higher (amounting to perhaps one billion Swedish crowns per partner) than any other pre-seed and seed investor. These private firms develop extensive networks of contacts, both at home and abroad, and are very active not only in investing in life science ventures but also in exploiting new venture ideas wherever they identify a practical need and a market demand.

In addition to private venture capital firms, there are various funds that actively invest in life science ventures. In Sweden, there is a major state-controlled fund that is given the assignment of supporting the growth

and renewal of Swedish industry, but this fund acts just like any private venture capital firm in terms of how it makes its investments, The political influence of the fund is relatively limited. Moreover, there are the pension funds, including AP3 and AP6, which have been actively encouraged to take on an extended responsibility to invest in high-potential sectors of the economy. Today, only AP3 is actively investing in the life sciences and AP6 representatives claim, for example, that the risks are too high given the prescribed returns. There is a constant concern regarding the uses of the enormous amounts of capital controlled by the state pension funds, and every now and then, there are discussions about the possibilities of using this capital to advance the next generation of Swedish companies. Third, there are private funds that invest capital accumulated in the insurance industry, but here also there is a general concern that life science venturing remains a risky and uncertain domain for investment. Of all the major insurance companies, there is only one company actively investing in life science and medical technologies.

Taken together, the Swedish venture capital market is quite vital, and there is evidence of successful life sciences ventures. A key concern remains how to bridge the activities taking place on the supply-side of the equation, the development of entrepreneurs and their ventures in the university setting and in the incubators, with a demand-side perspective – that is, how can new life science ventures acquire customers and verify the clinical relevance and market value of their products? To date, much effort has been expended to create an entrepreneurial class and an accompanying infrastructure that actively support this new entrepreneurial class. In the field of information technology and digital media, for example, including the development of video games and Internet-based services, there are many good examples of venture capital investment, but in the life sciences, one of the flagship areas for the Swedish university sector – and with the internationally renowned Karolinska Institutet as the jewel of the crown – there are fewer positive examples of how venture capital leverages promising academic research projects.

Practical research matters

Design of the study

While this study examines the access to venture capital in life science venturing, a domain of research dominated by neoclassic economic theory and quantitative methodologies, the design of the study is more influenced by a sociological research design that have been very influential in management studies. Rather than just testing hypotheses

about the behaviour and actions of various actors involved in business venturing, the research has been anchored in the desire to learn, in Watson's phrasing, "what 'actually happens' or about 'how things work' in organizations" (2011: 204). In Watson's view, such insights are best acquired through the means of ethnographic methods, but for practical reasons (including the complicated issue of access to key actors), I have relied on interviewing and published data. To learn "what actually happens" and "how things work" in organizations implies following Czarniawska's dictum that the researcher should "attempt to minimize that which is taken for granted prior to the analysis" (2004: 780), advice that in many ways run counter to the tradition of "hypothesis testing" as the bedrock of positivists' research programs. Still, this dictum is consonant with Becker's claim, "We make best use of theory when we refuse to base our research on what organizational personnel tell us, or on what 'everybody knows' ... and instead build theories on unexpected observations made in the field (2009: 548).

"Unexpected" here denotes that we have no preconceived ideas of what to be able to observe – that is, that the analyst have taken relatively little for granted prior to the analysis. Based on this proposition, Becker argues that researchers simply do not know enough to be able to formulate fruitful hypothesis prior to the actual research work, and therefore theorizing and data collection are two processes that are entangled in actual research activities. In Becker's (2009: 548) terms, the research work unfolds as an "iterative process" wherein data and theorizing (the process of using existing theory and formulating new theoretical contributions) are closely bound up and not always easily separated from one another. In addition, as Becker remarks (1992: 211), "imaginative, well-read social scientists can go a long way with little a fact," indicating that every single piece of data can be subject to almost endless theorizing and conceptual elaborations. The risks involved are thus *overtheorizing* or *overinterpretation* (Eco, 1992), the inability to use analytical frameworks in a credible and moderate manner on the one hand, and "data reification" on the other, the assumption that data per se is solely constitutive of theory and that theory-claims must always be justified on basis of empirical observations.

Max Horkheimer (cited in Mills, 1959: 123) addresses the idea of "premature conclusions" on the basis of a verificationist epistemology:

The constant warning against premature conclusions and foggy generalizations implies, unless properly qualified, a possible taboo against all thinking. If every thought has to be held in abeyance until it has

been completely corroborated, no basic approach seems possible and we would limit ourselves to the level of mere symptoms.

This emphasis on verificationist standards for theory-claims are not supported by the so-called Duhem thesis (after the French physicist Pierre Duhem) specifying that “a theory inconsistency with an observation can always be saved by modifying an auxiliary hypothesis, typically a hypothesis about the working of an instrument such as the telescope” (Hacking, 1992: 30). That is, any theory can always be saved by the adding of ad hoc hypotheses, a social solution to practical and cognitive concerns in actual research work that Karl Popper (1959, 1963) took seriously in his falsificationist turn in epistemology. The way out of this difficulty, pointed out by Becker (1992, 2009), to determine whether theory *or* data should be given a privileged position (see e.g., Swedberg, 2012: 7) is to follow Canguilhem (1989: 32) in his view of science as being a “discourse governed by critical correction.” Truthful accounts of the data demands a theoretical framework, but the theoretical framework also acquire its value through its practical use, and as we can never call tell for sure what comes first, scientific work is the iterative process of correction. In summary, in order to learn to “what actually happens” and “how things work” in organizations is a most complex epistemological issue, but in order to find a pragmatic way out of these big discussions on how we can learn to know the actual world, theory is enacted as what is helpful in making us apprehend and recognize the unexpected that Becker (2009) wants us to pay attention to.

To turn to more practical concerns, the present study uses a case study methodology (Eisenhardt and Graebner, 2007; Quattrone, 2006; Gillham, 2000) to examine corporate governance practices in Swedish life science ventures. Case study methodology is a staple methodology in management studies. Being guided by the pragmatic objective to understand the field of life science venturing, case studies provides a set of possibilities and opportunities. To start with, the case is, this research monograph is the Swedish life science venturing sector and as there are no fixed and once-and-for-all agreed-upon boundary between this sector and other professional sectors, case studies permits a somewhat fluid and porous line of demarcation between the case and the “non-case.” In addition, case studies allow for the use of various data collection methods including interviewing, the use of documents, participative observations, and ethnographic approaches, and exploring domains as messy and changeable as life science venturing. Case studies are helpful in tracking down a variety of practices, actors, and institutions that are

all part of this production of new health care therapies and medical technologies and devices. That is, the case study methodology serves its purpose as being the pathway for effective data collection.

Data collection

The present study includes three categories of interviewees: First, venture capital investors serve to supply capital to companies that are in a more mature phase, where they need to clinically verify the research findings and create marketing and sales channels for the new product. In Sweden, this group, which specializes in life science investment, is relatively small, and the sample of ten interviewees basically covers all the key actors. Second, representatives of what is here referred to as the innovation systems include a more heterogeneous group of actors including state innovation agencies, business incubator CEOs, science park directors, and interest organization representatives. This category of professionals serves to identify and develop entrepreneurs and their ideas and to support them in the building of a start-up company around their idea. Twelve interviewees were included in this category. Third and finally, four start-up and relatively mature company representatives were interviewed to provide the entrepreneurs' view of the access to venture capital and the support received from the national and regional innovation system. In total, 31 interviews were conducted. In addition, statistics from the Swedish Venture Capital Association, an interest organization, was collected. A single senior researcher conducted all the interviews. The interviews were structured by an interview guide and were tape recorded. All but three interviews were conducted in situ. The remaining three were conducted over the telephone. The interviewees were asked about their views of the Swedish life science industry and its prospects for the future, the role of and access to venture capital, the quality of the services provided by the innovation system, and similar questions pertaining to life science venturing.

Data analysis

A senior researcher transcribed interviews verbatim. In the first stage of the analysis, interview excerpts were given labels (i.e., coded) denoting the content of the discussion. In the second stage, interview excerpts from different interviews were co-labelled into broader categories, including terms such as "access to venture capital," "commercial human resources," or "board of directors." In the third stage of analysis, these different categories of texts were structured in a sequence that enabled an emplotment (White, 1978) of the empirical material into a storyline.

In the analysis, the venture capital investors' views were given much weight, as they are the owners, and according to corporate law and business practice, they are responsible for the establishment of adequate corporate governance practices. The life science company and innovation system representatives basically shared the view of the venture capital investors regarding the structure of the Swedish life science venture capital market and the access to venture capital, but they had less experience with corporate governance work.

Part II

Empirical Studies

4

Valuing and Investing in Life Science Companies

Introduction

Life science innovation is about creating biovalue, the ability to influence or enhance biological systems and primarily human biological systems, and translating such biovalue into economic and financial value. Venture capital investors, innovation systems representatives, and start-up company executives and directors all share this commitment to produce therapeutic value and economic worth in the ventures. What venture capital investors refer to as the pre-investment phase in the venture capital investment process involves all analytical procedures that precede the actual investment decision, including the first contact between the venture capital investor and the start-up firm, the evaluation of the investment proposal, and the additional analysis of the market potential and therapeutic value of the underlying basic research finding. All these pre-investment activities and decisions show that the venture capital investor is by no means strictly operating on the basis of calculative practices and predefined algorithms for the assessment of the economic worth of biovalues; on the contrary, the venture capital investor takes a broader look at the start-up firm and its potential to determine how a variety of stakeholder and actors will respond to and possibly acquire the new therapy or product offering. The venture capital investment process thus unfolds as an analysis of the socioeconomic and institutional conditions wherein the new therapy will be embedded if being successfully developed and launched in the market.

In the following, the empirical material will be structured into two sections. The first reports the venture capital investors' views of their pre-investment practices and concerns, and the second adds the innovation system officers' and start-up firm representatives' understanding

of the pre-investment process. The empirical material is structured into four sections, including (1) the venture capital investors' assessment of the scientific qualities of the investment proposal being submitted by the start-up firm, (2) the analysis of the clinical demands and practical usability of the underlying new therapy or research finding, (3) an evaluation of the quality of the entrepreneurs managing and directing the start-up firm receiving venture capital, and (4) and only discussed in the first section the possibilities for syndication – that is, forging joint investment agreements with other venture capital investors. Taken together, these various aspects of the start-up firm and its estimated ability to bring the research finding into the clinics are quite diverse and examines many factors, not least the exit market possibilities for venture capital firms commonly operating on the basis of ten years' investment horizons. Unfortunately, if there are weak exit markets for the start-up firms, it is complicated for the venture capital investors to receive an adequate return on investment within their stipulated investment time horizon, regardless of the potential of the new therapy. That is, venture capital investment ultimately relies on what Zuckerman (2012) refers to as the “principle of self-recursion,” as it is not always the value per se but *other* relevant actors' perception of value that determines whether an asset should be acquired or contracted. This principle demands that effective venture capital investment demands not only an understanding of the clinical value of new therapies and their market assessment, but also calls for a wider market outlook where, for example, the major pharmaceutical and medical technologies firms are key players whose activities are to be taken into account when making the investment decision.

The venture capital investors: Making assessments and investing capital

Value creation in venture capital investment

The venture capital investors' role in the economic system is to create and extract value on the basis of, in the case of life science venturing, academic research findings or research conducted in industry. The economic value is created on the basis of the venture capital investors' ability to mobilize a variety of resources and contacts that benefits the individual venture and to secure that commercial human resources are added to the life science ventures. One venture capital investor pointed at difficulties involved in both activities but emphasized the value extraction part, the realization of the economic value of the venture:

Our assignment is to create a yield given a balanced risk on the pension fund capital that we handle. We invest venture capital in the Nordic countries. That is where the formal assignment ends, and the rest is the board of director's interpretation of what is a suitable strategy for accomplishing that. The strategy today is to invest in more mature companies – that is, in companies that operate according to a business model and that have been established adequate possibilities for growth or other forms of value creation. (CEO, state pension fund and former venture capital investor)

As there are large uncertainty involved and receding exit markets for life science ventures, most venture capital investors choose to invest in more mature companies that are able to provide more evidence of the therapeutic value of the product offering. A business area manager in a venture capital fund addressed his concern regarding the value extraction in life science investment:

Life science have been a problematic area for a long, long time ... The most important driver for us the last few years has been to demonstrate [that there are opportunities for making money]: "Unless we do turn this around and show that there are possibilities for making money in this field, then there is no future for it!" The best contribution to a dynamic life science sector in Sweden, that is to show that we can generate a return. That would build [investment] models and attract investors. We have had a few years with good results in the business area, and we are very happy about it. That means that we are criticized for being too short-sighted, that we should invest contrarily, as the term is used, and that we should take more risks and have longer investment horizons. But we do have a very clear compass guiding us toward the creation of a reasonable predictable and robust method to be able to deliver a cash-flow. (Business area manager, life science venture fund)

The CFO of a university-based life science venture capital fund claimed persuasively that the high degree of failed investments tended to brand the life sciences as a high-risk, low-return industry, but he also pointed at their own quite positive return on the entire stock of capital invested:

The more investors that get burned by those attrition rates, the less capital there is coming into the business... It is extremely important for us to make a good example. We have an attrition rate of 50%

across the board, and we are not claiming to be the most successful drug developer of all time, but we *know* we can have 50%, and we plan for it. (CFO, University Life Science Fund)

The founder of a private life science venture capital firm could also report satisfying results from their investment activities:

This has become an industry associated with high risks and low financial performance, very much on the basis of negative publicity based on statements from investors losing money. Thank God, we have not lost money. To date, we have made a total of 47 exists...with a good return-on-investment. The multiple is roughly two times the money. (Venture capitalist firm founder and partner)

In the companies invested in by the venture capital firm, the annual sales today amount to US\$4 billion, and around 6,000 people are employed in these companies. In addition, these firms have attracted 60 billion Swedish crowns in equity financing, further testifying to the market value of original investment. In other words, venture capital investors who successfully create value in the companies they invest in can report satisfying returns on their investment. According to the CFO of the university-based fund, one of the keys to successful venture capital investment is to critically examine how value is created in the new regime of life science venturing and to be able to drop certain favoured ideas when they prove not to hold water. For instance, rather than investing a start-up firm per se to see it grow organically and to eventually acquire a market value on the basis of its net cash-flow, the CFO advised that value is created by the biovalue generated as concepts were clinically tested and verified. As a consequence, there is no use in clinging to scientific research findings regardless of their academic qualifications as long as they fail to demonstrate their therapeutic and consequently their economic value. According to the CFO, much money in life science venturing are spent on research based on an ad hoc hypothesis added only after the original ideas have failed to prove its clinical value, and therefore venture capital investors needs to be able to “take a loss” at the earliest moment. There is thus limited room for melancholia over lost chances in life science venturing, as failures must soon be overcome to be able to exploit other opportunities.

Pre-investment skills and competencies

A key process in the pre-investment work in venture capital firms is to attract investment proposals. As there is an oversupply of start-up firms seeking to

raise capital, the access to investment proposals is not a major problem for venture capital investors. One of the key terms here is visibility:

The method is based on the fact that we have 15 years of operation and that we have done a good job, making us visible out there. This has been a quite tough industry the last few years. Unfortunately, many venture capital firms have disappeared. If you examine the boom around 1999–2000, there were close to a hundred venture capital firms in Sweden, and many were competing over the opportunities. Today, there are only a few venture capital companies specializing in the life sciences. That makes our footprint on the market quite substantial. We get a good overview of what is available on the market for investment. (Venture capitalist firm partner)

The partner said the firm participated in so-called partnering conferences, arenas where start-up firms and finance market actors meet to make contacts. In addition, more regular scientific conferences and specific product conferences (e.g., medical technology conferences) were visited to meet the entrepreneurs, the big medtech company representatives, and other actors in the field. The participation in such events give the venture capital investors “a quite good hold of what is new” and give them the chance to “absorb the new ideas” (Venture capitalist firm partner). The business area manager of a life science venture fund argued that the life science sector was “quite dense” and that the fund’s investors had very “good statistics” and overview of what companies are active, where the investments are made, and by whom. The founder of a venture capital firm argued that in addition to being the receiver of investment proposals, the venture capital firm also actively created businesses on the basis of perceived clinical needs:

At a higher rate, we generate our own business ideas. We start quite a few companies based on our own ideas where our partners or partners in collaboration develop an idea. This is a purely entrepreneurial and innovation-based activity... For the time being, we examine medical devices in cardiology in a structured manner. We have understanding for the difficulties involved in developing this field and a qualified understanding of the clinical needs, the size of the market, and so forth. (Venture capitalist firm founder and partner)

When making the assessment of the investment proposals, there is a variety of skills and competencies being used. While the concept of

venture capital investors has strong finance theory connotations, in many cases the medical expertise played a more central role than advanced calculative practices in the decision-making process. A partner in a private venture capital firm, himself a trained physician, pointed at the role of medical and clinical competence:

We are five PhDs in medicine in the partner team. The rest of the partner team has a background in finance. That is the model we adhere to, to make use of both financial know-how as well as know-how regarding science and the content of the business. We often work in couples with the investment decision. (Venture capitalist firm partner)

Another venture capital investor stressed the differences between venture capital investment in the life sciences and in other sectors: "There is an element of being a generalist in investment work. Life science is actually an exception from this rule. What is needed here is a combination. You need both generalists and life science competences to be able to quickly become knowledgeable regarding the right issues" (CEO, State Pension Fund and former venture capital investor).

Another domain of expertise in life science venturing is to anticipate the economic value of a successfully developed new therapy, medical device, or medical technology. As fewer life science ventures are expected to be able to develop its own marketing and sales channels, the value of these ventures lies essentially in what the business area manager of a life science venture fund referred to as "market evidence" – that is, the value of the new therapy or technology in the eyes of the major pharmaceutical or medical technology companies that could acquire the firm. "Our medtech companies in our portfolio are all but one focused on demonstrating their market," the business area manager explained. The difficulty is then determining the economic value of something that is not yet clinically verified and still not priced on a market in order to decide how much capital are reasonable to invest, given the level of risk and uncertainty:

You need to conduct a quite extensive analysis regarding "If this comes out fine, what would be its value? How many patients are there, and how much can we get paid?"...In addition, there need to be a financing strong enough. If you have credible data and have accomplished fine results, you need to be able to resist too low bids [on the company]. (Venture capital investor, life science, state fund)

The pre-investment work thus includes a significant share of economic judgment.

Assessing the scientific quality of the proposal

The deal assessment process starts in most cases with a company contacting the venture capital investor. In other cases, there are other venture capital investors contacting a presumptive venture capital partner, and in a few cases, the venture capital investor him/herself initiates certain new ventures on the basis of perceived clinical demands. In this first stage, venture capital investors screen the proposal to find out if there is something unique about the venture that can be further developed:

We do a very, very crude first assessment to examine if this lives up to our main criteria, and one such criteria is the time to business... We need to feel this is possible to invest in, and that there is a credible management team and an ownership structure that can be invested in. If we think it is still interesting, we invest more resources. We discuss [the investment proposal] in the team and make use of some external part to make this first assessment. If it last through this "touch and feel" phase, then we do what we call a preview; we address it in the investment committee. If it is still works, then we do a more qualified and structural assessment, the due diligence. If it's still a green light, then we make a decision. (Business area manager, Life Science Venture Fund)

While this early stage assessment included an integrated overview of the venture, including its human resources, it was, the interviewees argued, primarily the underlying scientific qualities that mattered; unless there was some intriguing scientific findings being worked on, there were only limited chances that the research finding would lead all the way to the market. The CFO of a university-based private life science fund referred to this quality as the innovation height of the underlying research:

The first thing we decide is, 'What is the differentiation? What is different about this? That is what we call the innovation height'. The difference between what is currently being done for that physical condition and what this innovation will do. If that is not significant, we tell the researcher and we explain *why* it is not significant. If there is something that can be done about it, then we help them do that,

so we direct them to where they can actually create something. (CFO, University Life Science Fund)

In addition to an intriguing research finding, today the venture capital investors are quite concerned about receiving some kind of clinical data that indicates its practical utility: “We would prefer to see a bit of data from clinical studies... [That is] not a holy rule, but we also examine early stage projects,” one interviewee, a business area manager, life science venture fund, said. Another interviewee pointed to the role of clinical data in revealing the risks involved in the venture:

We do not work in the early stages. And why is that? That is because that entails very high risks. It demands a considerable engagement to develop a company that is little more than just an idea and an entrepreneur. We prefer to see that there is some kind of technical or commercial validation or anything helping us believe that, ‘Here, some capital can make a difference. Here, our engagement and network, or our brand, can help this company to develop further.’ (Venture capital investor, life science, state fund)

Such clinical data indicates that the entrepreneurs have tried to think about the practical relevance of their research work and have already at an early stage tried to make a connection between the research work and clinical applications.

In the early stage screening of proposals, there is thus a need for a quite detailed understanding of the underlying scientific theories and models. Several interviewees stressed that this is a domain where life science venture capital investment differs from other venture capital investment. The founder of one of the largest and most successful private life science venture capital funds emphasized that they were not strictly adhering to standardized calculative practices but tried to see a broader picture of how the underlying research findings could be translated into therapies and new clinical practices:

I believe we think differently than other big [venture capital] firms. We believe we are somewhat more liberal in making a synthesis of the scientific documentation, that we examine the proof-of-principle indirectly: ‘What has been tested on patients and under what conditions?’ or ‘Has this been tested on animals, and how reliable is that animal model?’ ... We try to surpass CAPM [capital asset pricing model] and try to find ways to understand the biology and the products

[in a manner] that may not be self-evident for the rest of the world. That is our specific competence... We do not work in a perfectly transparent market. That helps us create a greater understanding [of the product than others have]. (Private founder and partner)

The venture capital firm founder argued that the concept of intuition was important when assessing proposals, while on the other hand he claimed that “we cannot just rely on gut-feelings, but it helps us to know when it is worth further exploration” (private venture capital firm, founder and partner). Unless there was a sense of genuine novelty and a demand for new or better clinical practices, the venture capital investors did not proceed with the assessment. Even though the research finding was the most important quality of the proposal, already at the first screening stage, the venture capital investors pay attention to all the details that they regard as being of relevance for their investment decision:

There need to be a solid chain all the way. There is research, clinical trials, regulatory demands, product know-how; if you have a stable fundament that can stand critical assessment, and if there is a market, then I believe there is capital and people capable of accomplishing this... But there cannot be any weak spots. (venture capital investor, Life Science State Fund)

When the interviewees were asked if they believed the qualities of the proposals have changed over time, there were some divergent views. Some of the interviewees claimed that the quality was basically the same, while others saw a worrying trend in a slow but significant decline in the quality of the proposals, arguably correlating with Sweden’s gradual loss of its competitive position as new regions and countries expand their life science research activities. “I do not think we have a positive trend, but the situation is stagnating. I can see that in our deal-flow,” one interviewee, a business area manager, Life Science Venture Fund, said. Few interlocutors saw any evidence of better proposals today. The CFO of the university-based private fund argued persuasively that the barriers for launching new therapies have become higher, and therefore there were fewer chances to make quick and substantial returns on investment:

The quality is just as high. The barriers have got higher; what the market will pay for has been reduced; what the regulators will approve has been reduced. I believe, the last year there were fewer than 50 new drugs approved in the US, for example. Ten years ago, there were probably

250. What this comes down to is differentiation again. That is why differentiation is so important. (CFO, University Life Science Fund)

One of the effects of these higher barriers is that many investment proposals that include very solid and promising academic research work and findings unfortunately remain unattractive investments for venture capital firms, given their present business model. The CFO of the university-based life science fund referred to a review of the portfolio of projects at Karolinska Institutet, the medical university and the highest-ranked Scandinavian university according to the *Times Higher Education Supplement* league table, and remarked that in this stock of academic research work, only a limited number of projects are qualified for venture capital investment:

The most prolific universities, and I include Karolinska [Institutet, KI below] into that, need to access as much capital as they can but they need to access it with projects that are genuinely commercializable. That is not a very big percentage of projects. For example, we have studied some 1,200 project from the KI over the last seven, eight years and of those 1,200 I think we invested in about 25. The reason is very simple: A vast majority of academic projects are very good science but not very good commercial opportunities. They are either fixing a problem with an existing therapy, which doesn't make it very much different, or they are ideas without too much backup. (CFO, university life science fund)

The CFO of a private venture capital firm shared this view and argued that despite being pleased with the standard of the basic life science research in Sweden, "many [investment proposals] are too early and too uncertain and would need additional state-funded venture capital." He continued: "Many of these companies we have seen, they need to return to the academy, back to the world of research work. They are too far from [clinical applications and markets] to make it!" More generally, the CFO thought there was too much emphasis in the Swedish innovation model on academic entrepreneurship, which leads to skilled academic researchers spreading their competencies and time too thinly on both academic research work and entrepreneurial projects: "In quite a few cases, [academic researchers] just run off too early and try to create a company on the basis of things that would benefit from staying in the academy longer... It is not that venture capitalists are not willing to take risks, but the risks are always almost too high" (CFO, venture capital firm II).

These higher barriers also lead to a shortage of interesting investment opportunities, and consequently many of the interviewees argued they had more capital to invest. The widespread concern that there is a shortage of venture capital thus had to be seen from the perspective of the venture capital investors, who were of necessity not always hitting their investment roofs: “We do have additional capital to invest, but that is more of a matter of waiting for the right things we believe will show up. We’re not fully invested. If we see something interesting coming, we are happy to invest in it,” the CFO of “venture capital firm II” said. Another interviewee shared this view:

You can always discuss things in terms of, “Are there too much or too little money?” We who invest ... do not think we are taking advantage of a deal-flow being as big as we wish it would be. It is not the case that we hit the roof in terms of our investment capacities. We would like to invest more! We have a too-low levels of our capital invested ... But we do not see more investment opportunities. We do not think we fail to get them ... We have never been forced to throw in the towel because we have failed to mobilize the investment community. (business area manager, life science venture fund)

Taken together, it is the quality of the scientific research work that serves as the starting point for a more detailed assessment procedure prior to any investment decisions being made. If clinical data or other forms of verification accompany such research findings, the venture capital investors are very likely to proceed to the next phase: that is, to assess the clinical demand and to figure out the size of the market for the new therapy.

The clinical demand and practical usability of innovations

In the next stage, venture capital investors examine the market opportunities of the underlying research finding. In many cases, such assessment starts not so much from some market value calculation perspective, but from the health care clinicians’ perspective: What are the clinical needs and demands in health care organizations? What new drugs, medical technologies, or medical devices would increase the quality of the health care, reduce treatment periods, make the clinical work easier, or, more generally, cut costs? One of the interviewees explained:

Assuming that [the proposal] passes [the first scientific] test, that it is genuinely novel and it has places to go, we then assess the commercial market. Not the commercial market today, but the commercial

market as it might be when this innovation gets to the market, so probably ten years head. We do that by assessing what therapies there are today, and what's wrong with them, and what is in development. If the combination of those [assessments] suggests that there is a space for this innovation in the future, then it passes that gate. (CFO, University Life Science Fund)

In general, venture capital investors are not so much interested in financing venturing in quite mature fields but supports innovative therapies because economic value can be generated there: "We look at new therapeutic areas being in demand of new treatments," said a senior portfolio manager of a state-owned pension life science fund. "That is what enables new drugs to be approved and what prices them. We do not invest in hypertension, for instance, for that reason." On the other hand, with the immense uncertainty involved in new drug development, for example, venture capital investors avoid investing in too nascent fields, or fields where there is yet an inadequate understanding of the human biological system and its pathways – for instance in the field of Central Nervous System (CNS) research that was widely regarded as "a graveyard" in the clinical phases because new substances frequently failed to demonstrate their efficacy.

When making investment decisions in the life sciences, there is a line of demarcation between investing in new drug development, monitored by a specific regulatory framework, and medical technologies, regulated by other directives. In the former case, the main uncertainty relates to the efficacy and safety of the drug – that is, its product risk – while in the latter case, there is more risks involved in launching the product on the market – its market risk. If you successfully develop and register a new drug, it is very likely to sell, but the path towards the new drug registration is crooked and beset by difficulties. "In new drug development, the largest risk is always, 'Is the efficacy adequate in comparison to existing drugs?' In most cases, you cannot tell prior to the clinical trials," a venture capital investor in Life Science, State Fund remarked. On the one hand, there is less risk involved in developing medical technologies, but on the other hand, there is the risk that clinicians will not approve the new technology and make use of it in their practice. As a consequence, investment decisions in these two categories of ventures pay attention to different issues.

In order to assess the market opportunities of the new therapy or technology, the venture capital investors maintain significant networks of skilled and experienced clinicians who serve to inform the venture

capital investors of the clinical and practical relevance of the proposals. This close collaboration with clinicians is vital for the investment process:

We have these networks that we use in our diligence... We speak to the clinics, with people in health care that we know as part of the assessment. Is there an acceptance for this kind of products or not? What are the hurdles? This is something that innovators and entrepreneurs should do at a much higher degree. (partner, private venture capital firm)

In the ideal case, as the interviewee above indicated, this work should be done already by the entrepreneurs when submitting their investment proposal, but in many cases, academic researchers fully committed to their laboratory research tend to overlook or ignore the importance of a clinical perspective. Therefore, venture capital investors serve a key role in bridging the context of discovery – the research laboratories – and the context of application – the clinics – by stressing the practical use of the innovation and/or its economic benefits. In all the venture capital investment funds, there was a strong presence of clinical know-how that informed the decision-making:

We might be a little different in having large medical expertise and competence. I think it is an advantage that we are both physicians and researchers to both see where there are possibilities for improvements in the therapies in health care today, to know what medical disorders that are not fully treated... and to be able to assess products through rational and objective approaches. (private venture capital firm, Founder and Partner)

As a consequence, as many of the interviewees indicated, the investment decision is not so much derived from superior capacities to calculate future rents from the investment as it is a quite down-to-earth exploration of clinical demands, and how the specific proposal can serve to satisfy demands: “This type of activities we’re engaging with, it is very much *hands-on*. Not because we know clinical trials better, or because we know accounting better, but because we know where we can acquire such competences,” a venture capital investor in Life Science State Fund argued.

Regardless of all of the scientific and clinical assessments being made, all the interviewees argued that life science venturing is indisputably a

risky business and that it is very complicated to make any prediction prior to the more sophisticated clinical trials being conducted. Despite medical expertise, clinical experience, and substantial investment track records, life science venture capital investment still remains relatively complicated. “Unfortunately, it is really hard to find the right things [substances, molecules, etc.]. Very much does not work as well as you wished it would,” a venture capital investor, Life Science State Fund admitted. In addition, this genuine uncertainty makes it complicated to learn from experience, making “successes and hits” appear to emerge in an almost random pattern. The investor continued:

Nothing works in accordance with plans, but some things come out well nevertheless. If you take an historical perspective, it is hard to determine, ‘What works and what doesn’t?’ ...it is hard to say that ‘these types of investments are the most reasonable ones,’ but there are amazing examples from all industries and terrible examples from all industries.

As suggested by the venture capital literature, one thing that can be assessed *ex ante* is the quality of the leadership team in the companies that are financially supported, and given the influence of uncertainty, it is perhaps little wonder that a significant proportions of failed investment are explained on the basis of inadequate entrepreneurial or leadership skills. Therefore, venture capital investors tend to pay detailed attention to the scientific and commercial human capital in the companies they assess.

The quality of the entrepreneurial team

All the venture capital investors argued that they were active in the field, and systematically looked for investment opportunities. Several interviewees also claimed that it was important to “learn to know” the companies that were financially supported to be able to evaluate their potentials and their needs, in order to be able to better support their transition from the research laboratory to a more mature stage. Said one CEO of a state pension fund and former venture capital investor:

It is a matter of being active and proactive in the market, because prior to making the investment, you need to create an understanding of what are the interesting objects out there and to follow them closely. I would say that the best investments I have seen and been part of, they are the result from the ability to actually have followed

the companies during a period of time rather than just being given an offer to invest that needs to be responded to within eight weeks. (CEO, State Pension Fund and former venture capital investor)

Another interviewee strongly emphasized the preference for having personal contact with the entrepreneurs in order to assess their potential to fully exploit their research findings: "In principle, we always invest where we have some kind of contact, where we know someone. There are very few investments where we were not informed...Quite often, there are broad academic networks" (CFO, venture capital firm II). Such declarations support the idea that venture capital firms and life science start-ups are part of an ecology wherein quite close-knit relations are valued and treated as helpful in supporting the ventures.

The role of humans cannot be ignored when it comes to successful life science innovation work:

["Learning to know the companies"] includes all the components that you assess when you make an investment, not the least to learn to know and to create an image of the persons. These early phase companies are immensely dependent on the persons involved. In hindsight, when you examine why things came out as they did, why certain things went well and others did not, you notice that there is to an astonishing degree of matter of the persons involved. The same fine technology or product idea can become a success in the hands of one team, and become almost nothing in the hands of another. (CEO, state pension fund and former venture capital investor)

On the other hand, while innovative and committed founders and entrepreneurs play a key role in explaining successful cases, the very same people could also be cantankerous and unruly figures unwilling to comply with the investors' interests and intentions. Interviews with company representatives indicated that the relations between the investors and, for example, the founders, were not always perfectly harmonious, and therefore venture capital investors were anxious to sort out all kinds of issues that could potentially lead to conflicts further down the road at an early stage. For instance, venture capital investors are quite concerned about making a yield from their investment within their stipulated ten-year investment horizon, while the entrepreneurs were quite satisfied to continue what they had been doing for some time, and were oftentimes primarily concerned with finding someone who was willing to support this *modus vivendi*. Says one interviewee:

Many companies approaching us pursue some kind of 'bread-and-butter strategy'... This thing is what the entrepreneurs enjoy the most. He loves it and he thinks he's good at doing it. If he can make someone else pay for that, it is hard for him to leave it... Therefore there is a need for a joint agreement around this [the future role of the entrepreneur]. (venture capital investor, life science, state fund)

Rather than developing their company and bringing the therapy to the market, some entrepreneurs are happy tinkering in their research laboratories. In addition, in the start-up stages, they receive substantial amounts of positive feedback and recognition for being highly acclaimed entrepreneurial figures at the intersection between basic research and industry. Moreover, they have possibly been given relatively much so-called "soft money [grants and subsidies with no ownership claims]" from state agencies and other financiers further reinforcing their image of doing things just right. When venture capital investors enter the scene, their self-image as heroic figures may be somewhat tarnished, and while most entrepreneurs are aware of their limitations in the more commercial stages, there are some founders who have a hard time in these transition stages.

Practically speaking, the sourcing of qualified commercial human capital is part of the post-investment phase (see next chapter), but when assessing the investment proposal, venture capital investors try to determine the need for, for example, recruiting a CEO with market experience. In addition, it needs to be made very clear what the investors demand from the entrepreneurs, especially if the investors expect founders or principal scientists to take a step back during the coming period, for example. Due to time pressure and the various scientific and practical difficulties the company encounters in the coming period, venture capital investors cannot afford to have conflicts with company representatives. At the early stages of the venture, such issues need to be addressed and resolved.

Syndication: joint investment agreements

When venture capital investors examine a proposal, they try to bring in the wider life science venture capital community to be able to pool the risks and to take advantage of the know-how and expertise of other venture capital investors. Venture capital investment is the skill of seeing and anticipating the economic and therapeutic worth in what has not yet proven its value, and that demands a wide variety of skills and experience. As one of the interviewees emphatically argued, life science venturing

is, contrary to widespread belief, not a competitive but a collaborative field, and there is no zero-sum games played. As a consequence, venture capital investors are fond of syndicating their investments – that is, they co-invest with other funds or firms. Unfortunately, in the Nordic countries, but also in other regions, there is a shortage of professional actors to collaborate with: “Today, there are substantially fewer actors having the muscles to work in life science. There are less than ten in the Nordic countries,” one interviewee, a venture capital investor, life science, state fund, claimed. Again, it is a matter of reducing the risks taken:

There’s a technical risk, a medical risk, and a market risk, but we would like to reduce the financial risk. Therefore, we want to build solid, reasonable syndicates and to be able to... attract foreign investors to the Swedish projects. There are the same market situation here as in Denmark or Germany, so it is matter of acting in collaboration and perhaps regarding Scandinavia or Northern Europe as a cluster rather than just targeting Sweden. (business area manager, Life Science Venture Fund)

“We are comfortable taking risks: we can live with *some risks* but not *all risks*,” one interviewee summarized in regard to the strategic use of syndicated investments (venture capital investor, Life Science State Fund). Practically speaking, venture capital investors favoured something like, “three or four venture actors, sharing equally. We bring in the owners and the top management team, and that’s it!” he continued.

Another interviewee elaborated on this position:

In parallel to being a passive recipient of proposals, we work very proactively...in this case, we need to work closely with other venture capital firms out there. We always use the model to syndicate the investments. We do not carry all the investments ourselves, and we are almost never majority owners. We refer to ourselves as *influential minority owners* [English in the original], which means that in what we invest in, we own 20–30 percent, and we work through the board of directors...In the life sciences, at times it takes longer time than you anticipate and all sorts of things may happen delaying the process. In such cases it is important to have owners that are prepared to support the company even in the event of setbacks. (partner, private venture capital firm)

Preferably, there should be three or four professional venture capital investors, sharing basically the same idea about how the company should

prove its worth and sharing an investment horizon. Venture capital investors were not very positive towards, for example, the presence of business angels, as this category of investors may have other priorities and interests and could therefore easily disrupt the decision-making process. By and large, there is a preference for a clean slate when the company enters a more mature stage where it has to verify the clinical and commercial value of the innovation. Only in one specific case, a private venture capital fund whose entire capital derived from the successful selling of a medical technology company, generating around half a billion of dollars that were to be invested in new life science ventures, syndication was not favoured. In the specific case of this private life science fund, there was less emphasis on securing a return on investment on a short term basis, as the money invested were already secured:

Quite often, we are very sceptical when there are other venture capital firms involved. In principle, we have not co-invested with anyone else. It is not the case that we prefer being on our own, that it is some kind of prerequisite, but we often think that if there is another venture capital firm involved, having all these rules and regulations, then their valuation are made accordingly: if [the company] is that good, why would they like to involve someone else? (CFO, venture capital firm II)

For the life science venture capital investors, the stipulated ten years' investment horizon very much determined what kind of investment could be done, and there were some discussion about the need for potentially extending the period of engagement to, say, fifteen years. On the other hand, the quite meagre results from life science venturing over the last two decades suggests that venture capital investors should take less, not more, risk to secure adequate returns. The consequence of this increased risk aversion is that venture capital is invested at a later stage, and investments are syndicated.

The innovation system representatives

The scientific quality of the proposal

The representatives of the innovation systems, various experts and advisors working in state agencies, university-based incubators, and technology transfer offices, and regional business agencies basically share the same view as the venture capital investors on the qualities of new life science ventures. In the beginning of the second decade of the new millennium, there are increasing concerns regarding the national

innovation policy being centred on funding early-stage projects developed within academic settings. According to the innovation system representatives, the practice of providing a limited amount of funding to virtually all academically promising projects to develop their commercial potential has possibly come to an end, as relatively few of these interesting research projects had commercial potential. As a consequence, the innovation system representatives tended to critically self-examine alternative routes for the life science innovation system, to date more or less failing to take off in the same manner as the Internet-based and digital media industry had done during the last few years. At the same time, the sheer potentiality of the academic researchers' proposals and business ideas made them very stimulating to review and assess, one of the investment managers at a university holding company said:

Everything that shows up here has a remarkable potential ... Everybody we see has a firm belief in themselves, and they do not have a hard time convincing us regarding the opportunities of what is new and exciting. In fact, very many things *are* new and exciting! This is the best job in the world where you can see loads of enthusiastic researchers bringing their babies ... It is a very rewarding encounter. (Investment manager and counsellor II, University Holding Company)

Basic research results are in many cases very intriguing, and academic researchers are often good storytellers, pointing at the practical and clinical relevance of their research.

In terms of assessing the scientific qualities of the investment proposals, the innovation system representatives, such as the investors in state innovation agencies providing seed-money to start-ups, used a methodology similar to that of the venture capital investors. The investment manager of one of the state innovation agencies listed five qualities she examined before making the seed-money investment. First, she asked the entrepreneurs, "What is the benefit of the product? What does the market say? How is the competition and what do the customers think?" Second, she examined the technological components of the proposal: "The technology: What is different here and how far has it been developed? That is very important when it comes to life science. How has it been verified?" While the first point stressed a more integrated view of the entire therapy or medical technology, its actual purpose and use, the second point examined to what extent, for example, a pharmaceutical compound or a medical technology had been verified through clinical studies. Third, the investment manager examined the intellectual

property rights in the investment proposal. Regarding IPRs, one of the investment managers argued that she more recently had become more sceptical about the actual role of IPRs:

I tend to question [IPRs] more and more because it is incredibly expensive with patents. At the same time, it is something really fancy about them. That means that if a researcher further down your corridor has filed for a patent, then you may want one too even though that may not be the most important thing. (Investment manager and counsellor II, University Holding Company)

Regardless of this more structural critique, she admitted that IPRs was an obligatory passage point in the assessment work. Unless IPRs would be in order, there would be few chances of expanding the business idea.

Fourth, the finance plan was scrutinized. Fifth and finally, the leadership team was examined. For the investment manager, the enterprising qualities of the team was perhaps a key parameters when granting seed-money, as virtually all other issues could be handled and resolved as long as there were competent and entrepreneurial leaders and managers in the team. "If I should pick one single term that is of great importance here it is, a sense of urgency – the ability to understand what to prioritize," the investment manager at the state innovation agency said.

A general concern for the innovation system representatives was that the second point, that of the verification of the therapy or technology, easily located the start-up company in a "Catch 22-position" as they were expected to demonstrate that their therapy had been clinically verified before attracting more substantial venture capital investment, while such clinical studies were costly and could not be conducted before long-term funding had been secured. The money needed could therefore not be secured until reasonably credible clinical data could be reported. This dilemma could possibly be handled by the state and regional innovation agencies providing such "verification grants," but the amount of money in the system was very limited and covered at best only the costs of very small-scale studies. The director of a science park incubator addressed this concern: "There is a need for money for the verification in life science. That cannot be accomplished without resources. It is more reasonable to examine [the possibilities for] the verification process than early stage venture capital."

In the present model, start-up companies were competing over seed-money and verification money from the same stock of capital, and the director argued that there was a need for a new policy wherein these

different sources of money were kept separated and where the individual capital investment in verification studies needed to be larger. He said, "I believe there is a need for new structures...The term 'new structures' include verification phase support that actually precede the commercialization of the product."

The clinical demand and practical usability of innovations

Like the venture capital investors, the innovation system representatives also stressed the clinical application of the new therapies as the single most important factor to consider when assessing investment proposals. The investment manager at the state innovation agency outlined the procedure for this analysis:

First, we collect all this qualitative data to create a sense of understanding of the market; how large is the actual need? Then we examine the market...and then we expect [the companies] to have seen a few customers...More that kind of analysis rather than just to Google the figures, like 'We will reach one percent of the world market, and the market amounts to 2 billion [Swedish crowns]!' In that case, we always rewind the tape: 'How many customers and what does it cost?'

Speaking to customers – in many cases clinicians working in health care organizations testifying to the demand for new therapies – was the most credible form of market analysis in the eyes of the seed-money investors. In addition, life science entrepreneurs needed to estimate how large the market could be as a too-small market would never justify the development costs and full-scale clinical trials that would be required. The investment manager at the state innovation agency suggested that the ability to reach a market in the size of "30 to 50 million Swedish crowns" (3.5 to 5.8 million euros) "within five years," was one rule of thumb she and her colleagues used when examining investment proposals. In addition, in life sciences venturing, there is no use in exploring the local home market as a first testing ground (as in the case of e.g., retailing) as there is "a global market immediately" – at least theoretically, even though it takes some time to develop a sales and marketing organization – and therefore there need to be what is referred to as a "scalable business" that could expand as soon as the wheels start rolling.

One of the issues that were addressed by the innovation system representatives was the role and responsibilities of the state and regional authorities when it comes to the active development and support of the

life science industry. While the state invests heavily in basic research in the university system, the financial support for the commercialization of the research findings was more controversial. Politically speaking, there was a broad consensus across party lines in favour of financial and administrative support promoting a strong regional and local life science industry, the CEO of a regional business development agency argued. Again, both a willingness to exploit the commercial opportunities derived from the investment in basic life science research, and the ambition to actually develop new therapies are the principal drivers of the political agenda: "Someplace, at the end of the chain, there is a patient that needs to get help to improve or prolong his or her life," the CEO argued. "Would we drop that issue [from the political agenda]? I don't think so!" A vital and competitive life science industry was, the CEO argued, one element of the welfare society and served as an indicator of the level of value creation and competitiveness in the local industry. From a political perspective, a competitive life science industry was a prestigious mark of an advanced economy and a dynamic regional and local business life.

At the same time, interviewees pointed at many warning signals suggesting that there was a need for reconsidering national, regional, and local innovation policies. For instance, as some of the venture capital investors also remarked with reference to the American life science venture capital market and its practices, the innovation system representatives sketched the idea that it was better to bundle a few research innovations into platforms rather than to invest in individual projects one-by-one and treat them as autonomous and clearly separated economic entities. Said the investment manager of the state innovation agency: "In the life sciences, we would benefit from national platforms in certain areas... There are many good ideas but on their own they are not capable of making it [individually]." She continued: "One idea gives you too little return-on-investment: Bundle a few ideas and turn them into a company in order to share the various costs, like overhead costs, for instance. It is hard to find any private investor being willing to pay for that."

Also the CEO of the business region development agency called for a better integration of individual research findings in order to make entrepreneurs collaborate within "strategic platforms." In the more mature stages, when venture capital investors actively invest and participate in the corporate governance activities, there is an integration of relevant competencies and skills, such as leadership, entrepreneurial, and regulatory affairs skills, marketing and sales competence, etc., but what is still

needed is exploitation of the synergies of interrelated research findings in the early start-up phases. Unfortunately, the relatively weak position of the universities hosting individual research teams and the tradition of the teacher's exemption rights in Sweden, granting the ownership rights to the individual researchers, prevent such initiatives, and therefore, there is potentially a weaker degree of integration in the early stage life science venturing. Traditionally, individual researchers and scientists have been treated as autonomous, enterprising individuals embarking on the quest to create their own life science company – one may speak of an entrepreneurship view of life science venturing – but this model has proved to be relatively unsuccessful in terms of generating both new therapies and new companies, and consequently there may be possibilities for developing a new innovation system that emphasizes the individual research findings and their therapeutic potential rather than the ownership rights of the individual researcher. This shift from the entrepreneurs to the research findings or therapies-in-the-making represents a major shift in policy in the innovation system, and it may take its time, as there are many policies, practices, and standard operation procedures that stress the role of the entrepreneur as the key actor and the privileged agent in life science venturing. Under all conditions, there is a growing concern in all life science venturing quarters that there is a need for new ways of thinking about how to bring new therapies from the lab bench to the clinic.

The quality of the entrepreneurial team

In addition to the business proposal per se and the clinical demands and estimated market size, the innovation system representatives strongly emphasized the role of the leadership team in the start-up companies they were financially supporting. Again, the interviewees were concerned about not squandering tax money, and therefore the entrepreneurs needed to demonstrate their enterprising capabilities during presentations and investment meetings, for example. The investment manager of the state innovation agency were at times annoyed by overtly bureaucratic CEOs who got stuck with formal issues and concerns and failed to understand what really creates value in life science ventures: "There is a need for enterprising, ambitious CEOs in the companies.... You cannot just be preoccupied with formal issues! Get out there! Sell! Get your hands dirty!"

Again, the entrepreneurs end up in a most precarious position as, on the one hand, the national innovation system and the Swedish world of business is pervaded by laws, regulations, and directives that needs to be closely understood and followed, while on the other they are supposed

to be fuelled by an “entrepreneurial spirit” that, the popular entrepreneurship narrative proposes, by its sheer force overcomes all formal and technocratic impediments. In this business folklore, the entrepreneur is romantically portrayed as an unruly figure who overcomes all kinds of obstacles and setbacks and eventually manages to make it on the market and build fortunes for him or herself. Unfortunately, in everyday enterprising, there are significant workload derived from the demands for formal reporting and administrative issues, and there is in fact relatively little room for the entrepreneurial figure of this popular narrative. Also entrepreneurs are expected to adhere to the same regulatory frameworks as mature companies and industries, at times in operation for decades or even centuries. In addition, life science venturing is perhaps different from entrepreneurial activities in other sectors of the economy, as there are long development periods and high stakes, making the ultimate outcome of the enterprising limitedly dependent on more than solely entrepreneurial skills. In other words, while there is certainly an element of entrepreneurialism in life science venturing, there are many other competencies that needs to be secured to bring new therapies into the clinics. The CEO of the Swedish venture capital investors’ interest organization addressed these concerns, arguing that in other entrepreneurial fields there was a shorter distance between activities and measurable outcomes, making short-term investments easier to monitor:

I think the fund-in-fund model is not so good for life science because...in medicine there are extremely long development periods...In medicine, it is binary: you work for perhaps 15 years before you can do your third [phase] trials and you cannot tell whether this will come out well until that third trial is done...Those who invest in life science have a ten-years fund, and they will never stay until that day when you can reap [the economic benefits], but they need to step down earlier, and that increases the uncertainty. That means they cannot get a return on their investment, and not the enormous return they counted on from the beginning. There is a systemic difficulty in funds investing in life science. They should have fifteen years funds or something.

The CEO of a university-based business incubator working in the pre-seed and seed phases argued that in the early phases, when an academic researcher, a company representative, or an independent entrepreneur contacts the incubator, it is very complicated to calculate the economic value of the ideas-in-the-making; instead, it is the enterprising qualities

of the individual that are scrutinized: "It is very hard to calculate a certain [economic] value. It includes a feel for the idea, and our experience [also matters]. We examine the individuals in detail; what kind of individuals bring the ideas, and how would they take this forward?" As a consequence, much of the early state assessment of the ideas and the entrepreneurs relies on professional judgment rooted in experience and previous learning: "We rely on our experience. We have worked with so many [entrepreneurs]... A business coach meets the [entrepreneurs], listens to them, and spend time with them."

One of the company representatives, an entrepreneur and CEO of a medtech company, shared this view of the individual entrepreneurs as being of key importance when making the decision whether to not support or invest in a certain company:

The raising of capital is based on a good idea, a good story to tell, but it is also a matter of who is working in the company, who is part of the team. My impression is that it is more important for those investing the capital and their comfort than the perception of risk... When I meet new people, they no longer are concerned about how we and the investment banks produce figures and all the underlying factors but they ask, "Is this credible?" "Who are the people working with this project?" Those are the things that matter.

Since entrepreneurial activities are by definition impossible to fully anticipate, a number of lessons were learned over the years in the business incubator. The CEO of the university business incubator argued that one was, "one should think twice before investing in projects that derives from the academy to avoid investing in academic research work. At times, that is too early, but it is hard to tell [in advance]." Ideas that are academically and theoretically intriguing may not yet be ready for the corporate form, and consequently resources are ploughed down at a too-early stage. Another issue was that the incubator was often working with companies that operated on a global market, and therefore there were attempts to take these companies overseas and into foreign markets at a premature stage: "Some projects and companies are global and then there may be the risk of moving too fast to their overseas markets," the CEO noted. "We have done these trips to California, and it has demonstrated that it has been too early, prior to a very clear business model has being adopted."

Despite such small setbacks, the CEO took pride in the accomplishments of the incubator and provided extensive performance metrics

showing how well the companies developed in the incubator had demonstrated their present market values. At the same time, he was fully aware that working in the pre-seed and the seed phases is not enough, as companies with a high-growth potential sooner or later need larger sums of capital than can be provided by the pre-seed and seed financiers in the innovation system: "We can have extraordinary incubators and outstanding processes, but unless there is any fuel... then things won't move a bit! We cannot move things on the basis of sheer thinking!" he said. "It is the fuel – capital, money – that is needed."

The CEO referred to a "capital gap" between the seed phase funding and the venture capital investment phase as a major challenge for all companies:

Around 2005 when we had fixed the first pre-seed funding, the companies ended up in a situation where they faced the classic 'capital gap'; you visit a venture capital company and they say, 'Do you have three paying clients and a positive cash-flow?' 'No, not really!' 'Well, then, come back when you do!' That is their business, that is how it works! There is this capital gap."

The lack of venture capital overshadows the activities taking place in incubators.

In summary, the innovation system representatives were struggling with the same issues as the venture capital investors, anxious to identify the companies with the highest potential for both developing adequate therapies and for generating future income. However, the innovation system representatives were working in the start-up phases, had more limited capital, and were in many cases operating under political directives and agendas. As the supply of life science investment proposals was larger than the available funds, there was an endemic sense of underinvestment in promising companies or a tendency to spread the money too thinly across the entire population of start-ups. In addition, the innovation system representatives had a nagging feeling that the one-sided focus on individual researchers' and entrepreneurs' idiosyncratic research findings in many cases became a form of lottery where it was practically impossible to anticipate or predict the winner. As will be demonstrated in the coming chapters, the innovation system representatives called for a great deal more patience among the scientists, waiting for some time to turn their research findings into start-up companies.

Valuing life science companies

Venture capital investors in the life sciences encounter a difficult problem assessing the possibility of a specific research finding becoming a new therapy for use in clinical practice. Like in all venture capital investment decision-making, there are market, financial, and human capital risks involved that need to be taken into account and properly evaluated. In addition, in the life sciences and in new drug development in particular, there are product risks or medical risks that derive from the difficulties involved in predicting the efficacy and safety of the drug prior to the large scale and costly clinical trials (normally conducted in three distinct phases) that are conducted in the so-called development phase. The in-vivo animal models in many cases only crudely predict the outcomes from studies in humans, and consequently the clinical trials often reveal qualities of the candidate drug that was not anticipated. Many stories are told in the field about venture capital investors who have failed to make an adequate return on investment. The decline in the number of venture capital funds accounted for in the literature (e.g., Rider and Swaminathan 2012) is indicative of such failures.

In order to counteract these genuine uncertainties, venture capital investors take a quite wide and comprehensive perspective on investment opportunities. Venture capital investors host expert know-how in scientific disciplines, maintain large network of practicing clinicians that can assess the value and relevance of a particular innovation, and pay attention to the enterprising and commercial competence of the top management team of the candidate companies. Venture capital investment is therefore not primarily relying on calculative practices derived from finance theory, but rather such calculations and uses of various metrics complements a more qualitative analysis of the potentials of the underlying research findings. Venture capital investment, especially in life science ventures, is based on the capacity to connect two worlds previously set apart – the research laboratory and the clinic – to determine how specific research findings may translate into therapies or technologies that improve clinical practice and/or cut costs.

Regardless of the detail of the deal assessment, venture capital investors select very, very few of the investment proposals. In one of the private funds, around 99.5 percent of the investment proposals were turned down. There are many different reasons venture capital investors do not choose to finance a company, including the research findings being at a premature stage – not yet being ready to be clinically tested – the therapy potentially demonstrating too little additional therapeutic

value, or the market being too small, as in the case of so-called orphan drugs – therapies for “uncommon diseases.” By and large, interviewees claimed that a good research finding with an adequate therapeutic application would oftentimes, sooner or later, attract the venture capital needed, and if there were a shortage of commercial human resources in the company, such competence could be recruited. A standing concern among the interviewees were that academic entrepreneurship, otherwise praised in the literature (Stuart and Ding, 2006; Grimaldi et al., 2011; Rasmussen, Mosey, and Wright, 2011; Berman, 2012), had been taken too far; as soon as there was some research findings made, academic researchers were encouraged by representatives of the innovation system to start a company to protect their research findings by intellectual property rights. In many cases, premature research findings – years from any meaningful clinical application – only became an additional burden for academic researchers, who were both committed to pursuing their academic research careers and working in their companies. In such cases, the progression of the research work was often too slow, and what was initially an intriguing research finding often failed to move very far beyond such early promise. As venture capital investors increasingly prefer to invest in later stages, preferably when some clinical and commercial verification of the concept can be provided, there is little use in overstating the role of academic entrepreneurship and pushing academic research into the company form too early, the interviewees argued.

In the innovation literature, at least in more formal accounts, entrepreneurs and capital owners are at times treated as if they just meet at one single point where the capital is handed over, and the entrepreneurs take their project from there on their own. The present study demonstrates that venture capital investors in the field of life science venturing do not serve such a rentier role (see e.g., Epstein and Jayadev, 2005), but on the contrary are quite concerned about creating a detailed understanding of the company, its founders and co-workers, its underlying research findings, and its potential to make a contribution to clinical practice. Venture capital investment is thus not a single, clearly demarcated decision to invest or not invest, but rather the beginning of a long-term commitment to the development and refinement of initial academic research findings. The study thus contributes to the literature on venture capital underlining the broader role of venture capital investors as not only suppliers of capital but as help with embedding the company in a network of relations that in various ways is beneficial for

the business venture. The venture capital investors thus serve as a hub in a network of relations (Lingo and O'Mahony, 2010; Obstfeld, 2003; Ruef, Aldrich, and Carter, 2003). Such network include IPR experts, other venture capital investors, academic and industry researchers, clinicians, regulatory and marketing experts, and so forth: that is, a wide variety of actors who jointly contributes to life science innovation. When taking a strictly calculative view of venture capital investment, grounded in finance theory and cost-benefit analyses, much of the actual work of venture capital investors are either overlooked or obscured. In Fourcade's view (2011), economic valuation is revealing because it is the instant where monetary valuation is effectively co-aligned with wider social, cultural, and material interests and resources. Skilled and successful venture capital investors are experts at engaging in calculative practices and seeing beyond such calculations to anticipate the potentiality of a specific research finding in a clinical setting.

Summary and conclusion

This empirical material reported in this chapter makes a contribution in bridging the literature on economic valuation and commensuration developed by economic sociologists, and the literature on venture capital in management studies. Economic sociologists have not been very concerned about life science venturing per se, but have primarily examined cases of economic valuation that resolves social concerns and political disputes, such as the costs of polluting natural resources. The venture capital literature, on the other hand, recognizes the need for seeing beyond calculative practices to fully understand the work of venture capital investors, but this literature has ignored the economic sociology literature on economic valuation and commensuration. The study demonstrates that venture capital investment decisions is based on economic valuation wherein calculative practices derived from finance theory and specific models such as the capital asset pricing model (CAPM) is only a subset of the activities leading up to a decision. In addition to formal calculations, venture capital investors pay a great deal of attention to the clinical relevance of the research findings. History demonstrates that life science venturing is a most difficult domain, and substantial amounts of capital have been invested in dead-end projects (Rider and Swaminathan, 2012). Most of the venture capital investors included in the sample have demonstrated the capacity to generate a yield on their investments, and their capacity to perform better than the

average investor on the basis their competence to see the wider perspective and to recognize, as one interviewee argued, that “there need to be a solid chain all the way.” Further qualitative research in life science venture capital investment may reveal how such know-how and skills are acquired over time and how they are shared both between partners and across organizational boundaries.

5

The Corporate Governance of Life Science Companies

Introduction

After the venture capital investors have made their pre-investment decision work, the post-investment activities take place: that is, all the activities aimed at monitoring and supporting the value-adding activities in the start-up firms. The extensive literature on venture capital investment suggests that venture capital firms not only provide financial capital but also add value to the firm they choose to invest in when these firms become part of a network of contacts and expertise that benefit their long-term success and ultimately their survival. Consonant with such claims, this chapter demonstrates that venture capital investors are highly involved in securing leadership skills, commercial human capital, and director competence to the boards of the companies throughout their engagement in the start-up firms. Similar to the previous chapter, the venture capital investors are first examined and thereafter the view of innovation system officers and start-up firm representatives is presented. The chapter addresses first how venture capital firms carefully distinguish between academic potentials and scholarly interests on the one hand, and therapeutic and commercial possibilities on the other. What may be a very promising academic breakthrough that in the future may lead to new therapeutic areas may still be premature from a venture capital investor's perspective. As venture capital investors run ten-year funds, the basic research finding being the grit in the oyster of the start-up firm must be quite close to some practical, clinical application, or else the development of this finding is more subject to basic public research funding. Second, the chapter examines how venture capital investors engage in corporate governance practices, by ensuring an adequate level of commercial human capital and

know-how in the firms, and they participate in recruiting both executives and directors to the board. Taken together, the work conducted in the post-investment phase is very much concerned with the active recruitment of key business competencies, individuals who have experience from actively marketing, selling, and promoting new health care innovations and therapies. As the economic value of the start-up firms are not always derived from the potentials for organic growth of the firm and the accumulation of capital through sales, economic valuation is based on the assessment of the market potential of the new therapy per se in terms of market share and market penetration. Therefore, start-up firms with negative cash flow and running on the basis of debt – that is, their economic performance is poor or unsatisfying according to standard metrics – can still be highly valued by venture capital investors and others if the underlying therapy has the potential to be widely used in the clinics. For instance, if a new orthopaedic material proves to cut costs in the clinics or to shorten treatment time, the firm developing the material can be highly valued regardless of its present market position and financial fitness. As the upside risk in health care innovation is quite substantial, the know-how and the IPRs are the real drivers of economic value, and consequently the commercial human competencies and the ability to market health care innovations are of key importance to create highly valued start-up firms. The post-investment phase is thus crucial for their long-term survival.

The venture capital investors

Assessing commercial potentials of the life science innovation

As all venture capital investors strongly emphasized, the international competition over limited venture capital investment is fierce, and there is little room for national and regional preferences when it comes to the funding of the most promising research proposals. While the venture capital market is on the one hand regional (e.g., the venture capital investors in the study regarded the Scandinavian countries as their home market), it is at the same time truly international, or at least transatlantic, as, for instance, venture capital funds located at American elite universities are frequent business partners of Scandinavian venture capital investors. “This is a most elitist activity. It is a matter of competing on a global scale to be able to attract capital,” a business area manager at a life science venture fund argued. In order to secure an adequate return on investment, venture capital firms are highly selective in what they choose to invest in, and one of the key issues is to carefully distinguish

between on the one hand academically and scientifically intriguing research findings and commercially promising research results. The chief financial officer of one of the university-based private venture capital funds explained the difference:

From an academic scientific standpoint, almost everything that we see is very interesting; it advances the frontiers of science. But from a commercial development perspective, a lot of it is “undevelopable.” And the main reason is that it is a me-too.¹ For example, we’ve had people through the door with second-generation statins. But first-generation statins worked extremely well and making a slightly better one doesn’t really help. It doesn’t make a lot of difference, and if it doesn’t make a lot of difference, nobody will pay for it when you launch it.

For instance, to the chagrin of academic researchers, certain research accomplishments (e.g., diagnostic tools) have a limited commercial value unless they can be accompanied by relevant therapies. The CFO referred to one specific example: “About six years ago, a US company... developed the first definitive test for Alzheimer’s disease, and they could not sell it! The reason they could not sell it was that there is no cure for Alzheimer’s disease. So knowing that you had Alzheimer’s disease wasn’t helpful because you couldn’t do anything about it anyway.” Rather than being infatuated by amazing research findings, venture capital investors emphasized the path to commercialization as an important investment criterion. A partner of one of the major life science venture capital investors stressed the relationship between scientific novelty, clinical benefits, and the economic potential of the new therapy as what determined the risk of the investment:

If you provide a new innovative product, it can be fantastic in terms of its novelty, but it is not for sure it suits the workflow in e.g., a hospital. If this changes the workflow too much, that is you need to modify the logistics or you need to bring new technologies to make the new innovation useful, then that threshold is too high and we cannot take the risk.

One important element of the assessment procedure is to calculate what the (targeted) clients are capable of paying for the product. According to the venture capitalist firm partner, “The road to commercialization, that also includes the capacity of client’s to pay. We examine that in

detail, who's paying for the product." In most cases, however, it is not the client's or the end-user's capacity to pay that is the largest concern but rather how to get the new innovation clinically verified to make it commercially qualified. Unless someone in the health care organization can recognize the therapeutic and/or economic benefits of the new innovation, there are few chances to bring the innovation to the market. The partner explains:

It is relatively simple – “simple” within citation marks, that is – to get a [medical technology] product approved. But that doesn't make it an attractive investment, because you also need to have it valued commercially. The clinics need to start to use it and they need to be prepared to pay for it. This threshold is *much* higher than to get a product approval in Medtech.

Another venture capital investor addressed the increasingly higher thresholds into the clinics as being one of the challenges for the firms:

Generally speaking, it is more complicated to introduce products [today]. First, because the complex procurement systems [in health care organizations] but also because the physicians today, making the de facto decision whether to buy the product or not, do not have the time to work with innovative products... In the past, there were some time for the physicians to spend some time on research or innovation activities, or to work with medical devices, to test them and to introduce them in the health care sector. Today, there is no such time. The physicians are fully occupied with the production of health care work.

In the present period, new drug development has become increasingly costly and challenged by regulatory complexities.

The role of commercial human capital

In addition to what the CFO of the university-based fund referred to as the “innovation height,” venture capital investors were concerned about what may be referred to as the commercial human capital in the life science companies they assessed. All interviewees emphasized the central role of people with an “entrepreneurial spirit” and a “commercial mindset” in taking life science innovations to the market. “The most important issue in our analysis, that is, what people that are supposed to accomplish the work? It is not whether we get 17 percent, 19 percent,

or 23 percent [ownership and votes] but, ‘Who’s doing the job?’” one interviewee claimed (Venture capital investor, life science, state fund). At the same time, while the scientific and therapeutic value of a particular innovation is relatively easily assessed, “assessing people is hard,” one of the interviewees, business area manager at a life science venture fund admitted. Drawing on both previous experiences and a set of practices that the business area manager referred to “human diligence,” venture capital investors tried to evaluate the need for complementing the scientific expertise with commercial know-how: “If the wrong persons hold these [key] positions, they you have a problem, and you need to do something about it. If there is no possibilities for changing the situation, we stay away, quite simple” (venture capitalist firm founder and partner). The founders of one of the major life science venture capital firms addressed the need for a detailed analysis of the need of commercial human resources:

[Commercial human competencies] is a very important component. There is this silly debate these days that “Scientists shouldn’t become businessmen!” ... Most researchers who see a commercial potential in what they are doing... fully understand that they are not the right persons to commercialize the idea. In most cases, additional competencies, deeply respected by all parts, are needed. First, there is a need for the competence to organize the industrial development program. Another competence is “How to commercialize this?” “How can we make a commercial product?” And in between there is one very important step, that is, “How to acquire strategic incomes, that is, how to get partners being in the position to finance parts of the development program?” (Founder and partner, private venture capitalist firm)

While some of the stock of commercial human resources could be examined as quite hands-on experiences and practices, some of the interviewees argued there was also a demand for a certain enterprising attitude or entrepreneurial spirit that was more complicated to pin down for the venture capital investors. The business area manager stressed this element:

It is rarely the case that there is a lack of competence, but it is more of a matter of attitude ... It is question of energy. I don’t know if this sounds a bit cheap when speaking about the ability to motivate people, to speak of a “winning attitude.” Above all, to demonstrate this capacity to see the opportunities and seek to be explorative, while

at the same time being able to have a great deal of understanding and respect for the underlying details, figures, and so forth.

Also, the CEO of a state pension venture capital fund made use of the term “passion” to explain this quite rare entrepreneurial quality:

I think there is a need for a passion and a drive to develop things and make them happen, that you are unafraid and unconventional in the methods you make use of. You want to proceed and test new tracks, being unrestrained by old dogmas and principles regarding how things are to be done. Perhaps that is entrepreneurship, I don't know. Creative enterprising skills, that is of vital importance. An *incredible, unbelievable will to accomplish things* – that is incredibly important. (Emphasis in the original)

For the venture capital investors, the ability to identify or spot the absence of such skills was an important competence in venture capital investment. While few instruments or procedures could fully reveal such competencies, the CEO argued that experience from the field enabled an understanding of this competence:

I think you can acquire the competence to assess that; I really do. Unless you have seen the failures and the successes, then it is in principle impossible to evaluate it... That doesn't mean that we do the right assessment every time, because that is something you learn when spending time together [with the entrepreneurs]... [If such qualities] are missing, then there is a need for a change, to bring in new persons and to not be afraid of taking such action.

In many cases, these entrepreneurial skills were not in place, and therefore, venture capital investors, if otherwise being interested in the deal, had to secure managerial and commercial competencies for the development of the research findings into a therapy. Practically speaking, the venture capital investors engage their network contacts to recruit qualified individuals to key positions in their companies. Said a senior portfolio manager investing in life science companies:

We use our networks extensively. The networks we have developed, we are incredibly generous with... We still have real networks with real people that knows the industry and we know whom to count on... We try to recruit such competence to the board of directors.

To be able to recruit qualified new managers and directors, the venture capital investors turned to labour markets outside of Scandinavia: “On recipe is to bring in foreign competence in the company boards. Then they can maintain their operational role where they work at the same time as they sit on the board in Sweden and they can lift the competence. In addition, they bring their network.” (Senior portfolio manager I, state-owned pension life science fund).

Venture capitalist firm partner pointed to the cultural differences between the United States and Scandinavia, where, for example, the recruitment of a new CEO was no major issue in the United States, but quite a delicate matter in Sweden:

[In the United States], it is not a big issue to be the CEO or have some other leading position and to be replaced. That is not a failure. [In Sweden] that is the case... Here we tend to have the same management throughout the journey which may not make it optimal. The company passes through quite diverse processes and are in different stages of development in which different competencies have different weights.

Cultural differences and historical conditions apparently play a role in life science venturing.

Corporate governance practices

The venture capital investors all shared a concern regarding how to recruit qualified executives and members of the board of directors:

Our job is both to ensure that there is capital in the companies, but we do also work in close collaboration with the board of directors and the management team with all these issues. We organize a board of directors having the right competencies. What ‘the right competencies’ are matters from case to case. If you’re in an early stage, you need certain competencies; if you’re in a latter phase, you have other demands. (Venture capitalist firm partner)

The business area manager in one of the life science venture capital fund argued that he had witnessed both remarkable accomplishments and daunting setbacks during his years of work with corporate governance issues: “There are many things that could be said about this... There are remarkable challenges in this area in our field. We have been active in shifting management and the board, and we have seen the enormously

strong positive effects that can be achieved when you do things right, and the negative positive effects when you do wrong.” For the venture capital investors, having limited time to spend in the companies they invest in, top management and the board needs to act in accordance with their interests at the same time as the board maintain some kind of “autonomy” when making their decisions. The business area manager was not entirely happy about past accomplishments and called for some novel thinking in this domain:

We want competent management being in charge of the operations with the support from a professional, strong board working on basis of owners’ directives and a clear strategy...That anatomy is really complicated to achieve. There is a tradition in venturing that owners should dominate the board of directors. But this is an industry that have failed for fifteen years when working with a group of people that have travelling around, seeing the one project or company after the other going down the drain. I have many times argued that we need to try something new: Leave the board room, and work as owners...when recruiting board members and other types of competence. (Business area manager, life science venture fund)

Also the partner in one of the private venture capital firms shared this concern, and compared Scandinavia with the United States that could benefit from experienced entrepreneurs whose skills and experience could be exploited in new ventures:

This is one of the major challenges...to recruit experienced, qualified people for the managerial positions in our companies; that is a major challenge, we need to admit that. Researchers and skilled scientists are not hard to find: we have this tradition life science research and to produce innovations [In Sweden]. What we are less skilled in... that is the next step, to be able to commercialize the products, to validate them clinically and to turn it into a commercial commodity. Unfortunately, there are too few persons, I think, having that experience to have developed a company, made a product innovation and brought it all the way, sold the company or had it introduced on the stock exchange, and then wants to turn back to do the entire thing one more time. We do not have that tradition, especially not in Sweden and Scandinavia ... [in the U.S.] this is a tradition; they are *repeat entrepreneurs*, as they say. We don’t have many repeat entrepreneurs. (Partner, private venture capitalist firm)

What was in particular shortage was what the business area manager (life science venture fund) referred to as “business skills” and “business development and market competencies.” Here, the venture capital investors could choose between “younger talents having much energy and an ambition” or rely on “seniority and experience” (business area manager, life science venture fund). From his perspective, there has been too much emphasis on the latter strategy, to rely on senior managers as being competent directors in start-ups: “We had endured a long period where we have reused experienced persons from the medicine technology industry and the pharmaceutical industry, with most varying results, I would like to say” For instance, he claimed, “it is quite often the persons that have been away from industrial activities for some time...The industries change quite fast and you lose your hold of it.” More specifically, board members recruited with experience from big pharma often represented a “too non-dynamic and unimaginative view on the business development process and too little understanding of the industry, competitors, [and] trends.” Sweden has traditionally entrenched a comparative strong position in both life science research and in the multinational pharmaceutical industry – Sweden “punched well above its weight,” as one of the interviewees put it – and in many cases, board members have been recruited from these companies. However, few of the venture capital investors were impressed by their performance, nor the recent research output from these large companies, and there was a widespread scepticism regarding their use in the boards in smaller life science companies. Said one of the interviewees:

Sweden has an historical strong position in the field of international sales and marketing, but those are ‘big firm competencies’ being quite different than what you need in small companies. This is a resource in short supply, entrepreneurial, commercial persons active within the biosciences. Hopefully, things will change for the better [in Sweden] because there are actually new generations raised in this kind of companies...if you look at the U.S., there is an enormously larger supply of this kind of competent persons. (Founder and partner, private venture capitalist firm)

The CFO of a private venture capital firm argued that Big Pharma people by and large failed to understand the everyday work in life science start-ups: “These big corporation-minded people are just drivers of costs. So we do not recruit that kind of people very often, to be honest. It is almost that we fly a warning flag when there is someone from Pharmacia

or AstraZeneca showing up. To put it frankly, these companies have not been very successful in terms of producing new therapies.” A senior portfolio manager in one of the venture capital funds shared this view and accounted for her own experience as a board member in one of the start-ups:

Above all, I don't think [Big Pharma representatives] are able to imagine how limited resources these companies control. In the company where I sit on the board, I noticed the CFO was printing power-point copies and using a stapler [to prepare for a meeting]. That would *never happen* in [a Big Pharma company] that the chief financial officer would stand there pushing the copy-machine button. (Senior portfolio manager I, state-owned pension life science fund)

The business area manager (life science venture fund) quite frankly expressed his concerns regarding the presence of this category in the boards: “I believe the average age has been too high, a bit too much of *fat cats* on the boards and in top management.” The CFO (venture capital firm II) were even more critical, claiming that, “It can cause a real damage” to bring in big pharma people into the start-up firm's boards.

Regarding the actual recruitment of commercially minded top management and boards members, it differed between venture capital investors how they worked. The private venture capital firms commonly claimed one seat on the board, but the state-controlled venture capital funds were prohibited to actively work in the boards and therefore had to operate through the election committees to secure adequate managerial and commercial skills: “It could also be the case that we are dissatisfied: if the board behaves oddly year after year and do short-sighted things and the CEO is weak, then we come knocking on the door,” a senior portfolio manager (state-owned pension life science fund) said. In most cases, the founders, in most cases academic researchers, were not given managerial responsibilities but CEOs were externally recruited when the companies had reached a more mature stage. “The board is composed of us and other investors, and the founders and their representatives. We do not have the founders manage the companies. They are better at doing the academic science, that is what we like them to do and that is always an essential part of the company. We bring in a big pharma experienced CEO and we will bring in independent directors who have expertise in either the scientific area or in the commercial area,” the CFO, university life science fund, said. All venture capital investors made use of their international contact network of contacts to recruit skilled managers

and directors, and there was a general concern regarding the lack of commercial skills in the life science in the Scandinavian outside of the big pharma circles. A senior portfolio manager addressed this concern:

We think that in the Nordic countries and in continental Europe there is shortage of skilled business oriented persons qualified for managerial positions. There is a need to reach a mature phase in the companies. First, you have the founders and soft money investment and then you make use of business angels and then there are higher demands on some kind of return-on-investment. If you move on the next stage and bring in investors like VC firms, then the demands for the commercialization opportunities are much higher. At some point on that developmental path, there is a quite cumbersome transition. Founders tend to think that this is their baby that they want to hold on to, and then there are capitalists with money saying, "We want a business-minded CEO" ... We believe that CEOs having an understanding of global business development... are in short supply. (Senior portfolio manager, state-owned pension life science fund)

To handle this endemic shortage of commercial expertise, venture capital investors "bring in foreign competence in the company boards" (senior portfolio manager I, state-owned pension life science fund). These externally recruited managers and board members arrived mostly from the United States and in addition to their practical competence, they also contributed with extensive networks of contact that were invaluable for the life science companies. The senior portfolio manager claimed that she and her colleagues in the venture capital industry were "incredibly generous" with sharing their networks, underlining that venture capital investment is, as one interviewee said, "a collaborate, not a competitive industry."

There was a general tendency to treat the United States as the role model in venture capital investment, having more experience from life science venturing. Some of the interlocutors even criticized the frequently addressed concern that there is either too weak entrepreneurial skills and traditions in Europe, or that there is a shortage of venture capital that starves promising life science ventures, two commonplace explanations for the European inability to produce more return on investment in life science research. They questioned the European venture capital investors' competence and skills:

European venture capital investors are more risk-averse, invest smaller sums of capital during shorter cycles and may not have fully learned

what the real costs are. I think they have come longer in the U.S. They have more realistic expectations, have more experience, and have a larger access to capital. As a consequence, the life science companies are better supported... [It is a matter of] experience in the whole system, from owners to management and commercialization experts. (CEO, state pension fund and former venture capital investor)

In this view, not only the academic researchers and the accompanying innovation system composed of regional and university-based organizations such as incubators, science parks, and technology transfer agencies are to be blamed for the European disadvantage, but also the venture capital investors' inability to adequately predict risks and anticipate challenges may play a key role. Moreover, as studies of, for example, the Silicon Valley computer industry cluster have demonstrated, American entrepreneurs who fail are not stigmatized but instead their competence and experience is highly valued and appreciated. The differences between Europe and the United States are therefore arguably to some extent culturally embedded.

In summary, venture capital investors do not play a passive role as the mere suppliers of financial resources but rather examine the entire life science investment proposal from a more integrated and comprehensive view including the commercialization of promising basic research findings. In the cases where investment proposals are selected, venture capital investors most actively engage in securing skilled managers and board members to bring the new therapy into the clinics. In many cases, venture capital investors activate their extensive international networks to ensure that there are adequate commercial human resources in the companies they select for investment. In other words, rather than having a passive role as the mere supplier or finance capital, venture capital investors are spending much time and effort to ensure efficient management and governance practices in the ventures receiving investment.

The view of the companies and the innovation system representatives

Identifying research findings with commercial potentials

The company representatives were fully aware of the venture capital investors' expectation on their companies, that they expected a positive cash flow or a significant market share in a targeted market within the regular ten-years investment horizon. Company representatives also saw how they should preferably be acquired by some larger corporation

controlling elaborate marketing and sales channels and distribution networks to get the therapy into the clinics. One project leader in a university spin-out said: "We are all very well aware that this is not something that we can pull all the way on our own to the market, but it is a matter of collaborating or being acquired by a larger corporation. Once you get the chance, you take it!" (Project leader, herpes vaccine start-up company). The company representatives shared the view with the venture capital investors that the supply for venture capital was limited. At the same time, they understood the risks involved in life science venturing. One chief scientific director with experience from starting several successful life science companies pointed at the difficulties involved in comparison to, for example, technology venturing:

It is not that easy for the government to specify such orders; "Find a drug that will cure cancer!" It is much easier with a radar system where you can provide specifications. That is a tricky thing to do [in the life sciences]. You could have the ambition but it is much more difficult. Much is found in the domain of basic research in our world; you identify a target. It is not that often discoveries emerge in the pharmaceutical companies, but that comes from, if I may use such a term, *creative environments*... [Technology development] is easier to plan. (Chief scientific director and bioentrepreneur, life science company #2)

In this account, basic research is the driver of the life science industry but in Sweden, the interviewee argued, basic research is more or less confined to the universities and other academic settings. In order to increase the degree of innovativeness in the life science sector, the Swedish state could use the National Institute of Health (NIH) in the United States as a role model, being less concerned about where the research is located institutionally and more interested in a qualitative output, the chief scientific director argued: "NIH allocates resources where they believe the best research is conducted" (chief scientific director and bioentrepreneur, life science company #2). He continued:

Quite often, targeted research areas are confined to academic research. If you invest in one research area, it is important that it eventually will lead to products... There are certain strategic projects but then only academic researchers [receive grants]. I think we need to reexamine the applications and stimulate the connections to industry. (Chief scientific director and bioentrepreneur, life science company #2)

The chief scientific director claimed that one of the difficulties with the funding of the Swedish life science research was that too many actors received too small research grants, leading to piecemeal and limited research programs. In contrast, he wanted to see larger and more integrated research programs where a few targeted fields of research are given substantial resources:

What you can do in The States [the U.S.], defining targeted research areas that you make a bit bigger. Rather than fertilizing the entire field, you select a few vegetables that have higher value and you fertilize them and care for them a bit more to improve the competitiveness in such areas. (Chief scientific director and bioentrepreneur, life science company #2)

This ambition to support every single promising research project was also reflected in the way the university spinouts were financed by the innovation system. The project leader of the herpes vaccine research project admitted that her start-up company had been quite successful in receiving research grants and other forms of financial support during its first years of operation, but she still thought that there was a tendency in the system to award research projects that fitted into a predefined innovation system framework. These demands from the financiers had two consequences for the life science entrepreneurs. First, there is a risk that truly innovative research ideas are excluded because they do not comply with the formal requirements enacted by the innovation system organizations:

I think we tend to miss many good ideas when we develop a framework for how good ideas should look. That is dangerous! For starters, you don't know what a good idea looks like before it appears. That is part of its nature: being innovative means that you deviate from what is expected. Then there's a problem to define in advance how things should take shape. (Project leader, herpes vaccine research project)

The paradox is that science is by definition uncertain and unpredictable but still the innovation system organizations expect the life science entrepreneurs to be able to anticipate and predict how their research work will unfold and to at an early stage consider the therapeutic and market value of the research work. Second, when the start-up firms receive funding, the money is almost always bound up with certain formal requirements that need to be fulfilled on part of the recipient. In

some cases, the project leader argued, these requirements imposed additional burdens on work on already busy life science start-up firms: "Most innovation money comes with certain requirements, both in terms of who can receive them and how they are to be used, instead of starting with the idea and what you need to do with it" (project leader, herpes vaccine research project). "Since you are dependent on the money, you try to work in accordance with the requirements, but that is not always for the best [for the research work]," the project leader argued.

In this view, the innovation system organizations, the state agencies, university-based incubators and technology transfer offices, and so forth, were all managed on the basis of a bureaucratic and administrative logic and therefore the ability to monitor and regulate the start-up companies were given a higher priority than the actual research output. Since the national and regional innovation system is financed by tax-money there was a strong focus on "not squandering tax-money" in everyday activities of innovation system. "There is this obsession with controlling and monitoring where this public money is used. That slows down the process," the director of a university-based incubator argued. Representatives of the innovation systems were more prone to talk about their role as something like "dressing up the start-ups for the venture capital investors," a form of window-dressing of the life science entrepreneurs' accomplishments. "It is important for me to know what [investors] want further down the road so I can clarify that [for the life science entrepreneurs] at an early stage," investment manager #1 at a state innovation agency argued. In her view, there is quite good access to early-stage soft money in Sweden but later on, when the company needs to attract larger sums of money to finance, for example, the clinical research studies, the competition over financial investment is much tighter. Her role was therefore to try her best to inform life science entrepreneurs about what life science venture capital investors expect from the companies they choose to invest in. The state agency investors thus examined "whether this [company] is qualified enough to attract some of the larger actors?" (Investment manager #1, state innovation agency), and if that is not the case, to take measures to prepare the entrepreneurs for the later stages. The state innovation agency played this role to "fertilize the field" in order to see what would come out as credible candidates for more long-term venture capital investments: "[If] we think, 'This may be an interesting idea but it is not yet mature for owner capital investment,' then we can throw in a bit of money and give them some advice on how to proceed and then we'll see what happens" (program manager, state innovation agency).

In many cases, the state agency's involvement led to further investment by professional venture capital investors, but unfortunately the period after the 2008 finance market collapse has been characterized by lower venture capital investment activities:

When we invested in a company [prior to the 2008 financial crisis], at the time of the raising of new capital, we attracted three times the money [the agency invested] and in reinvestment it was seven times our invested capital... After the financial crisis, the figures are something like one-to-three – that is, if we invest one million, three millions of private equity is invested. (Program manager, state innovation agency)

One of the explanations for the post-2008 decline in venture capital investment was the principal challenge for the venture capital investors to secure an exit from their investment. Traditionally, the major pharmaceutical companies, having an above-industry level of profits and a substantial cash flow, and large multinational medical technology companies have served as an exit market for venture capital investors, but during the last two decades the pharmaceutical industry has struggled to maintain a high level of output of new registered drugs and therefore their interest in acquiring firms with uncertain market potential has been lower. In addition, stock market introductions through IPOs (initial public offerings) are not very favourable exit opportunities either, as these life science companies often generate a limited cash flow and are still not holding any significant market shares. As a consequence, life science start-up companies that previously could be sold after the ten-years venture capital investment period were more complicated to sell. This in turn led to a less busy life science venture capital market and investment activity. "If the major pharmaceutical companies have been active buyers, then it would have been more attractive for these venture capital firms to invest, because then there would be a distribution channel or a buyer of these [companies]," the CEO of the venture capital investors' interest organization summarized.

Taken together, the life science company representatives appreciated the efforts to support the commercialization of life science research findings, but were at the same time critical about the absence of a more integrated research funding policy in Sweden. The life science company representatives also thought that the financial support of start-up companies were often putting additional administrative demands on the companies that only limitedly added value to the original research

finding and its path towards commercial application. On the other hand, the innovation system representatives thought of their role to select and further refine promising life science start-up companies to make them more attractive investment opportunities for the professional venture capital investors.

Corporate governance practices

Even though it was generally claimed among the interviewees, venture capital investors, company representatives, and innovation system actors alike, that the early-stage soft money grants were not very complicated to receive, there was some criticism regarding the corporate governance practices of the early-stage investors. The chief scientific director of the stem cell technology company argued that this early funding often came with quite detailed ownership demands, and consequently such early investments were quite “costly” for the start-up firm: “I think the [local] universities claim substantial ownership right for these early investments. The demand a large share of the ownership for a quite limited amount of money in the early stages because they regard themselves as being important... Those are ‘expensive money’ when you run a company” (chief scientific director and bioentrepreneur, life science company #2). The director here points at a principal concern regarding the protection of the entrepreneurs’ ownership right and how to balance investment and ownership. The CEO of a medtech company emphatically defended the entrepreneurs against various capital investors’ ownership claims accompanying their money, pointing at a general problem in the design of corporate law and the regulation of capital markets:

[The founders] are eaten alive! ‘Of course we can invest additional five millions, but then we need 20 percent more [of the stocks]!’ and then the founders are left with 15 percent and then it is fun no more. Since this is tax-money and not private money, and their [the state agencies’] role to get companies started and make them profitable [this model can work]. They have no other objectives! They are not expected to maximize returns or anything. (CEO, medtech company)

Also the CEO of the university business incubator shared this view: “It is a concern that the founders’ [ownership] is thinned out to an unreasonable level; you kill the soul and the motor or the company.” He continued: “If you own 5–6 percent of the company and work for 22,000 [Swedish crowns] per month, 16 hours per day, then people drop

out and all go wrong." To handle this concern, the CEO of the medtech company suggested that the state agencies, operating on the basis of tax-money and having no other assignment than to support start-ups to grow in size and economic value, could design contracts where the stock could be returned to the entrepreneurs at a discount once the company generates a cash flow:

No matter what, the founders that are passionate about this and have been around for a long time with very low compensation, when they have used all of their resources, it is very common that someone else just takes over and materializes all of it! My view is that in order to help these entrepreneurs survive, there should be a clear model where the [state-funded] capital investors could be combined with a re-purchase program where the founders could buy the stock back [corresponding to the costs involved for the government agencies] (CEO, medtech company)

Needless to say, the innovation system representatives thought it would be impossible to invest tax-money in privately owned companies without receiving the authority to monitor the use of the money. Company representatives, but also venture capital investors, thought it would be a better idea to have higher degrees of taxation on future profits generated by successful life science ventures than to execute detailed control on every single penny invested in the life science sector. An administrative regime of governance here clashes with an entrepreneurial culture, leading to discussions regarding the best uses of tax-money in exploiting life science investment.

Practically speaking, the innovation system representatives stressed a balanced board of directors that represented various fields of expertise and competencies. The investment manager at the state innovation agency argued that the principal role of the board of directors was to "implement structured work procedure for the coming period," that is, to secure a strategic and tactical plan for how to be able to attract more long-term venture capital investment. One concern for the investment manager was that the board of directors easily took over managerial responsibilities and started to act as "management teams." This led to a situation where "the roles are mixed up very easily," and where the regular corporate governance structure distinguishing between managerial and board roles are no longer maintained. For the investment manager, such practices did not signal to potential venture capital owners that the company was a credible investment opportunity and that all

governance functions were in place and fully operating. In addition, the investment manager argued that she preferred an external chairman of the board of directors, a feature of the board being prescribed by mainstream corporate governance theory.

The company representatives also shared the view of some of the venture capital investors that “big company professionals” were not of necessity the most suitable member of the board of directors in the small-scale life science ventures, not yet acquiring any cash flow or holding any market position. The chief scientific director echoed some of the venture capital investors when he pointed at his own experience from a number of life science ventures and emphasized the difficulties involved in making “big pharma people” understand the challenges of small start-up companies: “I think one common mistake that is done in small companies that is to bring in people with experience from large corporations in early stages. They do fulfil a function later on. But a small company wrestles with many other challenges, and these ‘big corporation people’ do not always understand that” (chief scientific director and bioentrepreneur, life science company #2). He exemplified by pointing at the belief in formal reporting and communication rather than substantial value creation in the firms: “Perhaps, you have two million [Swedish crowns] and then they say, ‘We need to develop a better business plan,’ and then you invest half a million in that job.” This critique did not suggest that all sorts of competence derived from large pharmaceutical companies were useless for the start-up companies; scientific expertise and competence in the field of clinical trials and regulatory affairs were for instance highly valuable competencies. Both company representatives and innovation system actors agreed that the board of director was of great importance for the life science start-up companies. The program manager in the State Innovation Agency argued that in addition to scientific expertise and “accountants,” there is a great need for what he referred to as “market-savvy people” – board members with a “commercial mindset” and an ability to conceive of the shortest route from the lab bench to the clinics. According to innovation system actors, this recognition of the commercial competence needed to generate cash flow and acquire market shares was one of the difficult issues to handle for the scientists becoming entrepreneurs as they were primarily concerned with the scientific and therapeutic potential of the research findings. Said the investment manager:

They [life science entrepreneurs] have a real long trip ahead of them. Highly professional people that have earned academic recognition,

they cannot understand that I ask questions like, ‘Yes, but what does the customers say?’ ‘But all my friends make use of it [a new medical technology] and think this is really good!’ ‘Well, but how much did they pay for that, and what does it take to make Pfizer buy this product?’ (Investment manager #1, state innovation agency)

In many cases, the life science start-up companies hired very junior persons to work with the commercialization activities but as these co-workers tended to work on their own, it is complicated for them to find their ways into the marketing and sales channels in the life science industry:

Many of these ideas being presented are presented by a solid and secure researcher, but the person working with the commercialization is often a very junior person, having a bit of work experience but frequently no more than that. I think that is really hard! They are really competent and make amazing business plans and are very receptive, but they lack a manager to communicate with. (Investment manager #1, state innovation agency)

By and large, despite acquiring much respect and even admiration, the life science researchers were frequently portrayed as some kind of introvert loners that were more concerned with securing their academic careers and spending time in the laboratories than to actively build and develop their companies. In short, there was an implicit assumption regarding a trade-off between academic excellence and enterprising skills. For instance, the CEO of the venture capital investors’ interest organization reiterated this narrative:

Those who innovate, they are no entrepreneurs but academic researchers, and our performance-reward system is built on publications in scholarly journals. The more publications, the more research grants. There are no incentives to commercialize [research work] and they possible also lack the ability to assess what can be commercialized. (CEO, venture capital investors’ interest organization)

The chief scientific director of the stem cell technology company, having a foot in both worlds and an impressive track-record in life science venturing, was not fully convinced this one-sided belief in the virtues of commercial thinking was always beneficial for the life science start-up companies: “The board members in these companies put much emphasis

on [commercial concerns]. It is almost too much of that!" (Chief scientific director and bioentrepreneur, life science company #2). In his mind, the innovation system representatives and others were in cases too eager to exploit the commercial potentials of life science research findings and therefore underrated the time needed to advance new therapies and to reap their commercial potential. The chief scientific director made a comparison with his experiences from working with German venture capital investors, being much more tolerant of slower economic growth and having a longer time perspective:

I have been working with very much with German companies. They build up things slowly. They prefer not to bring in venture capitalists. They build their own corporations and are unwilling to see any limitations, so they get by, using perhaps a few private investors... I have seen many examples during this period I have been involved in this industry, how the Germans are capable of building companies. You [first] run into them and they [carry all the company administration in] a backpack and have five persons [employed], and today they have like 1,000 employees. (Chief scientific director and bioentrepreneur, life science company #2)

Some of the innovation system representatives shared this view, and for instance the project manager at the state agency deplored the limited resources and the short-term perspective enacted by his own agency:

If you examine the entire chain, from basic research to the final company, I think there is a need for more perseverance. We need to be able to collaborate with these companies for a longer period of time. At present, we can invest 2,5 million and then its over! Which means that there is this gap between us and the major players [i.e., venture capital investors]. (Program manager, state innovation agency)

Also the director of one of the university incubators addressed this concern, the difficulties for venture capital investors and other relevant actors to see the difficulties involved in life science venturing in comparison to technology-based venturing:

There *are* quite long development times in life science. Once you have decided to develop one medical technology product is it not that easy to change the path... In an industry project, I'd say, it is easier to find new customer groups if the first one fails and then you

can reconstruct the venture. In life science, you need to know from the very beginning what kind of business you are pursuing... In that respect, there are significant demands for a detailed analysis if there are any interesting clients' needs... and whether there is a technology that can be verified. (Director, university-based incubator)

Given these concerns, one may question whether corporate governance practices prescribed for more mature firms in technology-based industries are of necessity the best models for life science start-up companies. Perhaps there is a greater need for patience and long-term thinking in life science venturing.

Corporate governance in life science ventures

Life science venture capital investment includes what De Clercq and Manigart (2007) refer to as “post-investment processes” such as the establishment of a corporate governance practices. Much of the ownership rights are regulated by contracts in life science ventures but top management and the board of directors still play a decisive role in bringing academically intriguing research findings to the market. Still, in comparison to the control function that the board of directors are postulated to fulfil in agency theory prior to large-scale clinical trials, the work of both top management and the board of directors grapples with entirely different problems. First of all, there is no residual cash flow being generated in life science ventures prior to the launch of the new therapy, and consequently the very source of the antagonist relationship between managers and owners theorized by agency theorists is not a substantial issue. In addition, as there is a genuine uncertainty regarding the efficacy and safety of the new therapy, there are significant difficulties involved in measuring agency costs as neither top management, nor the board of directors, nor the venture capital investors cannot fully anticipate all forthcoming events, and claiming that top managers act opportunistically in this setting is not a credible standpoint. As a consequence of the absence of free cash flow and the uncertainty in the venture, there is no “finance market” to control executives in life science venturing – at least not in the sense postulated by agency theorists, stressing the stock price (i.e., market value) as the indicator par excellence of managerial competence. Instead, life science venture capital investors choose to syndicate their investments to spread their risks and to be able to take advantage of other venture capital firms' networks (Deli and Santhanakrishnan, 2010; Sorenson and Stuart, 2001; Gompers, Paul and Lerner, 2001). The syndication of investment and

the accompanying sharing of the work in the board of directors thus represent an entirely different corporate governance logic than the one being prescribed by agency theory. The empirical study thus suggests that agency theory is a “special theory” rather than a “general theory.” If one overlook the evidence of the “empirical failure” (Fligstein and Choo, 2005) of agency theory, this model for corporate governance may be capable of explaining corporate control in mature industries with high degrees of free cash flow and low degrees of debt, preferably having a tradition of mergers and acquisitions or the growth of conglomerates including unrelated diversification. The pharmaceutical industry, demonstrating above industry average performance (Lexchin, 2006), a growing inability to produce new innovative drugs (Garnier, 2008; Angell, 2004), and a tendency to engage in extensive merger and acquisition activities (Chandler, 2005) is perhaps a qualified candidate for the corporate governance practices prescribed by agency theorists. However, this is an idiosyncratic case. Instead, the study of life science venture capital investment and its accompanying corporate governance activities by and large supports the critique of agency theory as being unable to explain and predict organizational practices. Say Davis and Stout:

Agency theory fares rather poorly as an empirical theory, despite its imposing status as normative theory... Agency theorist seriously misconstrue the extent to which boards can be seen as vigilant monitors looking out for their shareholder principals—if anything, boards’ interest are much more closely tied to those of managers... Agency theory, as it stands, does not provide a credible alternative theory of organizations. (1992: 627)

If we follow Hermalin’s claim that corporate governance is the “means by which the externalities that controlling parties generate are regulated,” then the concept of “externalities,” a key term in neoclassic economic theory, needs to be defined and scrutinized (2013: 734). As demonstrated by the interview material, there were certain concerns regarding the corporate governance practices in the life science companies, for instance, the shortage of commercial human capital and the oversupply of individuals with experience from large pharmaceutical companies. This shortage of qualified managers and board members is more indicative of a “small-numbers market” (Williamson, 1975) than being an externality. That is, rather than monitoring agency costs through external board members, venture capital investors had to struggle to identify and recruit both qualified executives and board members. In other words,

while agency theory postulates that the “market for corporate control” (Manne, 1965) is located in supposedly rational financial markets, life science venture capital investors are themselves the key actors in constituting and creating these markets, or, better, the *networks of contacts and relations* that enable life science ventures to thrive as know-how and skills are traded and exchanged, at times over large distances (e.g., between the U.S and Europe); “externalities” cannot simply be transported to financial markets as these markets are not yet in place in these stages of the life science venture.

Agency theory’s empirical failure, based as it is on the solid belief in the efficiency of finance market control vis-à-vis “managerial control,” derived from neoclassic economic theory, has implications for O’Sullivan’s claim that neoclassical economic theory fails to “incorporate a systematic analysis of innovation” (2000: 41). Neoclassic economic theory assumes that market transactions are always more efficient in allocating resources than any other mechanism, but such a view assumes the presence of markets. In the domain of innovation and entrepreneurship at large, there are not yet any markets but that is precisely what innovations and entrepreneurs produce through their work. To repeat, as Schumpeter remarks, Adam Smith, who is something close to the patron saint of neoclassical economic theory (Jones, 2012: 115), overlooked the role of the employer (i.e., the manager) in “leading or directing activity as a distinctive function,” and consequently, “what a businessman does in the system of Adam Smith is, therefore, to provide real capital and nothing more” (Schumpeter, 1991b: 254–255). That is, the neglect or disregard of the role of managers – strongly articulated in the agency theory framework and in Michael C. Jensen’s writings in particular – in neoclassic economic theory runs deep. According to Schumpeter, it was the Austrian economist Eugen Bahm-Böwerk that first introduced the important difference between entrepreneurial rents and interests, paving the way for a more systematic study of what Schumpeter refers to as the entrepreneurial function in competitive capitalism. Therefore, agency theory as being the single most influential corporate governance theory and heavily indebted to Adam Smith and the neoclassical corpus, fails to provide a meaningful analytical model of life science venturing.

Summary and conclusion

The empirical material reported in this chapter contributes to the literature on corporate governance in two ways. First, it underlines how venture capital investors, as suggested by Samila and Sorenson, play a

variety of functions including a most active role in supplying commercial human capital to the firms they choose to invest in. To ensure an efficient corporate governance structure is an important element of the post-investment activities of the venture capital firms. Second, the study shows that venture capital investors perceive the market for commercial human capital in the domain of life sciences venturing as being limited. For instance, the stock of candidates for executive or board positions with operative experience from large pharmaceutical companies are treated with some scepticism as these individuals often fail to understand how small life science start-up companies generate a market value as they tend to prescribe costly “Big Pharma practices” for these companies. In terms of theoretical contribution, the study points at the acute need for “new theoretical perspectives” (Daily, Dalton and Cannella, 2003) in corporate governance theory that recognize the specific and even idiosyncratic difficulties involved in entrepreneurial and innovative activities in, for example, life science venturing. Innovations and new firms do not emerge *ex nihilo* but are created through what Andrew Pickering (1993) refers to as the “mangle of practice” wherein ideas, capital, human resources, intellectual property rights, managerial skills, and so forth, are co-aligned and put together and turned into an operative, yet hybrid whole that generate economic value in, for example, the form of patents, products, market shares, etc. In this process or entrepreneurial tinkering, venture capital investors are by no means passive rentiers (cf. Zeller, 2007) but are most actively involved in securing certain resources and skills. In Schumpeterian terms, they are a group of key actors being an essential part of the entrepreneurial function of competitive capitalism. The literature on corporate governance should therefore dedicate more systematic scholarly research to the role of venture capital investors in enabling economic growth in the life science industry.

6

Promoting Life Science Venturing and Innovations: Developing National Innovation Systems

Introduction

The two previous chapters emphasized the pre-investment and the post-investment activities of the venture capital investors and stressed that venture capital firm do not only provide finance capital but also participate in extensive managerial and governance activities in the firm to ensure that their investment in health care innovations will be highly valued after the ten-year investment period has passed. In this view, also supported by the venture capital studies literature, venture capital investors are by no means passive rentiers awaiting their capital to grow in secure investments but instead the venture capital investors are active professional knowledge workers that support and constitute the entrepreneurial function of competitive capitalism. The empirical material reported here does not support common criticism that venture capital investors are overtly risk-averse and unwilling to invest capital in risky but high-growth potential sectors. As roughly three-fourths of the venture capital funds are written off and only a five to ten percent of the entire capital stock invested accounts for the taxable income in these firms, there is on the contrary evidence of risk-taking being too high. After the Internet boom and bust of the early millennium, there has also been a substantial decline of the number of venture capital firms being active in the market, indicating the shortage of professional skills in venture capital investment, in turn being one explanatory factor for the perceived lack of venture capital.

Venture capital investors are always of necessity part of a wider institutional and economic framework being able to collaboratively produce

new life science ventures. In the predominant enterprising model being developed over the last two decades, the state finances basic research in the universities and a few state-controlled institutes. An innovation system including a variety of public organizations and institutions on the national, regional, and university levels comprises innovation agencies, incubators, science parks, and entrepreneurship training programs, serves to support academic researchers and others willing to embark on an entrepreneurship career and to build companies around their research findings. These two sets of activities can be claimed to constitute the supply side of the life science venturing field. On the demand side, there are the hospitals and health care organizations that are the end-users that acquire the new health care innovations and integrate them into the clinical practices. In-between the supply and the demand sides, there are a variety of regulatory organizations (e.g., FDA) that monitor the clinical trials and grant the rights to register, market, and sell new health care innovations. In addition, the venture capital firms serve to explore and exploit the market opportunities they anticipate for certain new therapies. In this general model, the venture capital firms are dependent on both the basic research work conducted in the universities and the innovation systems' ability to recruit, train and develop academic entrepreneurs, and on the end-users' willingness to make use of new product offerings. As venture capital firms are to some extent a go-between in the domain of basic research and applied clinical work – some venture capital firms for instance take initiatives to start new companies on basis of perceived clinical needs and accompanying market potentials – they have high stakes in a well-functioning innovation system.

While Sweden is one of the countries in the world investing the highest proportion of GDP in basic research and in life science research in particular (Lerner and Täq, 2013), a more effectively designed innovation system may serve to increase the quality of the start-up firms. This chapter starts with a short review of the literature on institutional logics to address how the market logic (Berman, 2012) dominating policy and political agenda over the last two decades needs to be complemented by a logic that not only emphasizes the supply of life science entrepreneurs but also recognizes the need for policy regarding how new therapies are to be adopted by health care organizations and how to actively encourage collaborations between start-up firms and clinicians. To date, the innovation system policy has been modelled on a “supply side economics” political agenda, where the sheer supply of academic entrepreneurs would be able to advance new health care innovations; if the state takes care of its part – financing basic life science research

work and fostering a new generation of life science (academic) entrepreneurs – “the market” would take care of its role – to bring new innovations into the clinics. However, this market logic has underrated the state’s role in discounting most of the risks before any private market can be established (Roy, 1997). Consequently, it is not enough to just supply a stock of academic entrepreneurs unless there is a favourable milieu wherein start-up ventures can clinically test their new therapies or medical technologies and where they can acquire a market value in the eyes of venture capital investors.

This chapter examines the view of the innovation system and addresses how the state’s investment in a national and regional innovation agencies, incubators, and science parks is the most efficient way to create possibilities for life science-based economic growth. While there are some immediate benefits from making life science venturing a prioritized political objective, there are also, some of the interviewees argue, possibilities for making the innovation system more efficient at recruiting, training, and advising life science entrepreneurs. However, at the end of the day, the interviewees argued, “good ideas will always attract investment,” and therefore it remains somewhat unclear to what extent the innovation system contributes to a more competitive life science industry in Sweden. The chapter is structured into three discussions, including (1) the role of receding venture capital markets, (2) the size of the innovation system, and the (3) the tendency to build companies around immature research findings – that is, research that may be intellectually and academically intriguing but that nonetheless remains quite far away from clinical applications. The chapter concludes that the innovation system should also include organizations representing the demand-side,, for example, health care organizations that are the principal buyer and end-user of health care innovations.

Institutional logic and the commercialization of basic life science

Institutional theory, both old and new, has historically been primarily occupied with explaining similarities across organizational fields and industries (Meyer and Rowan, 1977; DiMaggio and Powell, 1983; Tolbert and Zucker 1983; Zucker, 1987; Parsons, 1990; Scott, 1995). Only recently has the issue of agency been addressed by institutional theorists (Battilana, Leca, and Boxenbaum, 2009; Battilana, 2006), introducing a series of terms including institutional entrepreneurs (DiMaggio, 1987; Garud, Jain, and Kumaraswamy, 2002), institutional work (Lawrence, Suddaby, and Leca, 2009), and institutional logic (Townley, 1997; Thornton and Ocasio, 2008). While the institutional entrepreneurship

literature emphasizes the agent's role, and institutional work literature draws on a theory of practice view of agency, institutional logic as analytical concept remains overtly "structuralist" in its orientation. The term was introduced by Friedlander and Alford and seeks to bridge structure and agency without collapsing the two terms into one another. At the same time, the term "institutional logic" is relatively opaque in Friedlander and Alford's account, denoting "a set of material practices and symbolic constructions" (1991: 248). More recently, a growing literature on institutional logic has further fine-tuned the concept, and several empirical studies have illustrated the practical utility of the term. One strand of research emphasizes that institutional logic serve to structure and impose, in Dunn and Jones's formulation, "cultural beliefs and rules" that shape the "cognition and behaviour" of organizational actors (2010: 114). Institutional logic is then not only a prescribed rational order of how to act and behave, but becomes a set of operative principles that are internalized by organizational actors. Lok (2010) therefore speaks of the "identity work" that organizational actors engage in to co-align their own activities with predominant or emerging institutional logics.

In addition, much of the institutional logic literature examine how institutional logics shift (Meyer and Hammerschmied, 2006), or are combined and co-aligned (Goodrick and Reay, 2011; Thornton, 2002) in organizations or organization fields. There are relatively few studies reported of how institutional logic may be widely enacted and endorsed, but it is also leading to new challenges and concern that were not initially anticipated. This chapter suggests that the shift from an institutional "science logic" to a "market logic" in the university system, proposed by Berman (2012), has led to the ambition to capitalize on research findings at a too-early stage. Beginning in the 1970s, when Stanford University patented the recombinant DNA (rDNA) discovered by Stanford professor Stanley N. Cohen and his collaborator at UCSF, Herbert W. Boyer, universities started to move from the science logic examined by Robert Merton (1973) wherein publically funded science belong to society and its taxpayers and other beneficiaries, to a market logic characterized by private enterprise, the presence of intellectual property rights, and the ambition to translate publically funded research findings into assets held by privately owned corporations (Smith Hughes, 2001).

While Berman and numerous other commentators praise this shift in institutional logic, releasing and justifying academic entrepreneurialism arguably for the benefit of the general public taking advantage of

university professors' know-how and enterprising skills, there is also a downside to this shift. Critics claim that the university is being re-entered on basis of neoliberal ideologies stressing private ownership rights and entrepreneurship, being overtly ignorant of the historical track record of the public university, producing knowledge for "the greater good" (Bok, 2002; Washburn, 2005; Lorenz, 2012). Especially in the field of the life sciences, this tendency has been accentuated (Cooper, 2008; Sunder Rajan, 2012), by and large derived from the enormous economic returns from successfully launched new therapies and scientific concepts (see e.g., Chadarevia, 2011). More specifically, as will be discussed in this chapter, venture capital investors, being less concerned with defending the tradition of academic institutions, are concerned with an overemphasis on enterprising activities at a too early stage – that is, when the research findings are still far away from any practical application in a clinical and therapeutic setting – leads to (1) too many companies being registered that fails to raise the capital needed to bring the research finding from the laboratory bench to the clinics, and (2) too many academic researchers spreading their work efforts too thinly between academic research work and entrepreneurial activities. The strong institutional pressure from the national innovation system on academic researchers to protect their research findings by intellectual property rights leads to a situation where research work is oftentimes conducted in the company form. The consequence is an oversupply of companies that offer academically intriguing but clinically premature and thus commercially unattractive research findings, being not yet amenable to venture capital investment:

Fuelled by the expanded access to research tools and biological insights from initiatives such as the human genome project, the excitement of creating new companies has resulted in large numbers of small, undercapitalized start-ups focused on discovery of novel drug targets but lacking resources needed to convert these targets into drug candidates and to validate them in the clinic. (Ahn and Meeks, 2009: 23)

The study of the field of life science venturing in Sweden thus presents a more complex image of the shift from the science logic to the market logic advocated by Berman (2012); in fact, the term "market logic" is a misnomer, as there is not always yet any "market" willing to take on the risky financing of premature academic research projects. As a consequence, the study contributes to the institutional logic literature by pointing out the unanticipated effects of changes in institutional logics;

shifts in institutional logics not only emerge in a sequential or hybrid form but could equally emerge in a reversible manner, where a previous institutional logic can be rehabilitated when the social and economic benefit is not as pronounced as predicted. Institutional fields and their institutional logics that shape the agency are thus dynamic and continually changing as they respond to various external conditions, including, for example, the access to venture capital.

Academic entrepreneurship and institutional logic

New institutional logics in the academy

The concept of institutional logic, introduced by Friedland and Alford (1991), have been defined a number of times. For the sake of simplicity, in the following Lok's (2010: 1307) definition of institutional logic is adhered to: Institutional logic denotes "[a] set of material practices and symbolic constructions that constitute organizing principles for broader suprarational orders." Lok (2010) makes the important connection between the predominant institutional logic and the what he refers to as the "identity work" of the agent operating in accordance to a particular institutional logic: "I define identity broadly here as the institutional notions of who or what any social actor might or should be in a particular institutional context, and – by implication – how the actors should act" (Lok, 2010: 1308). Also Meyer and Hammerschmied, studying a shift in institutional logic in the Austrian state apparatus from legal-bureaucratic logic to managerial logic, suggest that for an institutional logic to operate effectively, actors need to enact "new social identities" on the "micro level" (2006: 1004). That is, an institutional logic cannot operate without significant actors modifying their identities in accordance with the new "suprarational order." However, in many cases (as demonstrated by studies reported by, for example, Reay and Hinings [2009], Dunn and Jones [2010], and Goodrick and Reay [2011]), there are combinations of institutional logic that operate in tandem, putting pressure on actors to simultaneously respond to different, adjacent suprarational orders. In such cases, identities emerge as hybrids containing various, at times irreconcilable, elements of different institutional logics. "Actors can *abduct parts of a new logic's identity and practice templates* to strengthen the legitimation of pre-existing practice that are actually contradictory to the spirit of the new logic's practice prescriptions," Lok argues (2010: 1330).

In the case of life science venturing, Elizabeth Popp Berman has argued persuasively in a number of publications (2008, 2012a, 2012b) that academic research has today become an "economic engine" in the

US economy. Such a prominent role of academic research (whereof life science is only one, albeit the largest part as “life sciences now account for more than 60 percent of all academic R&D expenditure” [Cockburn and Stern, 2010: 3]) is derived from a significant shift in institutional logic beginning in the 1970s. Until the mid-1970s, academic research was considered by the community of professional scientists and their sponsors and regulators to be a public good. When Jonas Salk developed the polio vaccine and was asked who owned the patent, he famously responded “No one. Could you patent the sun?” and Stanley N. Cohen admitted that he had not “dreamed of the notion of patenting” the rDNA (cited in Smith Hughes, 2001: 548). In the 1970s, life science research increasingly demonstrated its economic worth and universities enacted a more enterprising role for themselves; they should not only host publicly funded research activities but increasingly acted as enterprising agents in their own right, capitalizing on the know-how it produced. The community of professional academic scientists was initially very critical of this shift from the science logic to the market logic, from treating science as a public good to private assets protected by intellectual property rights. However, the enactment of the Bayh-Dole Act (Mazzoleni, 2011; Grimaldi et al, 2011; Berman, 2008; Rafferty, 2008) that grant the universities the right to protect their research findings created its own momentum, and by the beginning of the 1980s, at least in the US, the new institutional logic had gradually been established.

Academic science venturing

Murray examines the development and patenting of the first genetically modified animal, Harvard’s fabled onco-mouse, and suggests, “the logic of academic science attends to the pursuit of knowledge for knowledge’s sake” (2010: 348). “In sharp contrast,” Murray continues, “the institutional logic of commercial science is directed at turning ideas into private property and economic rewards, elaborating a logic built around the degree to which a scientist can exclude others from replicating his work and thus appropriate the value created by that knowledge” (ibid.) While disclosing research findings to other researchers to have the findings verified remain the principal mechanisms for knowledge-claims in the academic community, the market logic is based on the practice of protecting knowledge from being further explored and exploited by other actors. This difference has frequently been portrayed as an irreconcilable conflict between public and private science. In addition to this “cultural shift” in the academy, Berman tells another story where the norms of the community of academic scientists play a relatively

marginal role but where the access to venture capital is regarded as the *primus motor* of the market logic:

There were ...substantial barriers to making faculty entrepreneurship a new norm in the biosciences. These barriers were not, as one may suspect, primarily cultural, though there were definitely criticism of entrepreneurial activities within universities. Instead, the main barrier was the limited quantity of capital interested in investing in the fledgling industry, in which the path from academic invention to marketable product would clearly take years to traverse. (2012: 59)

In this alternative view, macroeconomic conditions, including high overseas savings and an overrated dollar, leading to an inflow of capital into the US economy in the first years of 1980s (Krippner, 2011: 101–102), accompanied by a deregulation of financial markets (Stearns and Allan, 1996), were the true drivers of the commercialization of academic life science (Cooper, 2008). In addition, this interest to supply venture capital to academic life science research was preceded by an increased patenting activity in the university system, signalling to investors the universities' willingness to capitalize on its basic research: "The number of patents issued to universities roughly tripled between the mid-1960s and the mid-1970s," Berman notes (2012: 95).

"Funds flowing into the venture capital industry increased dramatically during the late 1970s and early 1980s," Kortum and Lerner (2000: 676) write. "In 1984, in excess of \$4.5 billion of new capital was committed to the [venture capital] industry, an amount of over six times greater than the amount committed in 1980," Gorman and Sahlman add (1989: 231). In the early 1980s, the supply of capital was significant and life science research was increasingly privatized and located in privately owned companies. In 1993, Kary B. Mullis, a scientist working at the Bay Area biotechnology company Cetus was awarded the Nobel Prize in chemistry for the invention of the polymerase chain reaction (PCR), a standard method for the replication of DNA sequences (Rabinow, 1996). This was the first time a scientist employed by a private firm was awarded a Nobel Prize, testifying to the shift from the science logic to the market logic. Throughout the 1990s and until the stock market crash in 2001, caused by the information and communication technology bubble, the supply of venture capital was significant in the US economy. After 2001, the number of venture capital firms was reduced and the entire stock of venture capital shrunk, leading to a new situation. The university system and national and regional innovation system had quickly

responded to the new call for academic entrepreneurship, and the new situation after 2001 – further accentuated after the near-collapse of the financial markets in 2008 – has created a situation of endemic shortage of venture capital (Lerner and Tåg, 2013; Rider and Swaminathan 2012; Burrill, 2012).

The history writing on the development of academic entrepreneurship in the field of the life sciences is by and large a success story, but closer examination of the outcome reveals a few puzzling and worrying conditions. First of all, as demonstrated by, for example, Pisano (2006) and Hopkins et al., (2007), the much-praised biotechnology industry has under-performed both in terms of the development of new therapies and its financial performance. Very few companies, such as Amgen and Genentech, have managed to live up to the high expectations on the sector. “The economic performance of the sector overall has been disappointing by any objective standard,” Pisano contends (2006: 5). In addition, while the state has taken on an ambitious role as the primary financier of life science research and have invested substantial resources (Lazonick and Tulum, 2011), not the least in small economies like Sweden’s, in developing national and regional innovation systems. The short- and long-term effects of such investment have been disputed, and while few would suggest that these activities have failed, there has not been as much economic growth, work opportunities, and new therapies developed as was originally anticipated. The strong venture capital-backed and state-led shift from the science logic to the market logic has thus failed to produce as much “bang for the buck” as the committed proponents of academic entrepreneurialism expected. Today, a few years after the 2008 financial crisis, there are discussions regarding the strong emphasis on the supply-side of entrepreneurial ideas in an economy where the risk aversion has grown among venture capital investors.

The venture capital investors: the market logic and the shortage of venture capital for the life science development phase

Receding venture capital markets

One of the principal concerns for the venture capital investors was the inability to generate an adequate return on investment in health care innovation. The CEO of a major pension fund traced the lack of venture capital today to the historical development of the Swedish venture capital market in the 1998–2000 period. In his view, the inflow of capital and the enthusiasm over the idea of venture capital investment was not

in parity with the competence and experience needed to actually make a yield on the money invested:

Very few of these funds [that the State Pension Fund has invested in] have been even remotely close to being successful or to report a tolerable performance, Why is that? I think much of the answer lies in the emergence of these funds at the end of the 1990s and at the turn of the millennium. That is actually the birth of the venture capital market in the Nordic countries, or at least in Scandinavia. In hindsight, one can assure that too many funds were created, and that there was too little experience, and too limited previous learning regarding how to do the job...Very few of these teams managed to survive and ten years later they were not able to raise more capital.

When the Internet bubble burst in 2000, life science venturing field was contaminated too, the CEO argued: "Nobody could fully predict where the IT industry was going, and there was an attitude regarding 'all the possibilities' derived from IT... There was a hype that affected also the life science industry, that at the bottom line had *nothing* to do with IT." A former venture capital investor – a CEO of a state pension fund – pointed at the lack of previous experience from venture capital investment as the principal explanation for the poor financial performance in the first wave of venture capital investment. "There were too many balloons being inflated also [in the life sciences]," he said. "There were too many projects and small companies that did not have the critical qualities that were funded. That was part of the learning process, because there were really few experienced [venture capital investors]."

By and large, by the turn of the millennium, venture capital investors tended to underrate the risks involved in life science venturing:

Around [year] 2000 there was a hype regarding the new things and not the least in terms of their valuation... We underestimated the time needed to advance [a therapy or product] and couldn't assess the appetite among the users. The stock exchange was a much more credible exit opportunity than it is now. Many of these 'High-hopes companies' in many industries, they have failed to deliver. Some have managed to deliver and have done it remarkably well, but the vast majority has not. (Venture capital investor, life science, state fund)

Regardless of the history of the Swedish venture capital market, there was mixed views among the venture capitalist investors regarding the supply

of capital. Some argued more capital would be helpful, while others saw a lack of human capital as the key to a more effective life science sector. The CEO of a major pension fund addressed these issues: "From where can a large enough capital base emerge, given these [disappointing] experiences we do have? From where can a large enough capital base emerge that systematically supports clinical trials? I cannot see from where that kind of capital would emerge in Sweden today... I am really worried.". A venture capitalist firm founder and partner emphasized the difference between the actual and perceived supply of venture capital and stressed that other financiers including banks have been very reluctant to support life science, leading to a slow change in the Swedish industry:

This whole idea about the shortage of seed-money is based on an 'Ask a silly question' logic. We turn down 99% of all proposals we receive... We get like 400 per year and we invest in 3–4 things whereof half of the ideas are our own, making it roughly 0.5 percent emerging from the outside... Of these 99,5 percent, most of them are competent people being highly skilled and no wonder then they think there is a shortage of seed-money. But the structural problem is that if you want economic growth, then venture capital is important. This is where capital is missing. The stock exchange has abdicated from the sector... Also the large banks. There is an alarming shortage of capital enabling industrial renewal. The pace of renewal in Swedish industry is by and large terrifying if you compare to the U.S. It is self-evident that unless we have major financial investors... then it is not possible to grow because the venture phase demands capital.

At the same time as there is a perceived shortage of life science venture capital, one of the interviewees argued that many of the successful firms with high growth potential were subject to private funding and consequently there were few possibilities for the wider public to invest in promising life science companies. That arguably lowered the interest for life science ventures and the life science industry at large:

We have this quite crass line of demarcation between private and public financing... The companies that we believe in the venture world, we keep private. We claim that IPO is not an exit-option. We can finance them ourselves. That makes the interest for the field as such [weaker] and the success is not built in the public sphere. There has only been these news where 90% of the value disappear when

there is a negative result [from a clinical study] – 90% of the stock value in one hour... That issue needs to be considered too. (Business area manager, life science venture fund)

In contrast to the capital shortage thesis, some of the venture capital investors pointed at the organization of the life science and the shortage of human capital as an explanatory factor: One interviewee pointed at the slow progress of individual projects and the messy innovation system that was very complicated to oversee by the entrepreneurs and others:

There has been too little money per project, which increases the risk that each project is under-financed. That may lead to a problem to fail to reach the value steps needed to attract a partner – big pharma or large medtech – or to be able to find more financing in order to support oneself. There's been this problem that there are too many actors – innovation bridges, innovation offices, state-owned organizations – but very small financial resources, yet many people involved. (Venture capitalist firm partner)

In particular, the innovation system agencies and organizations need to be more effectively managed: “You need to create larger financial units. First, you get fewer persons working developing experience and expertise. But you also need to add [financial] resources” (venture capitalist firm partner). He continued: “Every single office controls a very small amount of capital but still they have three or four co-workers. That doesn't add up!”

In addition to all the venture capital being squandered on premature life science research findings by inexperienced investors, having little detailed understanding of, for example, new drug development, today also the exit market has changed, some of the interviewees argued. Historically, major pharmaceutical companies often acquired life science ventures, but today they are less willing to buy companies whose market value could not be fully determined. In addition, the regulatory control has increased and the possibilities for registering new drugs are smaller. Says the CFO of a university based venture capital fund:

What happened now is that this reimbursement gap has got a lot smaller, the regulation gap has got a lot smaller, there are fewer Pharmas [also] being more careful about what they spend on and the amount of capital therefore has had a lot of bad luck because there

are more companies that did not get through the gate [of regulation] ... Because of that – reduced returns – the number of people who are backing the funds that support biotech has been reducing.

This shortage of venture capital served to starve especially companies approaching a development phase where for instance costly clinical trials are conducted to confirm the efficacy and safety of, for example, a candidate drug. The CEO of the pension fund spoke of “narrower investment horizons,” where venture capital investors increasingly target more mature companies being able to report clinical data signalling the therapeutic value of the innovation:

The few remaining investors in this segment have substantially narrowed their investment time horizons. As we see it, our role is to be able to professionally and skillfully handle risks... We use to say that ‘We handle risks and eliminate uncertainty.’ The uncertainty derives to a large extent from the long time lines where the development of clinical practice and competition and other issues create extraordinary uncertainty. There are also uncertainties involved when certain investors lose their faith and run out of money. It is easier to take a three-four years perspective. (Business area manager, life science venture fund)

The most direct consequence of this shrinking exit-market is that venture capital investors target firms that are closer to the market or the clinical application. The business area manager of one of the venture capital firms addressed the cognitive difficulties involved when investing with a ten-year time horizon:

You need to concretize a real business opportunity within three to four years, otherwise the whole thing becomes quite amorphous. That is also because we need to feel the smell of the business, to be able to qualify it, to test it, to calculate it, to validate it. If we speak of a business opportunity being eight, nine years into the future, then it is very, very complicated to grapple with and examine. (Business area manager, life science venture fund)

The CFO of a university life science fund spoke about the venture capital investors reducing risks by focusing on “later stage opportunities,” but as government funding, as he remarked, “falls off a cliff after the pre-seed and seed phases,” this VC investment strategy opens up a big finance

gap for the start-up firms leaving these stages and the point where it has acquired a market value. "It's like mining for gold. One big strike pulls a lot of money into the business" the CFO said, pointing at the enormous economic value that can be extracted from a successful life science venture in an industry that serves millions of patients.

Oversized innovation system infrastructures

Several of the venture capital investors had somewhat mixed emotions about the extensive innovation system infrastructure that have been developed both by regional governments and around the universities in Sweden during the last two decades. On the one hand, they thought it was helpful that life science researchers aspiring to commercialize their research work were given adequate support during the start-up phase. On the other hand, the innovation system control too small financial resources and could therefore neither attract co-workers with relevant experience and know-how, nor supply sufficient amounts of capital to the start-up companies. One of the interviewees pointed at the fashionable idea of technology transfer offices (TTOs), imported from American elite universities such as Stanford as being problematic unless individuals with quite sophisticated expertise populated them:

There is a bit of too high expectations on tech transfer offices, that they can be financially sustainable... To be able to assess an idea presented by an academic researcher, you need quite bit of competence in immaterial property law, you need to know what the clinical work looks like – what do they do and what are the alternatives? What are the costs, and all that? – that is, there is a quite extended and time consuming assessment procedure. (Venture capital investor, life science, state fund)

Rather than serving an substantial role in the regional innovation system, TTOs were more indicative of the university's chancellors' ambition to demonstrate enterprising capacities. "It is a little bit like the universities putting on a dog and pony show" [when opening TTOs], he said. Another consequence of the imitation of American elite universities was the oversupply of laboratory facilities in Sweden, partly grounded in the real estate industry's strategies to capitalize on the universities' investments in basic research. Said the CFO of a university life science fund, "There is an enormous oversupply of facilities [in science parks and incubators]... There are more lab space than companies to operate them." Embedded in an neoliberal economic policy where competition

over limited resources leads to a “natural selection” of vital and competitive companies, the innovation system was designed to increase the supply of life science entrepreneurs. The CFO was not fully convinced such supply-side economics, stressing the output of entrepreneurs and start-up companies, was an adequate model for the design of the innovation system as it rested on a few fallacies. For instance, successful companies grow out of local conditions and therefore numeric key performance indicator comparisons between, for example, incubators are by and large irrelevant as they of necessity represent unique conditions. One of the representatives of a major venture capital investment fund with extensive experience from working with the innovation system and its various regional and university-based branches, confirmed this tendency to present key performance indicators that in fact said very little about the underlying actual activities and accomplishments: “What occurred to me after that week [visiting local incubators] was that everybody was anxious to demonstrate their own excellence. They showed key performance indicators that were totally irrelevant from a commercial perspective. Listening to all of that only made me very tired.”

This business area manager was quite concerned about what he regarded as an inadequate level of competence in the innovation system agencies, leading to a poor use of resources and a slow development of the firm and the therapy: “I see too much naivety! You may have a really exciting invention that has been on the shelf for six years and everything moves in slow-motion.” He continued: “I have seen innumerable cases where I have seen business coaches and patent advisors not being capable of handling their assignment. They have ruined good Swedish research and have written patents that have been totally substandard and have given misdirecting advice on how to expand, I think.”

Venture capital investors shared this concern regarding how resources are used when supporting life science venturing and academic entrepreneurialism: “The government’s structure [in the front-end phases] is quite messy, no doubt about it, with all these funds and incubators, etc. ... The government is unstructured in the way it supports enterprising activities ... They would need to consolidate and make things much more simple and more clear,” the CFO of a private venture capital firm claimed. In other words, in addition to receding venture capital markets, increasingly unwilling to handle all the risks involved in life science innovation work, entrepreneurs also have to navigate in a domain characterized by very many small and at times even competing innovation agencies that were still not able to provide very much capital to the companies. The

solution to the shortage of capital and the lack of adequate financial and advisory support in the innovation system was quite simply to avoid establishing the corporate form at a too early stage; contrary to the idea that the degree of newly registered companies (i.e., the ‘marketization’ of the ventures) is indicative of the vitality of an economic system, venture capital investors and a few innovation system representatives claimed that promising research projects should stay in the academy for a longer period of time to be able to compete over a limited supply of venture capital at a later stage when the research had been further developed. This is essentially a deviation from the institutional market logic – or at least one interpretation of it – that prescribes the corporatization of life science innovation at the earliest possible stage.

Companies built around immature research findings

The emphasis on the company legal form

For venture capital investors, the advice given by business counsellors to build a company structure around interesting academic research findings was perhaps relevant from an innovation textbook perspective, but it was nevertheless quite blunt advice inasmuch as it overlooks the milieu wherein such a company is expected to compete over limited resources. The CFO of a venture capital fund pointed at the limited understanding of the underlying biological pathway as being one of the key challenges when exploiting therapeutic opportunities:

Knowing what [a biological mechanism] *is* and knowing what *it does*, are two very different things. When we actually do discover what something does, we then have to work out whether it is good or bad for the body. For example, if you switch some genes off, you can kill the patient; if you switch some genes on, you can cure disease, so you need to be very, very sure of what you are doing... Once you know what does what, you have to find a way of treating it. That is not trivial!

The fallacy of the innovation system is to actively encourage researchers that have just mapped a certain biological pathway or mechanism to start a company based on such findings without having a clear analytical model of how a new therapy would influence the biological system. The CFO continued:

Then you come to the next point, which is, we do not really know what the disease are doing. There are a few examples where we have a very clear idea about the mechanism of action, and there are others,

like cancer, that operate through 50 or 60 or hundreds of mechanisms, and that can change...Elucidating those mechanisms and knowing what to interfere with to prevent them is another area of huge complexity.

Venture capital investors thus argued that too frequently, promising academic research work left the academy at a too early stage, thereby underrating the difficulties to attract venture capital, while having too high expectations on the short-term clinical relevance of the research findings. "Some [projects] leave the academy a little bit too early. That is a fine ambition to start a company and to have ideas, get them patented and to get support from local incubators, that's good! But too many rush things! They would have benefitted from being more mature, that is, been subject to more applied scientific research than today," the CFO of venture capital firm "II" argued. He continued:

In quite a few cases, we say no because we think, 'This is too early! All these things you should have checked while you were still in the academy!' In quite a few cases, they just run off too early and try to create a company on basis of things that would benefit from staying in the academy longer... There is a need for state funding or focused research grants. It is not that venture capitalists are not willing to take risks, but the risks are always almost too high.

The principal concern for the venture capital investors were that business counsellors advising academic researchers to register companies lacked an understanding of the venture capital market and therefore inadequately expected venture capital investors to carry higher risks than they are in fact able to. "You expect private investors to pay for basic research," an investment manager for a state innovation agency said. "In many cases, that is in many cases what it is all about: You have the [research results] on paper almost, and there is no clinical testing in animals, and yet there is a registered company! And this is supposed to become something you operate into a human being."

The investment manager here stresses the demand for significant clinical evidence needed to register a new therapy, a drug or a medical technology, and indicates that the distance from the laboratory bench to the clinic is long and riddled by uncertainty. Based on such advice to build companies around academically intriguing research findings, academic researchers were given credit within the innovation system

and the academy, but such activities unfortunately poorly translated into commercial value, the venture capital investors argued. The life science venture fund manager noted,

It is unrealistic to give researchers and professors credit points for commercializing their research and filing for patents, and then they receive 800,000 [Swedish crowns]. Two years later there is not enough money left to even defend the patents. There is too low development progress in the projects and the patent time goes and the costs increases.

The manager referred to another example when representatives of the innovation system failed to adequately account for the resources needed to bring new therapies to the market:

[During a seminar, Swedish Medtech interest organization representatives claimed] that the average capital needed to take projects to the point where they have some kind of market verification was five million crowns. That makes me really surprised, because in general we speak about a capital need that is around 30 times as high, say, 150 million crowns, perhaps even 200 million. That is what we see in the investment objects we examine.

The manager claimed that this strong pressure to build companies derived from an enterprising ideology that was not of necessity flawed but that nevertheless was ignorant of how life science innovation emerges: "There is a certain beauty in the idea that everyone should be given the chance of testing their idea in competitive situation."

The enterprising ideology and its strong normative pressure on academic researchers to bring their research to the market have been thoroughly institutionalized in the Swedish innovation system during the last two decades. On the other hand, as the business area manager indicated, in addition to this idea of competition, many of the interviewees argued that the innovation systems has been based on what could be referred to as a "procedural justice norm," wherein all entrepreneurs should be given equal chances to "test their ideas." The direct consequence, he said, was that "the resources have been spread out too thinly." This leads in turn to the funds allocated to life science ventures not being large enough to cover all the demand: "There is certainly lot of support for biotech in Sweden but [the funding] runs out too early. If it lasted longer, going to fewer people, then you would have more

successes, and longer-term success and those jobs would be much more secure," the CFO of the university life science fund argued. These two interviewees claimed that there is a need for being more selective in the innovation system regarding what projects to fund and otherwise support; in the domain of venture capital investment, there is no allegiance pledged to any procedural justice or democratic virtues, but only the investment proposals having the highest potential for return on investment are selected. "What we can do better, that is to consolidate the resources. At least we should try that; it doesn't need to be 'all or nothing,' 'black or white,' but we can take a few projects, and test them and then we give them a little bit more attention and a little more resources," an investment manager in a state innovation agency suggested.

One indication of the premature registering of companies is the presence of companies that have reached a mature stage where clinical data has been collected but still have not managed to register a therapy, yet failed to attract new venture capital investments. Gorman and Sahlman (1989: 231) refer to these companies as "the living dead" in the venture capital industry. Companies ending up in this stalemate needed to, one interviewee argued, "return to the academy, back to the world of research work. They are too far from [clinical applications and markets] to make it!" (CFO, venture capital firm II). The solution to this situation was generally claimed by the interviewees to give a more prominent role to the universities to host and further refine their research findings to the stage where they were capable of attracting venture capital investment: "The universities should be given more money...prior to that phase before they become companies," the CFO argued. However, Sweden is one of the very few countries in Europe (Italy being another) that has enacted what is called the teacher's exemption rule, granting the ownership rights to the individual researcher rather than the university. To give the university a more prominent role to further develop promising research findings would however demand a new innovation system organization. Sweden, like many other European countries, suffered from what is called the "knowledge paradox": that is, significant governmental investment in basic life science research, for example, do not translate into a comparable output in the form of patents, new companies, or new registered therapies. In order to counteract this disadvantage vis-à-vis the United States, there is arguably a need for a new policy that seeks to accomplish more than maximizing the sheer amount of new registered companies.

The role of the universities

While the venture capital investors were concerned about the tendency to rush to build companies around basic research findings, they were still very convinced that academic research work would remain the principal source of new research findings that could be used to develop new therapies and health care innovations: "The most innovative products derive [from the academy]. If you examine global Big Pharma, their R&D organizations no longer works! The licentiate products and buy small biotech companies," one senior portfolio manager in a state-owned pension life science fund argued. Another venture capital investors stressed the key role of the universities in innovation hubs:

I think this deal-making in the early academic commercialisation structure at the universities increases in importance. You can see that this model that Karolinska Development represents, that becomes more frequent abroad. Big Pharma approaches the universities directly...This has to do with their early-stage research not working. They scout much more. For them, these are cheap investments, to give research grants. If you examine Glaxo, they are very closely connected to the English universities such as King's College and Cambridge.

This affirmative view of the university-based research was complemented by a general concern regarding the possibilities to industrialize R&D work on large scale. One of the interviewees pointed at the role of skunk work in producing technological breakthroughs, projects that were developed outside of the regular R&D organization:

It is complicated to industrialize innovation processes...The commercially successful things that Ericsson [Swedish telecom company] have developed, they have been skunk works that top management has not known about or not invested in. The major projects supported by top management have frequently failed. What prove to be worth something, that is what people believe in and have engaged in on the side...Major corporations have a difficulty in making innovations and it is hard to industrialize processes, but such things emerge in smaller settings. They are dependent on persons and you need entrepreneurial people, but they mostly do not fit into the big corporation firm structures. (CFO, venture capital firm II)

In the pharmaceutical industry, what has been called “rational drug design” is one managerial model for the monitoring and control of new drug development, but today the venture capital investors use it as an example of a failed concept. According to a venture capitalist firm partner,

That type of rational drug design failed to deliver products and now there is a need for thinking in new terms. I think we will be able to change the productivity curve upwards again, but then the question is what kind of products [Big Pharma] should develop? The old school Big Pharma developed blockbusters and megabrand...to be sold to large patient groups. Today we know, as a direct effect of the development of new knowledge... that it is not evident that you and I should have the same therapy [in cases of the same form of cancer, for example].

The partner emphasized that the blockbuster new drug development model that has been successfully employed in the post-World War II period is now coming to an end, as there are fewer drugable targets suitable for this R&D model:

First, I believe that it has, to a certain point, been possible to address large illnesses and to pick the low-hanging fruit. That low-hanging fruit is very much picked by now. This explosion in biological know-how over the last 20–25 years – which has been fabulous – has demonstrated that the complexity is complicated to oversee. Attempts to do this have failed. Second, there has been rosy ambitions and perhaps there has not been a full understanding of the system, and therefore we have got lost. It has been the major corporations that firmly believed in this thing being popular, rational drug design where you screened the genome... Today, it has been realized that there are complexities in the regulations [of the biological systems] of mechanisms. We have barely scratched the surface. There hasn’t been detailed enough knowledge to enable rational drug design, quite simple.

This decline of the “one-size-fits-all” new drug development process opens up, the partner argued, concepts such as personalized medicine, which in turn were more adaptable to the venture capital investment model, as it demanded smaller clinical studies and more targeted patient groups. “For venture capital,” the firm partner noted, “this is a very

suitable model because if you develop more targeted therapies, you need only smaller patient populations and less clinical research because the therapy is more specific. Specificity leads to higher effects but also fewer side effects because you know exactly what you are treating." Therefore, the decline in research output in the big, bureaucratic pharmaceutical corporations is now possibly being gradually complemented by a venturing model that is more flexible and adaptable to setbacks and therefore can spread risks and allocate capital more effectively. A senior portfolio manager of a state-owned pension life science fund anticipated such a scenario:

In biotech companies, they have, say, three projects, and then they raise a lot of money, like one billion, and then the companies go public. If one study is failing badly...the board and management won't say 'We liquidate this company and give all the money generated to the shareholders.' Show me one such case, and I would be very interested! ...It is part of the board's and management's self-interest [to preserve companies] ...This is actually a difference in comparison to the VC firms that finance a study. They spoon feed their investments. If a study fails, then they go, 'Thank you and goodbye. Now we terminate this project because it is not sufficiently qualitative!' If you compare private equity and venture capital and their return on investment, I think the latter perform better because public firms, they just continue to do work in their failed project over and over... VC firms cut the funding much earlier.

In relation to public firms, the venture-backed smaller corporation has not yet developed feedback mechanisms that rationalize failure, and that possibly increases the chances of new innovative therapies being produced. Regardless of how new life science innovations emerge, the life science industry constitute a major challenge for politicians and policy makers as they commonly lack not only an understanding and an operative vocabulary to address life science innovation, but there is also a distinction between economic value creation made in life science firms and job creation. Historically, the creation of economic value has been co-produced with job creation in firms growing organically. If government wants to have a successful life science industry, they should, one interviewee argued, "*prevent* a lot of biotech forming" and "stop the waste at the bottom end" (CFO, university life science fund, emphasis in the original); if, on the other hand, they want many jobs, they can extend the entire innovation system and create even more

agencies, incubators, and science parks, but these represent two entirely political programs. The concern is that the expansion of the innovation system has been advanced as if it increased the quality of the life science companies. The CFO explained: “The difficulty is that if you are spending time giving grants to spinouts, you are effectively contributing to that failure rate. So it would be in the government interests to concentrate more along what to select to fund rather than just funding everybody that applies.”

The CFO suggested that government spending should be more committed to “things that are likely to be successful and less on creating jobs per se.” The “take care of the entrepreneurs and the life science innovations will take care of themselves” policy guiding the development of the Swedish innovation system is thus overlooking the role of the demand-side of the innovation equation and blurs the distinction between value creation and job creation, no longer of necessity strongly correlated.

The view of the companies and the innovation system representatives

Receding venture capital markets

The company representatives also argued that there was a shortage of venture capital in the life science sector. In addition, the chief scientific director of one of the stem cell technology companies argued it was complicated to introduce life science companies on the stock exchange. In the new millennium, “there are less favourable valuations,” according to one of the chief scientific directors, while in the 1990s, “there was this hype regarding IT and everything. There was more venture capital available.” He continued, “The risk aversion has grown over this 10–12 year period... It is more difficult, even if the ideas are good. They want companies to have moved forward. They also want to reduce the technical risks, which they used to tolerate, I think. [in the 1990s] They could accept to make a few bad investments.”

A general sense of risk-aversion is thus widespread, as too many funds have failed to raise money, leading to an endemic shortage of venture capital. One alternative to large-scale venture capital investment is to rely on business angels, whom the chief scientific director thought were “good owners,” when – “under regular conditions.” – He appreciated their long-term commitment and the absence of overly detailed “fund policies” giving them an opportunity to not divest as soon as the ten-year investment period has ended, but they could sell – “whenever it is best for them – If that would take ten years or longer doesn’t matter as

long as there is reasonable return-on-investment." In addition, business angels are relatively easy to get into contact with but the crux is that there is a limited supply of business angel capital in Sweden, making it an unreliable and too small a source of funding for the entire stock of life science ventures. This makes the state an important player in supplying venture capital to the life science sector. Even though the state-controlled and regional innovation system organizations are developed to serve a complementary role to that of the commercial venture capital market, it is questionable, the chief scientific director argued, if such a role could be served effectively. Instead, the innovation system organizations more or less mimicked the professional venture capital firms and increasingly competed over the same stock of new promising life science ventures:

Who do [the state venture capital fund investors] spend time with? Well, other venture capital firms! That makes them behave like any regular venture capital firm and demand just as much. There are good people working there, but it is still so that they act as everyone else. [A state pension fund] tried [to invest in life science companies], but they got negative publicity in the newspapers about bad investments and so forth, so they have stepped back. (Chief scientific director and bioentrepreneur, life science company #2)

The CEO of the university-based business incubator addressed the same topic and deplored recent changes where the state agencies are less committed to pre-seed and seed funding:

There have been a few initiatives that have made the arena messier. Innovation offices have been started and they have been given substantial financial resources to handle all kinds of verification projects. I don't understand how this works! There is a shift in perspective and a fragmentation and a thinning out the financing of the early stages! It is worse today than 5, 6, 8 years ago. Definitely worse! Definitely worse!

For instance, he said, one of the state agencies had taken on an entirely new role as a venture capital investor operating in the more mature phases:

[The state innovation agency] runs its own investment activities where they can provide these projects with capital. In principle, that

is a good thing, but they have not handled this process properly. They have their own agenda, and they think our role as incubators is to provide investment objects they can take advantage of... I am not happy with that logic... All of a sudden, [the state innovation agency] plays the role of venture capitalists, even though they are not! ... and they create their own rules of the game that are quite curious.

In other words, today, the innovation system organizations are not prone to take no more risks or make any long-term commitments that are any different than the professional venture capital firms. They operate in accordance with the same logic of limited risks and short-term investment horizons. The project leader in the start-up developing a herpes vaccine argued that the innovation system organizations provided some funding, but they were less qualified in advising the life science start-up companies on what to do to move on to the next stage in their development: "As soon as you approaches the venture capitalists, working on this in another manner to make their own money in comparison to the state-funded activities... [You notice that] they are more specialized... They are extremely skilled in identifying the problem and put their finger on what matters."

For instance, this start-up company (which is, in fact, still being defined as an "academic project" to get access to academic research funding) had acquired a venture capital investment grant from the Danish venture capital fund Novo Seed (financed by the pharmaceutical company Novo Nordisk) that offers funding for verification work that needs to be done prior to more long-term venture capital investment can be attracted. In comparison to the advice that the start-up had acquired from the state-based and regional innovation system organizations, the Novo Seed investors were more to the point about what the start-up company needed to accomplish to be able to compete over venture capital investment. Novo Seed had a better overview and understanding of the start-up company's situation and challenges, the herpes vaccine project leader argued. By and large, there was a concern among company representatives regarding counselling services and the underlying competence in the innovation system agencies.

The CEO of the medtech company had a story to tell about how they were treated by a state agency officer with what the CEO regarded as a blend of ignorance and bureaucratic inertia:

We have applied for money through [a state innovation agency], and the person we presented the application for, the first time he just

laughed and thought we were stupid! Us being 45 years old people with quite much experience! Then we returned at some later point, and then he said, 'You've moved too far! You can no longer apply for funding here!' He was totally disconnected from reality, quite simple. You can ask anyone having experience from working with them.

The concern thus both included the human resources in the state agencies and the bureaucratic regulatory framework the officers follow. "I do not think money is what's missing, but there need to be more qualified people... You get this feeling there are people holding quite well paid positions in these agencies and that they are perhaps also engaged in other things... It is like a safe haven," the CEO argued, displaying all his scepticism regarding the effectiveness of the innovation system. In terms of the bureaucratic procedures put to work, "There are too many safety checks and 'You need to...' and 'You have to...'," the CEO argued. The tendency of state agencies and agencies in Brussels and elsewhere, operating within the European Union administration and relying heavily on formal control and regulations, was a concern for the entrepreneurs and the start-ups. Money was made available, but they came only with additional administrative costs and demanded certain skills that were not always in place in the companies. According to the medtech CEO,

It sounds so amazing, with all this money all over the place [in the European Union]. But for the individual entrepreneur, to apply for this money and spend time doing it, that is almost impossible. It is a *waste of time* [English in the original]... Once you have received this grant, it is supposed to be reported! I see all these entrepreneurs, like professors and PhDs and so forth, (who) do not understand the complexity of the VAT reporting, or anything else!

Bureaucratic entrepreneurialism thus means regulatory and administrative procedures and forms of detailed control, leading to little value added and a not negligible share of frustration on part of the entrepreneurs.

Sources of venture capital

The innovation system organizations representatives were equally concerned about the limited access to venture capital investment. The CEO of the venture capital investors' interest organization remarked that while the "buyout side" of venture capital investment was "very successful" and managed to "raise new funds all the time," on the

“venture side” there was “very little Swedish capital.” The director of the university-based incubator claimed that “very, very few are investing in pharmaceuticals today.” Many of the interviewees endorsed an “only the strong survive” narrative to explain the present situation characterized by a broader interest in buyout activities and in information technology ventures. For example, the CEO stated, “Generally speaking, (it is) hard to find private venture capital, but the very best companies always find a way. That means that quite a few good companies that would otherwise acquire capital have a hard time ... Only the best raise [capital].”

For life science ventures, there are, practically speaking, three alternative sources of funding: (1) venture capital investment from either state-governed organizations or private venture capital firms, (2) business angel investment, or (3) stock exchange introductions. Regarding the role of the state-based innovation system agencies, all interviewees were convinced there was too little money available in the state-controlled or regional organizations to make the difference needed in the more mature stages: “In life science there is too little [venture capital]. If you have reached the point where you discuss private equity, then [the state innovation agency money] is too limited: it doesn’t make a difference!” one of the state innovation agency investment managers argued. An investment manager at a university holding company argued that “the very best companies” in their portfolio” are capable of receiving capital funding, while the companies “just below, that are not yet just as good, they miss funding” (Investment manager and counsellor I, university holding company). He argued that it was in this segment that the state-funded innovation agencies “make a difference,” and therefore additional money from the government would make a significant difference. When being asked about how much additional funding that would satisfy this most urgent demand, avoiding an overvaluation of this stock of companies, he estimated that budget increases in the range of 75–100 percent would suffice:

We brought in 32 millions [SEK] to our companies last year in the form of private equity, grants, and loans. The question is, ‘How much money would we need to advance the projects faster?’ We believe 75–100 percent more, then we would have been able to move forward quicker. If we would have received this capital [from the state], we think we could have been much more efficient. But we wouldn’t need much more than that. (Investment manager and counsellor I, university holding company)

Unfortunately, the CEO of the university holding company saw very limited interest in the political system for thinking beyond the “early-stage-public-funding-and-thereafter-market-transactions” tradition of organizing the national innovation system:

In the government, no matter what party representative¹ I speak to – and I see quite a few of them – think what we do is admirable and honourable, but it is absolutely to be done as a market-based activity. But market-based means that there is a basic stock of capital that the owners may add to when needed, but that is not the case right now; that is not what they do for the time being. (CEO, university holding company)

To illustrate this marginal interests and inertia, the CEO pointed at the recent new research and innovation bill presented, containing few new ideas or initiatives regarding the funding of start-up companies beyond the early stages:

There are countless billions in the new research and innovation bill. The majority went to research and the support of various research-based commercial activities, but in fact there is little money being given to holding companies or to the incubators... On page after page, there are statements regarding the importance of basic research and that commercial interests are involved, but the commercialization part is quite unreflected, I'd say. (CEO, university holding company)

In the present political climate, there were relatively limited interest in providing additional resources for life science venturing, and therefore more mature life science ventures had to seek its financiers outside of the state and the regions.

Second, business angel investment was an attractive option in theory while in practice there was a conspicuous shortage of skilled and financially robust business angels in Sweden. One of the explanations for this limited access to this category of venture capital investment is an absence of an entrepreneurial culture in the wealthiest strata: “There is only a very small part of the wealthy people that become business angels. Only a few percent of those controlling ten millions of more,” the state innovation agency program manager remarked. The CEO of the venture capital investors’ interest organization shared this view:

There is too little money in comparison to American business angels. We have a few of them visiting us a few years ago...Each of them

controlled as much [capital] as [one of the major Swedish investment funds]! They controlled like 2–3 billion [Swedish crowns] that they invested. What do we have here in Sweden? Perhaps they own 2–3 million and they, perhaps, may invest a couple of hundred thousand. This category of capital investors do not have long term stamina to work with this kind of companies where you need to invest a couple of hundred million before you get some money in return.

Business angels are, the program manager in the state innovation agency claimed, characterized by “a passion for social issues” and a willingness to “support local entrepreneurialism,” but their primary objective is by the end of the day to make money and to find “the new Google or Spotify.” As life science venture capital investment demands much expertise in not only life science research but also in the clinical work in health care organizations, life science investment is a knowledge-intensive activity. One of the consequences is that already risk-averse business angels further withdraw from the life science venture sector. However, in the case when business angels actually do invest, they are active owners being highly involved in the companies: “It is not the case that they donate a million or two and then just leave,” the program manager remarked. As the chief scientific director argued, business angel investors were reliable and patient owners with a long-term commitment to the firms they choose to invest in.

Third and finally, the stock exchange list for small start-up ventures was an additional source of funding, but practically speaking this was the least attractive alternative, some of the interviewees claimed. To start with, the shares on this stock exchange were only limitedly traded and companies introduced on the stock exchange, the program manager argued, also received a “bunch of weird shareholders, which makes the company more or less impossible to invest in for a venture capital firm,” as venture capital investors preferred to not have any private shareholders involved in their firms. In addition, these shareholders did not provide the start-ups with the corporate governance structure needed to bring the therapies to the market and into the clinics. As most of the start-up companies had not yet any market share to speak of, or any positive cash flow, the stock exchange was not a very attractive alternative to secure funding. Taken together, this leaves the start-up companies in a situation where the state-based and regional innovation system organizations can only provide relatively small research grants and early stage seed-money funding, where business angels are relatively few and above all either unqualified to invest

in life science ventures or demonstrating a risk preference that channels their capital into other sectors, and where a stock exchange introduction at a too early stage signals an inability to attract other forms of funding. The company and the innovation system representatives saw no other option than to let innovation system agencies invest more heavily in the clinical trial phases, which would provide the start-up companies with the clinical verification that was of central importance for the venture capital investors. Since the venture capital investors, in the formulation of the state innovation agency project manager, had “moved up the food chain” to more mature phases in life science venturing, there were few alternative sources of funding in the clinical trial phases. At the same time, the interviewees could not see any political will to transfer money from, for example, regional economic growth support investment funds to the life science sector. This was still a political initiative that the CEO of the business region development agency called for:

The private venture capital market is not interested in carrying these levels of risk, so they enter at a later stage. If the government should serve the role as a provider of capital, which it has decided to do, regardless of the colour of the government, then you should allocate this capital to the sectors [of the economy] having a significant growth potential, and in my opinion that means life science. There is very, very few that manages to receive public venture capital.

At the same time, the CEO were fully aware of the political implications from directing additional tax-money into a field of research that is heavily financed by the state in the first place, and that eventually would be transformed into private equity as soon as venture capital investors are engaged, and what with quite limited efforts could be acquired by foreign capital owners and moved abroad. According to the CEO,

private venture capital, regardless whether it is national or international, will have a hard time to move to [the early phases]...because the risks are too high...On the other hand, there is a need for between 25 and 200 million [Swedish crown] multiplied by X hundreds or even thousands of interesting projects. That is an enormous amount of money! I cannot see how the government could use the taxpayers' money to finance this, because it is simply too much money! Perhaps there could be some kind of private-public collaborations to reduce the risks for the private capital and for the tax-payers... We know that

if we invest in 1,000 projects, 20 will come out [profitable], but which ones we cannot predict.

The director of the university-based incubator addressed the liquidity of life science ventures, being based almost exclusively on abstract scientific know-how and the use of relatively standardized laboratory equipment:

Life science belongs to a global market. If we develop something here, the purpose is to make it on a global market. We attract venture capital from basically everywhere, and the venture capitalists sell their companies to anyone. These are really liquid assets! But of course, if you are wearing the protectionist hat, you may ask, 'How does this contribute to work opportunities in the Gothenburg region?' because that is what [the politicians] chase. Then we need to attract venture capital saying that 'Operations in Gothenburg, that's what we're looking for!' Or we need to do like the Danes – work with [venture capital] foundations having a much longer ownership commitment perspective.

Also an investment manager in a university holding company shared this concern that they were expected to both create economic value in the firms and job opportunities, two goals if not irreconcilable at least operating along divergent lines:

One big concern is how to avoid that all things end up abroad. When we need to acquire this capital above 10 million, then the international investors are approached. We hear at times our owners [i.e., the state] that, 'We need to create jobs here in Sweden and preferably in the local area' ... We want to be recognized for the value we have created if the research findings are brought into society and improve something, rather than in terms of the companies that we build ... [But] the politicians have not dropped this issue [of job creation]. The regional policy makers want us to build large companies, but it is really hard! That might take 20 years. We are more eager to be assessed in terms of the number of deals we do, or the amount of venture capital of financing that we attract, or the number of individuals and qualified persons that move to our region. The money all this engages, that is opaque because we do not see the turnover taking place in the acquiring companies in the later stages.

"I think it is a pity that job creation policies trickle down and determine everything," the investment manager concluded. In addition,

the concern for investing tax-money in ventures that would eventually become private equity was especially a concern for the state-controlled innovation agencies. Some of the venture capital investors had addressed this concern as a necessary evil, but for the state innovation agency representatives, the allocation of tax-money was a politically charged theme. Said an agency investment manager,

We cannot offer some kind of special treatment for this category of projects as they are based on private ownership. The owners control 100 percent of the stock at the same time as the state has paid for all of it. Based on a concern for the free competition, if you support only a few companies where private interests benefit while other companies that already have lived through this stage get nothing, competition may be biased. This is no easy matter!

Given all these practical and political difficulties involved in supplying venture capital funding to life science ventures, the so-called “valley of death” in-between the seed-money investment phase and the full-scale venture capital investment phase seemed to be a quite acute concern for all actors participating in life science venturing. Few had any detailed suggestions for how to change the innovation policy. Some of the state innovation agency representatives were speaking rather loosely about the need for being more skilled in identifying the right start-up companies to invest in and to be able to provide the right counselling activities:

I think we need to invest more money in fewer companies to attract the right persons and ensure that these persons are not left on their own. They need to take this relay race stick and move forward on their own. Fewer companies! There are loads of money in the system but there need to be fewer actors so we can pay them adequate salaries. (Investment manager #1, state innovation agency)

As some of the company representatives were quite sceptical regarding the expertise of the state innovation agencies, there are reasons to question if an increased ability to target the most promising life science start-up companies will be able to resolve the problem of the shortage of venture capital. On the other hand, if fewer companies abandon their research projects and its co-workers return to basic life science research activities, there are fewer companies competing over venture capital investment in the later phases. On the other hand, fewer investment opportunities may not lead to the growth of an adequate stock of capital that can be

piped back into life science ventures as there are fewer ventures to direct in the future. Perhaps not fewer but *more* companies to select from in the venture capital investment phase would be an alternative solution. The interviewees nevertheless offered few solutions to the shortage of venture capital.

Ineffective innovation system infrastructures

The chief scientific director of the stem cell company claimed that one of the main reasons for the shortage of venture capital investment in life science venturing could be explained by the decline in output of new innovative drugs in the pharmaceutical industry. The pharmaceutical industry has traditionally operated within a “small molecules paradigm” wherein a compound has been developed on basis of a molecule below the weight of 150 Newtons (the definition of “small molecules”). This compound connects to a target (e.g., a receptor in a cell) that in turn is related to a certain indication, an illness or medical condition. This model structured around the compound-target-indication aggregate has been remarkably successful until the 1990s where the number of new registered drugs and newly defined “drugable targets” started to decline. In addition, regulatory control became tighter, and the demands for clinical value-added was raised in the period, leading to the demand to exploit new scientific new drug development concepts. Concepts such as stem cell therapies, antibodies, and biologics proved to provide new opportunities for developing therapies but this new path demanded new scientific research methods and new methods for clinical trials leading to increased demands on the pharmaceutical industry to reorganize its discovery and development work (Styhre and Sundgren, 2012). One of the most salient consequences of the decline of the small-molecules paradigm was that more resources were consumed in R&D while fewer new innovative drugs were developed, registered, and launched. The historically very successful pharmaceutical companies found themselves squeezed between their historical track-record as a highly profitable industry and the demands for adjusting their research activities to new areas of research and new concepts, a situation that is particularly complicated to handle in the so-called quarter-economy capitalism: “The pharmaceutical industry is based on small molecules, but there are few new targets being identified. As a consequence, they need to test something new. The antibodies are on the move and then there will be [stem] cell therapies sooner or later, but that can take like twenty years! How can you explain that to the stock market?” the chief scientific director asked. “The pharmaceutical companies endure a really painful period. There are

a few positive cases," he continued. The program manager of the state innovation agency addressed the same concern: "The pharmaceutical companies, they are managed to find the Holy Grail, the blockbuster. And everyone is more or less running in the same direction. They search of coronary diseases, diabetes, obesity [therapies], and so forth. All these welfare diseases where people willing to pay [for the therapy]."

While the major pharmaceutical companies report a significant cash flow on basis of their available stock of patents and products, much of this capital has been used to acquire relatively mature and innovative life science companies or to develop new internal R&D facilities and know-how. In comparison, there is an unwillingness to invest in life science companies that have not yet proved their market value. This means that the venture capital investors have lost much of its exit-market for the life science ventures they invest in; few major pharmaceutical companies take any risks and this risk-aversion migrates down the chain to venture capital investors. As fewer life science ventures are capable of finding a stable long-term owner, there are fewer chances of making any money on a life science venture.

One of the consequences in the earlier phases of the life science venturing process is, as some of the venture capital investors remarked, an excess or oversupply of innovation system infrastructure,, for example, research laboratory facilities. "There are like 50 incubators in Sweden. It is popular beyond sanity," the director of a university-based incubator said, pointing at the mimetic isomorphisms in the Swedish innovation system where fashionable, preferably American, concepts are widely spread and held in esteem as an indication of a vital regional or local innovation system. The CEO of the university-based business incubator stressed that the Silicon Valley narrative is inspiring but also misleading as the Bay Area information technology cluster has been in operation for half a century, while in Sweden the very idea of venturing and venture capital is less than 15 years old: "Silicon Valley has developed over more than 50 years... When we started in '99 and talked about seed-money, people looked at me and asked, 'What did you just say?' Prior to that, there were only investment companies in Sweden. Nobody had ever heard about business angels."

An investment manager in a university holding company addressed the same issue, the relatively new tradition of regarding basic research work as a vehicle for economic growth and job creation:

The universities have taught to 1,000 years and conducted research for several centuries, but the third assignment is actually no more than

20–25 years. It is no wonder we have not moved so far. Not until a chaired professorship would be based on the number of patents... the third assignment is not really valued properly.

In addition, the director of the university-based incubator remarked, there is a tendency to overrate the number of successful incubators technology transfer offices in the United States: “There are only a few successful TTOs in the world.” These are primarily located at elite American universities such as Harvard, MIT, and Stanford, which take advantage of the global recruitment base of these universities and benefit from the larger and more mature venture capital market in the United States. In addition to the mimetic isomorphism, the strong emphasis on entrepreneurialism in the predominant neoliberal ideology has led to the normative belief in every scientist and researcher having both the right and the obligation to capitalize on his or her research findings. Over two decades of innovation policies stressing the supply of life science entrepreneurs have led to a shortage of venture capital funding for aspiring life science entrepreneurs. The incubator director commented,

We get the ideas here [in the incubator] quite early on, directly from the researcher's desk, but that implies the risk that we invest private capital in a too early stage of the research that isn't verified. The 'teachers' exception right' further reinforces that image. In this view, every researcher has the right to 'live their dream.'

The director did not disapprove the idea of the value of life science entrepreneurship but also thought that there was a certain naivety regarding what it takes to transform academically intriguing research findings into therapies. He preferred that the universities should play a more active role in further developing promising research findings. That would mean a more “actively structured TTO process,” which in turn would increase the incentives of universities to supply funding for “verification studies” (i.e., clinical trials) before the research findings were further commercialized. “A structure where the universities take a more clear responsibility for their [research] results would make it easier to raise the substantial amounts of capital needed to continue with the verification of early ideas,” the director argued.

The CEO of a university holding company stressed that the innovation system is today too fragmented into a number of agencies that serve their own specific interests and report to their own constituencies,

which leads to a innovation system that is complicated to oversee and understand for all parts:

There is a university-based system today but we suffer from the [organization] where 'You can get 100,000 [crowns] over here,' and 'You can get 300,000 over there,' and when you apply you need to write three reports, and then the money always arrives after the project is finished. This system cannot be run on basis of the researchers' private income.

Company representatives also shared this view and thought the innovation system was too unstructured and almost impenetrable including all kinds of funds, agencies, incubators, and business counsellors that were hired by regional branches of the state-governed innovation system, or by the local university-based innovation system to support and advice the start-up companies:

I have been in this business a few years, and I think there are still new organizations popping up. I still don't fully understand how it all hangs together. There must be a quite a fair share of confusion when being new [in the field] and not knowing where to go. There must be great sums of money disappearing in administration and non-value adding activities as there are many people doing the same thing. Perhaps, it would be beneficial to create one major life science organization with really competent people working in different fields rather than everyone having their own life science-area, leading to the situation where you are not really good at anything. (Project leader, herpes vaccine research project)

The innovation system has thus ended up in a situation where it needed to be thoroughly transformed and consolidated, some of the interviewees argued. Said the university holding company CEO:

I think we have ended up in a stalemate: Either you get rid of the teacher's exemption rule, or you provide more money to those supporting the researchers and give clear rules for how to handle the negotiations in good faith with industry. Today, all the companies we negotiate with [when selling companies] are American, Japanese, or Chinese, and then, again, the Ministry of Enterprise, Energy and Communications thinks we throw out the baby with the bathwater.

One of the investment managers in the university holding company shared this view:

I think we should eliminate the teacher's exemption right because then the universities would be forced to take an ownership role and be less dependent on the inflow of capital. If you consolidate the entire innovation system – there are so many of us – and instead located all of us quite clever individuals in a tech transfer office with funding from the state, I think we would be able to do an even better job.

By and large, neither the company representatives nor the innovation system representatives had any clear ideas on how to balance the delicate process of entrepreneurialism and the role of the state. On the one hand, a laissez-faire policy would leave the entire process of matching research findings and capital to the venture market, possibly starving good research ideas to death; on the other hand, a too heavy-handed and state-governed life science research program would potentially squander tax-money and/or help finance life science ventures that sooner or later would become privately owned corporations. Balancing these two equally undesirable end-points was a political objective that was delegated to the innovation system organizations and its representatives. The concern is, as the project leader in the start-up company developing a herpes vaccine argued, that at the end of the day, science is and remain highly unpredictable and therefore complicated to turn into a commodity in a capitalist regime of accumulation demanding predictable profits and cash-flows:

It's a very complicated science... That is part of science's essence that you don't really know what will come out of it. The more you try to control it, the trickier it becomes. Good ideas comes from creative persons and they cannot be fully controlled. There need to be a certain openness. The state's role is to finance unregulated open science research, because venture capital and industry will not serve such a role.

Representatives of the innovation system and the companies saw only limited concern in political bodies for the life science industry and life science innovation. “[If you read the government's policy documents], you won't be able to find anything because there is no strategy! There are these common empty phrases, but there is no action list!” the program manager for the state innovation agency argued. The CEO of

the venture capital investors' organization shared this critique: "[The political rhetoric] is very imprecise. All these reports are just succeeded by new reports. We think there is a lack of concrete action. They better target two or three pressing matters they want to change and focus on them rather than working all over the place." "I see very few concrete proposals," she said.

The demand-side of the equation

In addition to what company representatives tended to regard as an inefficient and complicated innovation system, comprising a variety of actors and institutions that at times were competing over resources, at times not fully capable of providing adequate advice to the start-up representatives, there was a general concern that the demand-side of the equation, the health care organizations and the clinicians, were complicated to get into contact with and to fully understand. The CEO of the medtech company addressed the lack of policy and regulatory framework on the national level regarding how new health care innovations could be clinically verified, tested, and adopted by the regional health care organizations. The state and the government have been fully occupied with implementing the new enterprising policies during the last two decades, that is, activities that aim to make entrepreneurs out of professional groups that have previously legitimately specialized in their own domains of expertise, for example, basic research work in the universities. Based on the dictum, "successful innovations will always find their champions and end-users," the demand-side of venturing has been less emphasized and developed. As a consequence, the regional health care organizations are, company representatives claim, poorly equipped to respond to and absorb new innovations. Also innovation agencies representatives addressed this concern:

There is no activities promoting the procurement of new innovations, and then the start-ups are not really invited. In addition, there is the Public Procurement Act, and then it is really difficult...The small firms are never really able to participate. (CEO, university holding company)

The medtech CEO was frustrated about the lack of policies and guidelines for how new health care innovations should be handled by the health care organization, having the feeling that it is the company that

needs to prove the benefits of the new technology rather than developing the product in collaboration with end-users:

[We] encounter resistance in terms of being placed in a position where we have to 'prove things' that everybody had already agreed upon. That is not helpful! They could professionally have helped us to verify what we claim to have seen elsewhere and that would have been beneficial for Sweden. In contrast, we need to chase the right people for yet another half a year so they can acquire the information they need.

Being located less than 150 meters from the blood central at a major hospital, there were still no collaborations between the medtech company developing a new blood bag for the transportation and storage of blood and the hospital. This is indicative, the CEO argued, of the limited interest for and capacity to collaborate with health care innovators. In addition to the closed doors and high thresholds of the regional health care organizations, the CEO decried the lack of conventional economic thinking in the health care organizations. He offered a series of examples of how regular, mainstream calculations would reveal the cost benefits of the new blood bags being able to secure the quality of the blood they contain: "The cost we add is less than five percent of the blood bag's value...[T]here are 30 million blood packages; 900,000 are being wasted [annually in Europe]...That is two billions of economic worth" (CEO, Medtech Company). In addition to the 900,000 blood bags being destructed at the same time as there is occasionally shortage of blood, there is a lack of strategic economic thinking in the health care organization, the CEO claimed, using the example of an investment made in one of the regional health care organizations:

[One regional health care organization] has invested in a 'blood-bus.' Great! It costs something like two-three millions and they handle 13,000 blood bags annually, each worth 1,500 crowns...There is shortage of blood in many places in Sweden and [this organization] are capable of producing more blood...but there is no coordination in Sweden. (CEO, Medtech Company)

Some of the entrepreneurs thus had to run their own companies on basis of quite detailed accounting principles and be responsible for their use of scarce resources, capital in particular, but when they reach the point where they have to communicate with the end-users in a more regular

basis, they encounter an entirely different business logic. In their minds, they have to become some kind of “Kremlinologists” to figure out how to convince purchasers and procurement officers in the health care organization to assess their innovations favourably. If nothing else, the Swedish health care organizations and its reliance on a health care logic and a scientific emphasis on clinical data is at odds with the enterprising and more money-minded world of life science entrepreneurs. Only the government’s more detailed engagement to reconcile these two worlds and their different institutional logics can arguably handle this situation.

The national innovation system and the shift of institutional logics

The shift from the science logic embedded in professional norms and regulatory frameworks outlined by Robert Merton (1973) to the market logic characterized by entrepreneurialism, intellectual property rights, and private capitalization of publically funded research represents a major shift in the governance of the university system. Consonant with the neoliberal credo emphasizing marketization, competition, and enterprise, the shift in institutional logic was accompanied by a burgeoning venture capital market that was ready to invest when academic research findings were transformed into private companies. In the case of Sweden, both Social Democrat and centre-right governments have been enthusiastic sponsors and financiers of an innovation system modelled on a North-American role model, blending public and private funding. In many ways this new emphasis on academic entrepreneurship has been successful in changing the attitude among academic researchers, and while it was widely regarded to be somewhat morally questionable and suspicious to collaborate with industry among life science researchers in end of the 1970s and early 1980s, today there are much more collaborations between universities, incubators, university-based venture capital funds, and university spin-outs and other industry actors. While this supply-side economics approach has successfully instituted a quite diverse innovation system, serving to increase the supply of entrepreneurs and investment opportunities, there is no comparable supply of venture capital that are ready to finance the development phases of the start-ups and university spin-outs. From an innovation system perspective, this shortage of funding – perceived or actual – is problematic as early investments in both basic research and in the promotion of venture capital cannot be fully exploited. In the venture capital investment field, it is commonplace to claim that the “best ideas” will always attract venture capital, while at the same time there is a concern that

there is not a sufficient amount of professional, experienced venture capital investors having the ability to assess and fund all the academic research projects turned into companies. The imbalances in the supply of start-ups and the supply of venture capital suggest that the one-sided emphasis on the increase in output of academic entrepreneurs, enacted by the state-funded innovation system, has failed to take into account the structure and mechanisms of the venture capital market. Studies show (e.g., Wright, et al., 2006: 485) that, for example, technology transfer offices located in universities play a most peripheral role in producing new innovations, and venture capitalists included in this sample had many examples of business counsellors giving what venture capital investors regard as misleading advice that diminishes rather than enhances the possibilities for attracting long-term venture capital investment. This suggests that representatives of the innovation system have only a partial understanding of how venture capital investors work, and what qualities they emphasize in the investment objects. As a consequence, the entire innovation system including the supply of venture capital is only loosely coupled. Therefore, authoritative statements regarding the university system and university-based research as being the new “economic engine” of the contemporary capitalist regime of accumulation made by, for example, Berman (2012) effectively captures the normative shift from the science-as-public-good view to the science-as-intellectual-property position and the accompanying inflow of venture capital into the life sciences. Unfortunately, this story conceals the fact that there is, even in the United States – otherwise widely portrayed as the role model for other regions – a endemic perceived shortage of venture capital taking the initial research findings through the clinical trials and translating them into new therapies or clinical practices. This suggests that the shift in institutional logic from *science logic* to *market logic* is by no means unproblematic or capable of solving all issues regarding life science innovation. On the contrary, one may speculate whether the state-led supply-side economics efforts to increase the output of academic entrepreneurs and university spin-outs have in fact reduced the innovative capacity of academic research as highly specialized researchers have been instructed to combine their academic laboratory work with enterprising activities in the companies they have registered. If that has been the case, the benefits of the market logic must be weighted against its unanticipated consequences.

The study contributes to the institutional theory literature being concerned with the role of agency when institutions change. More specifically, the study of Berman (2012a, 2012b, 2008), pointing out the

changes in the university system leading to the abandoning of the science logic and the gradual establishment of a market logic, has served as the principal analytical framework. However, while Berman both accounts for attitudinal changes in the community of academic researchers and the inflow of venture capital that provided economic incentives for academic researchers to abandon inherited beliefs regarding scientific research as a common good, her story does not say very much about all those ventures that end up being starved on capital. First, there are start-up companies that present research findings that are too far away from any clinical application, thereby including too much uncertainty for venture capital investors. Second, there are companies that have managed to attract venture capital at an earlier stage to initiate clinical trials, or to develop prototypes of, for example, medical technologies, but that have been lost on their way to the market and eventually have failed to attract new financiers. In the first case, the companies are not yet ready for market introduction, while in the second case they become “the living dead” (Gorman and Sahlman, 1989: 231) that eke out an existence but where they can only hope for things to change around the next bend. Berman (2012a, 2012b, 2008) arguably does not sufficiently account for these cases. Therefore the study contributes to the venture capital literature by stressing that there is neither a shift from the one institutional logic to the other (see e.g., Meyer and Hammerschmid, 2006; Thornton, 2002), nor a form of harmonious hybridity between the two (a “constellation,” to use Goodrick and Reay’s [2011] term), but rather the new institutional logic is imposed from above by governments and authorities in order to pursue specific goals derived from enacted exemplary cases (i.e., American elite universities and the venture capital markets they engender). In this case, an institutional logic is more of an ideal or a preferred order of things than an actual social order. That is, the institutional logic is advanced as the solution to certain administrative, economic, political, or social problems or challenges, but in fact, it either ignores the benefit of the previous institutional logic or underrates the issues derived from the new institutional logic. In this case, an institutional logic is not only a certain “suprational order” (Lok, 2010) that presents certain “cultural beliefs and rules” (Dunn and Jones, 2010), but is also embedded in ideologies (Jasanoff, 2004; Walker, 2003; Armstrong, 2001). For instance, the neoliberal emphasis on competition, market-based transactions, and the role of (private) intellectual property rights, all being advanced in sharp contrast to what Merton (1973) referred to as – the choice of wording here is telling – the “communism” of academic research, were all significant elements of the market logic.

Summary and conclusion

Institutional theorists are always prone to accept functionalist explanations—organizations do what they do regardless of its seeming irrationality because it enables a long-term survival (Meyer and Rowan, 1977) – and the concept of institutional logic is at times presented as if it emerged by the sheer force of history and the social, cultural, technological, and legal changes it brings. In the case of life science venturing, the change from a science logic to a market logic was the outcome from a series of interrelated but separated changes beginning in the 1960s (Sunder Rajan, 2012: 2–3), but the state has undoubtedly played an active role in promoting academic entrepreneurialism. As a consequence, the new market logic is as much a political fabrication as it is the effect of historical conditions and changes. While the period up to the burst of the Internet bubble and the accompanying stock market decline in 2000 showed that there was an adequate supply of venture capital available for life science venturing, the last decade demonstrates that there are severe difficulties involved in matching entrepreneurs and capital regardless of the supply of enterprising academics. Making money in life science venturing demands highly specialized expertise and very few venture capital investors can afford to develop the skills needed to select the best investment objects. In addition, there is an irreducible uncertainty in the life sciences, derived from an incomplete understanding of the human biological system and the difficulties involved in new drug development in making predictions on basis of the animal *in vivo* models used in the discovery phases. Therefore, the praise of the increase of the supply of academic entrepreneurs being the principal accomplishment of the market logic needs to be aligned with an analysis of the venture capital markets.

Part III

Analysis and Contribution

7

Managing Life Science Innovation

Introduction

This final chapter of the book will examine some of the implications of the financialization of the economy, the risks and the uncertainty involved in life science venturing, and the corporate governance practices in life science ventures. Based on a combination of the review of the financialization, venture capital, and corporate governance literatures and the empirical material generated in a Swedish life science venturing setting, the chapter will address some of the concerns pertaining to the role of both private and state-controlled venture capital investors and the national and regional innovation system.

Managing life science innovation

The first thing to recognize in the analysis of life science venturing is that more than four decades of financialization of the Western economies has by no means made the supply of venture capital and venture capital investors' skills and competencies in parity with the demand. Financialization is the institutional and regulatory change of the economy where higher degrees of profits derive from the finance industry. This growth of the importance of the finance industry has emerged gradually and is the outcome from a variety of regulatory changes and new policies, at times intentionally implemented to support the circulation of finance capital, while in other cases being implemented to handle other macroeconomic or financial problems (Krippner, 2011). As was detailed in Chapter 1, the Western economies and the United States and the UK in particular are today bound up with the finance industry that accounts for an increasing share of the accumulated profits. Financialization is not

solely a matter of piping profits into the finance industry, but finance theory has developed a sophisticated analytical framework that stress a number of calculative practices and descriptive and prescriptive models that taken together renders the firm as a bundle of financial resources to be effectively invested. The most prominent concept capturing a variety of institutional and managerial changes is the concept of shareholder value and shareholder value creation as the sole legitimate objective of the firm, stressing that firms that fail to enrich its owners will be treated as poor investments and consequently it will fail to attract the capital needed to secure long-term survival. Financialization represents a pervasive and inclusive change in the economic system that relies on new political agendas that ultimately rests on new economic theories and doctrines regarding the role of the market and especially financial markets as what most effectively values and prices assets and commodities. It is perhaps surprising that these overwhelming new economic conditions that have managed to accumulate enormous sums of capital still fails to provide adequate stocks of venture capital to what are widely treated as high-potential and high-growth industries, characterized by innovation, creativity, and new solutions to perceived problems (e.g., inadequate therapies). The significant growth of economic inequality and the accumulation of capital in the finance industry do unfortunately not solve the problem of uncertainty in life science venturing and therefore the historical performance of, for example, the multinational pharmaceutical industry is not enough to convince capital owners that life science venturing is an attractive investment. The stock of capital generated over the least decades fails to reach the entrepreneurs that are starved of capital. This is major concern for policy-makers, venture capital investors, and entrepreneurs.

The role of the state in life science venturing

One of the first thing to notice is that life science venturing remains dependent on an active state that financially supports, monitors, and regulates life science venturing, especially in the early stages of basic life science commercialization. Without the state funding and overseeing the university system there would be only a limited output of candidates for life science venturing. Lazonick and Tulum stress the role of the US government not only as the financier but also, ultimately, as the client of life science companies:

In the 2000s, the US government still serves as an investor in knowledge creation, subsidizer of drug development, protector of drug

markets, and, last but not least... purchaser of the drugs that the biopharmaceutical industry have to sell. The BP [biopharmaceutical] industry has become big business because of big government, and... highly dependent on big government to sustain its commercial success. (2011: 1180)

More specifically, Sternitzke argues that even the pharmaceutical industry, for decades entirely privatized and running its own research facilities and research functions, still remain dependent on research finding' from the university system and its basic life science research: "Almost 80% of the references from the US patents in pharmaceuticals relate to science published by public sector institutions. Mansfield (1991) observed that about 20% of drugs could only be developed with substantial help from recent academic research" (2010: 811).

An econometric study reported by Toole (2012) demonstrates that in the case of the United States, say, an increase of 1 percent in the "stock of public basic research" ultimately leads to a 1.8 percent increase in the number new molecular entities (NMEs), an important predictor of new drug therapies used by Food and Drug Administration (FDA). In addition, not the least in national health care systems that are in place in many European countries, the state plays a most important role as the buyer of life science innovations. Without the possibilities for generating a cash-flow, a market position, and a clinical application enabling the further development of the therapy, life science ventures would not acquire any economic value, which in turn would make them unattractive investment opportunities for capital owners including venture capital firms. "Public investment in human capital without taking care of the demand side... may result in the waste of such capital, or in brain drain," Niosi proposes (2011: 1817).

Many countries elaborate on policies that emphasize the use of new therapies and life science innovations, but the users of the new therapies – clinicians such as physicians – favour solid clinical evidence that the new therapy works better, are safer for the patients, cut costs, or otherwise benefits the health care organization. The inertia of the large-scale national and regional health care organizations and the alleged conservatism of the community of physicians are two of the main challenges addressed by both life science entrepreneurs and venture capital investors. Under all conditions, policy needs to stress both the supply side of life science ventures and the demand side, where investment previously made can be capitalized and gain a market value on basis of sales and market shares.

Corporate governance practices in life science ventures

One of the immediate effects of the financialization of the economy is that corporate governance practices have been increasingly fashioned to secure the generation of shareholder value. Agency theorists such as Michael C. Jensen strongly emphasizes that the sole legitimate objective of the firm in a market-based society is to generate value for the shareholders, as shareholders operating on the finance market are in the best position to make the decision about where to allocate capital to secure the highest return. This idea is grounded in neoclassic economic theory and its assumption that the market is an institution superior to any other social institution when it comes to the calculation of prices on basis of available information (Mirowski, 2013). In neoclassical economic theory, and especially its more neoliberal and libertarian branch of the Chicago school of economics, for example, the market is enacted as a natural, spontaneous, and superior order that effectively incorporates all information available into the pricing of an asset (Hart, 1995). In such a worldview, where the market has acquired an almost ontological status, there is little use of managerial oversight and competence in allocating the economic value generated in companies as market-based actors can more effectively do this job. Instead, any managerial activity is closely bound up with agency costs derived from the monitoring of managers and executives. In the agency theory prescription, shareholder value creation is a universal solution to the minimization of agency costs (Dobbin and Jung, 2010). As was suggested in Chapter 2, the agency theory model assumes that managers overseeing firms that are mature, stable, preferably operating in declining industries where no further investments are likely to generate additional returns, and generating a free cash flow, are benefitting from shareholders' discipline. In contrast, in life science ventures, few of these conditions are fulfilled: ventures struggle to develop a new therapy, are in need of capital investment to be able to conduct adequate clinical trials, have no positive cash flow, and operate in an environment riddled by uncertainty rather than significant risks of managerial malfeasance (Garg, 2012). Rather than monitoring executives and managers squandering the free cash flow, as proposed in the generalized agency theory model, corporate governance practices is here more concerned with balancing life science research competence and commercial human capital, skills, and experience needed to bring the new therapy to the market and into the clinics. The venture capital owners are thus not so much facing opportunistic behaviour, as they need to handle a situation wherein they have to recruit and secure the

human capital needed. Venture capital owners do not generally believe that the founders – often life science researchers who are part of a university faculty – are the problem, as researchers commonly understand they lack the expertise needed to commercialize research findings. Instead, venture capital owners find it challenging to identify qualified executives and directors with experience working in small-sized ventures with only very limited resources. There are, in short, substantial concerns in life science venture capital investor quarters regarding the supply of skilled executives and directors in Scandinavia and Europe, and occasionally there are such competences being recruited from the United States. Garg (2012) speaks of the “principal costs” rather than “agency costs,” as the executives and directors may display higher interests in securing a return on investment than the founders or the managers being recruited. It would be a fair assessment to say that venture capital owners by and large are more concerned about the structural features of the Swedish life science industry than the problems pertaining to corporate governance identified by agency theorists.

Developing innovation systems

A problem related to the corporate governance issue is what role the state and government agencies should play in the creation and support of the life science industry. Life science research is a prestigious branch of the sciences, and historically, the pharmaceutical industry has demonstrated a remarkable capacity to absorb research work conducted in the university setting and to translate such know-how into profitable products. This industry capacity has also contributed to the longevity and well being of millions of human beings. In many ways, the pharmaceutical industry has served as the archetypal life science industry, serving as the link between the world of academia and the world of commerce. Moreover, the pharmaceutical industry has been a most profitable industry, and it is therefore little wonder that the state and the government has been willing to financially support the development of more life science research to further expand the pharmaceutical and (more recently) biotechnology industries. Unfortunately, Big Pharma’s difficulty maintaining a high output rate of innovative therapies started to be pronounced in the early 1990s when the small molecules strategy, effective until then, started to run out of steam. In this period, new advancement in the fields of genomics and proteomics, and the interest in, for example, neurodegenerative diseases such as Alzheimer’s and Parkinson’s, imposed new challenges for the industry. What had previously worked very well was suddenly portrayed as a problem for Big

Pharma; its fairly standardized and streamlined R&D work – so-called rational drug design – could no longer produce new and innovative drugs, as the demands for therapeutic efficacy and safety were raised. Over more than two decades, the pharmaceutical industry has lost some of its ability to produce and register new innovative drugs, and instead the industry is characterized by an increasing rate of mergers and acquisitions and the production of so-called me-too drugs, variations of previously successful drugs (Busfield, 2006; Angell, 2004).

The decline of the multinational pharmaceutical industry has two immediate consequences for life science venturing. First, it has complicated the national innovation policy, at least in Sweden, which focuses on the output of new life science ventures and the transformation of academic researcher into life science entrepreneurs. In the era of financialization, where the market is enacted as a superior information processor that more effectively than any other social institution prices assets and lowers the costs for economic transactions, a supply-side economics policy of life science venturing has been widely endorsed. In this policy framework, the deregulated capital markets and the presence of mature organizations that generate a stock of free cash flow that can be used for investment constitute the market's demand-side. This model worked quite well when there was a satisfying supply of capital and/or a low degree of risk aversion and expectations that investments would generate returns. This was precisely the situation in Sweden and most of the advanced economies in the years around the millennium; as venture capital abound, life sciences start-up companies could benefit from the information technology hype and the risk-seeking money that flowed into the industry. Unfortunately, things proved to be more difficult than the first generation of venture capital investors anticipated, and many of these ventures would not generate sufficient returns on their investment. As venture funds failed to report adequate returns, they failed to raise new funds from the original financiers, primarily investment banks and pension funds. The second blow, more gradual and less dramatic, was the decline of research performance and the profitability of the pharmaceutical industry, which reduced the chances of life science ventures being acquired during its first ten-year period of venture investment. The Swedish innovation system, strongly stressing the normative view of life science enterprising, thus faced the challenge of how to motivate academic researchers to embark on entrepreneurial activities that had fewer chances of acquiring both funding and, further down the road, generate individual economic returns. As the government and the political system have demonstrated only a limited concern

for the Swedish life science industry, representatives of the innovation system try to figure out what they can do with the present set-up and how to allocate the relatively limited financial resources they control. For the time being, there appear to be no short-term solution to the shortage of capital in life science venturing. The government has many other areas of interests that arguably generate more public and media attention, and as the life science industry hires relatively few people, while it generates, when successful, substantial economic value, actors in the political system are often better rewarded when committing to other socioeconomic issues.

As was demonstrated in Chapter 5, venture capital investors, life science entrepreneurs, and innovation system representatives are equally concerned about how the state and the government support, monitor, and develop life science ventures. While there is a quite persistent concern about the performance of venture capital investors among the venture capital investors themselves, the role of the state and the government in bringing life science innovations to the market is another area of discussion. Many venture capital investors tend to think that the innovation system controls overly limited resources, lack the expertise and know-how needed to counsel the life science entrepreneurs effectively, lacks resilience, and is susceptible to political influence. For instance, one life science entrepreneur argued that she received more informed and helpful advice from her Danish venture capital investors than from the various innovation system representatives she had encountered. By and large, the state and the government, operating through the national and regional innovation system, remain important for life science venturing, but venture capital investors thought the activities could be substantially improved if some novel thinking and new expertise could be developed. At that time, the innovation system was too fragmented into a variety of agencies, funds, and offices – national, regional, and university-based – and there was also a perceived shortage of expertise regarding what truly matters in life science venturing, some of the interviewees argued.

Contribution to organization studies

Evaluation of life science ventures

The study reported in Part II of this volume contributes to organization studies and more specifically to the innovation management literature in three ways. First, the study contributes to the economy sociology literature on valuation (e.g., Fourcade, 2011) that examines

how economic value is inscribed into assets that is not yet priced on a market. Economic sociologists argue that the process of valuing and pricing assets is by no means a social process separated from human interests, cultural contexts, and historical conditions. In the neoclassical economic theory, the pricing of commodities in markets is very much a rational process where all available information is of necessity immanent in the price; the so-called efficient market hypothesis thus enacts the market as a superior mechanism for balancing various actors' interests, while at the same time accommodating all the information available (Bryan and Rafferty, 2013: 132–133; Mizruchi and Brewster, 2005: 292). Economic sociologists believe this view represents a form of black-boxing of the operations of the market actors. Rather than occurring all by itself as a “natural process” and being devoid of costs, efforts, and interests, the pricing of commodities and the accompanying transactions is a human accomplishment that includes a good deal of know-how, skills, and experience.

When evaluating new start-up companies, venture capital investors need to carefully assess a series of scientific and managerial assets but also to pay close attention to clinical conditions and to predict the future exit market – that is, identifying who would be interested in and capable of acquiring the venture ten years into the future when the venture capital investors make the exit. Chapter 3 demonstrates that venture capital investors are not very focused on assessing figures and statistics reported by the start-up company in their investment proposal; instead, they seek a broader perspective, wherein the scientific novelty of the underlying life science research findings is evaluated in terms of its clinical potential. In addition, the novelty of the research finding need to be aligned with present work processes and practices of the clinical work in the health care organizations, and the new therapy-in-the-making cannot rely on some other therapy or medical technology to be successfully implemented. When assessing the fit with the clinical work process, the new therapy needs to either provide superior therapeutic qualities, including the ability to cut treatment time, reduce the workload of the clinicians, or cut costs for the health care organization. In addition to the assessment of the underlying basic life science finding and how it can make a contribution to the specific therapeutic area, venture capital investors examine the commercial human capital in the start-up company. In many cases, the start-up firm includes primarily academic researchers or privately employed researchers and perhaps, at most, one person working with marketing and sales. For venture capital investors, it is important to secure qualified managerial competence that

includes an understanding of how therapies are further developed and how they are marketed and traded in the health care market. In many cases, venture capital investors express their concern regarding the access to qualified candidates to executive and board of directors' positions. At times, they even convince experienced American life science entrepreneurs to move overseas to serve executive roles in the start-up companies they choose to invest in. Many of the venture capital investors argue that Sweden is a relatively immature market when it comes to life science venturing; there is a tradition of advanced life science research and commercialization in the major multinational pharmaceutical companies that have operated in Sweden,, for example, AstraZeneca and Pharmacia, but these companies have essentially failed to live up to their own new product development track record. AstraZeneca has only one site left operating in Sweden today. The American company Upjohn acquired Pharmacia in 1995, and after a few years, the operations were closed down in Sweden. There is a burgeoning life science cluster around Karolinska Institutet in Stockholm, and the universities in Uppsala and Lund produces a steady output of new life science ventures, but still Sweden is lagging behind the United States, for example, in terms of developing a new life entrepreneurial class. Only the future will tell whether the Swedish life science sector will be able to produce a higher amount of skilled and experienced entrepreneurs that can serve the critical role of managing and directing life science companies.

Instead of being some standardized calculative procedure based on available data, the economic valuation of start-up companies rests on a deep and detailed understanding of how initial life science research findings are gradually developed and brought to the market. The venture capital investors' pre-investment activities are not being fully explained by neoclassical economic theories that render the managerial function of organizations more or less irrelevant, as they assume that it is the markets, not the managers, which include and filter the information. In contrast, an economic sociology view of venture capital investment stresses the role of the professional judgment of the venture capital investors in terms of not only assessing available information but actively anticipating the possible future significance of the new therapy.

Corporate governance in life science ventures

Second, the study has implications for corporate governance theory. The dominant view in corporate governance theory and practice since the early 1980s is the norm of shareholder value creation, based on the fundamental assumption that finance market actors more effectively

allocate financial resources (what agency theory refers to as the residual cash flow or free cash flow) than executives and boards of directors do. Shareholder enrichment is part of a wider socioeconomic and ideological framework derived from both policy and neoclassical economic theory and agency theory serves as its central underlying theoretical framework. In particular, Jensen's work has been of key importance for portraying executives and other managers as ineffective in overseeing their corporations, and consequently, he proposes, the free cash flow should be distributed to shareholders rather than being reinvested in various costly projects. Jensen here speaks of the agency costs that the shareholders have to monitor and try to minimize; these agency costs could be reduced if finance market control is executed in the major corporations.

The agency theory framework has been portrayed as both theoretically fragile (Erturk et al., 2004) and poorly supported by empirical data (i.e., finance market control does not really reduce total agency costs but rather promote other forms of opportunistic behaviour, See e.g., Westphal, and Graebner, 2010; Westphal and Bednar, 2008), and it is not very helpful when examining corporate governance practices in start-up companies. These small life science ventures do not operate in stable or mature markets, and do not yet have positive cash flow to be allocated, but struggle with significant degrees of uncertainty in terms of the regulatory demands regarding the efficacy and safety of the new therapy, and seek to determine the market potential for the new therapy or medical technology. That is, few if any of the conditions that agency theorists claims drive agency costs are in place (Garg, 2013); instead, venture capital investors (the principals in the agency theory framework) are working very closely with the executives and managers that are hired to take care of the operative work (the agents). The principal challenge for venture capital investors is not to curb opportunism on the part of executives but to handle the mind-boggling complexity of providing clinical evidence of the therapies' efficacy and safety and developing the marketing and sales channels needed to acquire a market share or to generate a positive cash-flow from sales – two key predictors for future economic value attracting potential buyers of the start-up firm (Dainty et al., 2002). These challenges more or less render agency theory irrelevant for the governance of start-up companies. One of the key challenges, then, is how to recruit and maintain qualified life science entrepreneurs in a situation where there are relatively limited financial resources, especially when there is an endemic shortage of qualified candidates for both executive and director positions in start-up firms.

The study also contributes to the corporate governance literature by emphasizing that venture capital investors by no means act as passive rentiers who allocate their capital and thereafter withdraw from their companies, but instead they serve an active role in monitoring and supporting the start-up forms. Moreover, as most venture capital firms prefer to syndicate their investment with other investors in order to spread risks and to take advantage of a larger stock of know-how and experience, life science venturing is essentially a network-based process wherein individual firms become entangled in thick networks of relations (Paruchuri, 2010; McGivern and Dopson, 2010; Whittington, Owen-Smith, and Powell, 2009; Owen-Smith and Powell, 2004; Powell, Koput, and Smith-Doerr, 1996). Life science venturing is thus a collaborative activity embedded in what Granovetter (1973) speaks of as “weak ties” (also Burt’s 1997 concept of “structural holes” applies, see e.g., Nahapiet and Ghosal, 1998), wherein a relatively small community constitutes most of the Swedish life science venture capital market. Much of the corporate governance literature assumes an arm’s-length distance between the financiers and the entrepreneurs, being two quite distinct functions in contemporary capitalism, but in real life settings, things are far more messy and boundaries between different roles more porous; venture capital investors thus not only supply capital but also monitor and advise the companies they work with; “venture capital investors” is thus in a way a misnomer, as the term “investor,” at least in its classic definition, often denotes a less active role.

Furthermore, the study stresses the “legal environment” (Edelman, 1990; Edelman, Fuller, and Mara-Drita, 2001) of corporations: the law and regulations but also the norms and agreements that regulate the business matter for life science ventures. Some of the company and innovation system representatives stressed that the Swedish legal framework did not really provide any specific advantages in comparison to a few other European countries (e.g., France, the Netherlands) that for instance had lower payroll taxes for companies that do not yet generate any taxable income. On the other hand, Sweden has enacted a law to lower taxes for foreign “expert workers” for a limited amount of time. There were more legal and regulatory changes that could be made, interviewees argued, but at the end of the day, it is a challenge to deliver the clinical data testifying to the therapeutic benefits of the new therapy that “make or break” life science ventures. The venture capital investors rarely addressed the legal framework as a major concern in their activities. A few of the state-controlled funds (e.g., a pension fund) deplored that their regulatory framework prevented them from owning

companies not yet listed on the stock exchange, but this concern could be practically handled, they assured.

Third, the empirical material reported in Part II of the volume has implications for the innovation management literature. Much of the literature on life science venturing praises the increase in entrepreneurial activities in the university system, and outspoken proponents of academic enterprising such as Berman now regard the universities as veritable wellsprings of new and innovative business ideas. While there are particularly inspiring cases of academic entrepreneurship, especially in the United States (see e.g., Rabinow, 1996), there are also countless stories to be told about academic researchers who fail to bring their research findings to the market, and after years of struggling to develop their companies, lose valuable research time and thus possibly fail to accomplish the major therapeutic breakthrough they once dreamed of. These unsung heroes are also part of the shift from what Berman speaks of as the shift from “science logic” to the “market logic,” which is embedded in legal changes such as the Bayh-Dole Act and the inflow of finance capital in the United States in the early 1980s (Sunder Rajan, 2012; Grimaldi, Kenney, Siegel, and Wright, 2011; Mazzoleni, 2011; Mowery and Ziedonis, 2002). As the increase of entrepreneurial activities in the university system, commonly assessed in terms of registered patents and start-up firms, have been beneficial for the development of the biotechnology industry and the life science industry more generally, there is a relatively low degree of profitability in these firms (Pisano, 2006), and there is also a quite limited output of new therapies. For instance, in the field of biotechnology, only a few central companies have succeeded in generating a stable profit, and a vast majority of firms maintain a more vulnerable existence.

The empirical data suggests that venture capital investors, company representatives, and innovation system representatives share the concern that there is too much pressure on academic life science researchers to become entrepreneurs as soon as they find something that is even remotely interesting as a candidate for a new therapy. The Swedish innovation system is based on a supply and demand model wherein the role of the state and the government has been to increase the output of academic entrepreneurs through training, subsidies, and grants, and through the ideological work to widely advocate entrepreneurship as the motor of contemporary competitive capitalism. On the other side of the equation, venture capital investors and cash-rich pharmaceutical companies and medtech companies are supposed to select the most competitive of these academic start-up companies and supply the capital needed to

further develop the therapies. This set-up assumes that there is a demand for start-up firms, that capital is available, and that capital investors have a risk-affirmative attitude. After the recent economic crises – the 2000 Internet bubble and the 2007–2008 sub-prime market-generated crisis leading the finance market to the brink of collapse – the “utility function” of the venture capital market has shifted, and there is now less risk-taking on the demand-side. When academic life science researchers are encouraged to embark on entrepreneurial journeys, they increasingly face the challenge to attract more long-term investment beyond the initial and quite limited grants provided by the innovation system, and consequently there is a considerable mismatch between the supply and demand of entrepreneurs. As some of the interviewees emphasized, venture capital tends to be transferred to markets with lower risks and higher growth potential, for instance in the field of information technology, a field where Sweden is at the forefront for the time being, and in other forms of venture capital investment such as in the solid and highly profitable buyout market. This leaves the state-funded innovation system with a full apparatus developed to produce life science entrepreneur that is oversized in comparison to the venture capital supply.

Drawing on the concept of institutional logic being developed in the field of institutional theory (e.g., Thornton and Ocasio, 2008; Friedlander and Alford, 1991), it was claimed in Chapter 5 that there is no clear evidence of a comprehensive shift from the science logic to the market logic in the life sciences, as there is a shrinking venture capital market for life science ventures for the time being. If there is a growth in the life science market, it is in the field of medical technologies, which are treated as a less risky venture than, for example, new drug development. In addition, emerging areas of life science research in stem-cell therapies, neurodegenerative diseases and other diseases related to the central nervous system, and cancer therapies are still too immature to be able to provide a full explanation of the underlying biological pathways involved in these medical conditions. By and large, the pharmaceutical industry is in a stage where it is shifting from an innovation system based on small molecules and drugable targets, to a system where larger molecules such as antibodies, biologics, and vaccines are in focus (Styhre, 2011). This shift is cumbersome and costly, and in the meantime, there are limited possibilities for acquiring promising life science companies. In summary, the empirical material demonstrates that the national and regional innovation systems need to be able to adapt to the new world order, wherein venture capital is more limited and where only the truly innovative new therapies may be able to attract long-term

venture capital investment. As a consequence, there need to be some detailed changes in the innovation system: for instance, interviewees proposes, a more extended role of the universities to host reasonably mature research findings and to perhaps even finance clinical trials within its facilities, the university hospitals.

Implications for policy

The life sciences benefit immensely from being a domain of research and venturing that concern us all as human beings. All of us get older and eventually suffer from the marks of ageing, and ultimately our biological organisms are programmed to fail us and we die. In order to postpone this process or help us live better lives during periods of illness, the life sciences have made astonishing contributions to mankind. Consequently, the field of medicine and the adjacent life sciences are some of the most prestigious professional areas in the contemporary period. Still, medicine based on scientific principles and methods is of remarkably recent pedigree. Only at the end of the eighteenth century and the small-pox vaccine Edward Jenner introduced in 1798, and the work of the physiologist Xavier Bichat in France at the turn of the nineteenth century (Haigh, 1984), could medicine offer effective therapies and cut itself loose from the ancient doctrines on human physiology (Bynum, 1994; Warner, 1995). In the first half of the nineteenth century, a novel academic institution, the medical school, was established in France; it was closely associated with the hospitals in the major French cities. In the period, pioneering figures such as Claude Bernard advocated an “experimental approach” to the study of medicine (Bernard, 1865/1957) and ever since, medicine has been firmly rooted within the sciences and their increasingly advanced technoscientific methods. Not entirely different from the engineering sciences, contributing with technologies and infrastructures, academic medicine became one of the true wonders of science, offering humans a long series of new therapies throughout the twentieth century. Engineering and medicine therefore essentially defined the modern period of time. Curiously enough, it was not until the 1970s that the academic research work started to blend with private capital, and during the 1980s’ strong emphasis on deregulation and the emergence of the finance industry, life science venturing became a professional field in its own right. While the United States, the site for the newly developed neoliberal policies and an unprecedented inflow of foreign capital in the Reagan era of the 1980s (Krippner, 2010), led the way for this new life science market, in Europe and Scandinavia, things changed slower.

Not until the end of the 1990s, when Sweden had endured one of its most dramatic economic crises, the bank crisis of 1991–1992, one could talk about a regular venture capital market in Sweden. As detailed in Chapter 3, the Internet boom and a general appetite for risk at the turn of the millennium led to a substantial growth of venture capital supply, primarily benefitting the new dot-com companies but also spilling over to the life science sector. Unfortunately, many of these investments were made on basis of limited information and understanding of both the underlying scientific procedures and the clinical practices, and many venture capital funds failed to report adequate return on investment and consequently they disappeared as they failed to raise new funds. Most new businesses and social practices have their own initial difficulties, and the enthusiasm for venture capital was somewhat dampened, while a few skilled venture firms survived the burst of the Internet bubble. After a few years of recovery, the next crisis emerged; the North American subprime loan crisis had repercussions throughout the global financial system as the underlying assets – private homes – had been repacked into increasingly complex financial assets that had been widely distributed (Blinder, 2013; MacKenzie, 2012; Davis, 2009; Crotty, 2009). The short-term effect was a stalemate in the finance markets, but as the American government poured tax money into the privately owned and state-controlled financial institutions (e.g., the mortgage institutions Freddie Mac and Fanny Mae), the crisis was slowly overcome (Barofsky, 2012; Stiglitz, 2010; Fligstein and Goldstein, 2010; Sorkin, 2009). The most conspicuous effect of the financial crisis was not a downturn in activity in the finance industry but rather that the degree of debt in various countries grew, leading to draconian policies in countries like Greece, Iceland, and Ireland (Blyth, 2013; Blinder, 2013). The consequence for the Swedish venture capital market – Sweden was relatively limitedly affected by the financial crisis – was an even higher risk-aversion. After 2008, there has been a very slow and cumbersome return of venture capital to the pre-2008 level, and this time it has been primarily Internet- and technology-based companies that have benefitted.

Today, a handful of years after the 2008 finance market meltdown, it would be fair to say that there is some life science venture capital available in Sweden, but it is invested with great care and only after detailed analysis. The loss of the exit markets caused by the less venturesome pharmaceutical industry's limited activity on market is perhaps the most salient explanation for this decline in venture capital investment. In addition, the shortage of commercial human capital, and to some extent immature research findings with limited commercial potential at

this early stage, are two other explanations. At the same time, Sweden has the second highest rate of venture capital investment after the United States (Lerner and Tåg, 2013: 174), and Sweden remains one of the countries in the world where the government invests the most generously in basic life science research, close to twice as much as in the United States. These conditions make a policy for the Swedish life science venture sector a delicate matter: Should the government increase their stakes in life science venturing through, for example, expanding the role of the university as the incubator of life science ventures? Or is it more advisable to cut down on basic life science research as there is very few research findings of commercial relevance anyway, or would that in turn further reduce the stock of life science ventures to choose from for venture capital investors? Or, thirdly, should the national and regional innovation system be thoroughly modified to better suit the new condition where only a very limited number of venture capital investors are active? In addition, there may be a need for a more explicit policy for how the regional public sector health care organizations should make use of new innovations in their clinical practices. Such a policy would potentially provide the life science ventures with a cash flow and the opportunity to try their therapy or medical technology in a clinical setting. Above all, there is, interviewees across the spectrum claim, a need for some political action to signal both an understanding of the challenges in life science venturing and recognition of the role of the life science industry for the Swedish economy.

For the political system, the life sciences are emblematic as a state-of-the-art scientific field that have immediate and very specific consequences for the longevity and quality of life of millions of people. Most people can easily understand that the state and the government should finance basic life science research in the university system and support an innovation system that actively promotes the commercialization of these results. The crux is that investment made in the early stages are by no means secured as soon the start-up companies move into the development stage where they have to rely on venture capital investment. In many cases, such capital is foreign, and there is very little legislation and practical barriers that prevent professional life science research companies from moving abroad as soon as these firms have proven their economic value. These companies rely on professional know-how and expertise and fairly standardized laboratory equipment, two resources that can be acquired at relatively low costs overseas, and therefore investments made in Sweden by Swedish actors and governments may easily be transferred elsewhere. Venture capital investors and

representatives of the innovation system emphasize that policy cannot avoid this internationalization of venture capital and professional expertise, but for the political system, it is complicated to take on the role as a principal provider of capital in development phases where the clinical evidence of the new therapies or medical technologies are produced. In one scenario, at best Sweden can become a hothouse for new and innovative life science ventures, but these companies tend to be acquired by foreign investors. How much the state and the government should invest to accomplish this scenario remains to be determined.

In addition, even in cases where the companies do stay in Sweden, or at least maintain a significant amount of its operations in the country despite being owned by companies seated elsewhere, there is the issue of the size of these firms. The life science sector is fragmented into a large number of fairly small but innovative companies and a few large multinational companies (e.g., pharmaceutical and medtech companies) that have been in operation for decades. The small to mid-sized life science companies tend to hire relatively few highly skilled professional workers. That is, from a political perspective, the life science industry does create substantial economic value and has a high status in terms of being at the intersection between the sciences and the domain of practice. Unfortunately, the industry does not create very many jobs. Davis (2010: 333) examines the shift in the American economy from being manufacturing-based to service industry-based. In 1950, eight of the top ten American employers were in manufacturing, but today all of the top ten firms are in services, and seven are in retail, with Wal-Mart, a company frequently criticized for its low salaries and few benefits, including no health insurances for its employees (Ingram, Vue, and Rao, 2010; Brunn, 2006; Fishman, 2006), as the largest employer in the United States. In addition, the proportion of the American workforce being hired by large corporations has been reduced; in 1950, the ten largest employers hired five percent of the American workforce; today, that figure is 2.8 percent (Davis, 2010: 333). In other words, fewer jobs are provided by large corporations, and they tend to be in service industries, generally paying less and otherwise providing fewer benefits for their employees than the manufacturing firms, which once had long-term agreements with unions such as the United Auto Workers in the Detroit automotive industry to regulate the relations between labour and capital. When examining the most prestigious companies in the American economy, the fabled Silicon Valley and computer industry companies, it is also noteworthy that these companies, regardless of their capacity to produce innovations and their role as icons of the digital media era, employ relatively few people: "The

most innovative high-tech companies in America create relatively few American jobs in any direct way – Apple, Google, Microsoft, Amazon, Intel and Cisco – the crown jewels of America’s innovation economy – collectively employ fewer people than Kroger, a grocery chain” (Davis, 2010: 351). Davis suggests that these six firms would have to triple in the number of employees to whom they provide work to even cover the number of jobs lost in the American economy in 2009, the first year after the finance market collapse in 2008. Such a scenario is not very likely to occur, and therefore the high-tech or life science companies are not very likely to be the industries where a bulk of work opportunities is provided in the future. The skills needed in the life science sector – not primarily research skills but more of entrepreneurial and commercial skills – are, on the other hand, hard to develop and supply for the state and the government. Such skills are hard to predict and identify prior to actual experiences, and even though various entrepreneurship schools and programs have been highly popular in the university system in the last decade, the challenge remains to train entrepreneurial skills within an academic, essentially bureaucratic structure. If entrepreneurial qualities reside in intrinsic motivation and charisma, as is frequently emphasized, such qualities are not always of necessity subject to more formal training and examination; the entrepreneurs always emerge from the outside or from unexpected domains.

Taken together, it is complicated for the state and the government to fully monitor and control the life sciences and their commercialization as there are too high demands for capital investment, too much uncertainty, and too little “upside risk” for the political system. As was pointed out by some of the interviewees, when state-controlled institutions such as large pension funds have been given the mandate to invest in more risky ventures such as life science companies, any failure to secure an adequate return on investment has been scrutinized in detail by news journalists. In many cases, this allegedly ineffective use of pension fund capital is portrayed as irresponsible and questionable. The state and the government are thus enthusiastic sponsors of the life science industry, but it is hard to justify an extended responsibility for the commercialization of basic life science research results. One opening could potentially be the university system, but in Sweden all but two universities are part of the state administration rather than freestanding economic units, and an extended responsibility for hosting life science companies would still let the state and the government play a larger role. Writers such as Lerner who are critical of the role of the state and the government for intervening into venture capital markets and life science commercialization activities warn

that this merely squanders tax-money. For instance, science parks, one of the favourite political initiatives, create jobs in the construction and real estate industries and signal a progressive view of academic research work, but tend to make a relatively limited difference: "Not surprisingly, science parks tend to be located in countries that are losing jobs. But even after controlling for economic conditions, the basic pattern remains: these parks have no measurable impact, positive or negative, on venture activity or high-tech jobs more generally," Lerner (2009: 115) says. Lerner therefore advises against any extended role for the state and the government as sponsors and financiers of life science innovations.

This claim very much leaves us with the phrase repeated by some of the interviewees, the dictum, "Good ideas always find their money." This assumption, very much at the heart of the neoclassical economic theory view and its Chicago school of economics version, that markets will always price assets correctly as the market is a superior mechanism for processing information, is disputed. Perhaps, the proverbial "valley of death" and the degree of companies being starved of capital in its development phases is perhaps the price we have to pay to be able to identify the single viable life science idea and to bring it into the clinics and to the markets. On the other hand, this neoclassical view of the market is poorly supported by empirical evidence, as in both the United States and Europe, the state and state-controlled organizations play a decisive role in regulating, controlling, and funding the life science industry. In addition, the state is in many countries one of the major buyers of life science innovations. Therefore, anti-statist view such Lerner's that only emphasizes "failed" projects and programs tend to obscure all the accomplishments made by the state in collaboration with private interests. In countries like Sweden, with a long welfare state tradition that is recognized widely across the political spectrum, the role of the state is not suspicious or compromising but is rather indicative of the importance of the life science industry in the late modern society.

Practical recommendations

The interviewees, representing three different categories of venture capital investors, company representatives, and the innovation system, had relatively consistent views regarding policy issues in life science venturing. They can be summarized as follows:

- The present innovation system is too fragmented and control too little financial resources to make a difference in the development phase where clinical trials are to be conducted. The financial resources

are spread too thinly, and therefore they make no substantial difference. As a consequence, larger and fewer units that have the financial resources to provide both qualified counselling services and venture capital would be beneficial.

- The innovation system tends to lack the expertise needed to advise the life science entrepreneurs regarding commercialization activities. Frequently formal issues such as business plans and keeping track of various documents are favoured over market-oriented activities. More experienced staff should preferably be hired for the innovation system.
- Too many academically intriguing research findings with limited commercial potential become subject to venturing. The innovation system designed to increase the supply side of life science entrepreneurs, potentially triggered by the extensive literature on academic entrepreneurship, prescribes that research findings are transferred to private companies at an early stage to secure and finance the patenting of the research findings. As a consequence, many academic research projects are prematurely structured into formal companies. These ventures force academic researchers to “fight a war on two fronts” as they both have to continue to pursue an academic research career and to become life science entrepreneurs, potentially making them successful in neither domain. To prevent such an oversupply of life science entrepreneurs, the university system could potentially be given an extended role.
- Many life science findings are subject to venturing one-by-one rather than being bundled into larger aggregates of research findings. In the United States, interviewees claim, technology transfer offices and venture capital investors more actively bring together research teams to exploit synergies in the research findings.

This set of policy recommendations says little about the degree of risk-taking in the venture capital industry, and provides no solution to the weak market for life science venture exits derived from the increased risk-aversion in the major pharmaceutical and medtech companies. A few things still remain outside of the reach of the state and the government, or else tax-money that may make a larger difference elsewhere may be ineffectively invested.

Concluding remarks

In the era of financialization, beginning in the 1980s where the American financial markets were deregulated on the basis of the new

and emerging neoliberal and neoconservative policies enacted by the Reagan administration, and where overseas saving flooded into the American economy in combination with new theoretical development in finance theory, the “rules of the game” shifted significantly. What Peter Drucker called the “society of organizations” (see e.g., Perrow, 2012) was gradually replaced by the “ownership society” (Davis, 2010), or what Useem (1996) speaks of as “investor capitalism” – a “society of investors.” In this new regime, corporate governance shifted from the creation of horizontally integrated conglomerates controlled by CEOs and executives (Davis, Diekmann, and Tinsley, 1994), to a form of finance market control as prescribed by agency theory, that of shareholder value creation. The ideal organization form was no longer the resilient conglomerate including different industries to a lower degree susceptible to the ups and downs of the economic cycle, but the firm was reenacted as a portfolio of financial assets that in turn derived from the ability to use quite limited “core competencies” (Hamel, 1994; Prahalad and Hamel, 1990). In the era of financialization, the shift in corporate governance to shareholder value creation represented a major event in Western competitive capitalism as firms could no longer create “internal capital markets” to buffer the effects of the economic cycle but increasingly had to rely on finance markets. Their markets and its actors are, the newly developed finance theory suggested, carefully rooted in neoclassic economic theory, more efficiently allocating financial capital than managers located inside the firm. The change from the managerial control of the society of organizations to the finance market control of investor capitalism was beneficial for everyone, proponents of the new corporate governance practices suggested. In the period after 1980, the finance industry’s share of the accumulated profits in the Western economies has grown substantially – reaching its peak in 2002 when 45 percent of “all taxable profits in the private sector were absorbed by finance sector firms” (Tomaskovic-Devey and Lin, 2011: 539–540) in the United States – and the finance industry institutions and actors are today controlling companies and industries in detail. The long-term implications for this shift in terms of managerial practice and for social and economic conditions in Western societies have been subject to extensive debates and controversies (Lin and Tomaskovic-Devey, 2013; Krippner, 2011; Epstein, 2005; Stockhammer, 2004).

Leaving this debate aside, the investor capitalism renders venture capital a key role in supplying capital to the entrepreneurial function. Entrepreneurs are by definition debtors, relying on capital investment during periods of development work, and therefore the supply

and demand of capital must be in reasonable balance in any dynamic capitalist economic system. It is important to notice that in a healthy economic system, the supply of entrepreneurs is always larger than the demand, and consequently there is an endemic shortage of venture capital; not all entrepreneurial ideas are viable, and it is the role of the venture capitalist to identify and finance the most qualified candidates. That is, what “reasonable balance” means in practical terms is matter of discussion, and in the case of Swedish life science venturing, most actors deplored the shortage of venture capital in the present period.

At the same time as the venture capital market plays a key role, there are additional challenges for life science ventures. The life science and pharmaceutical industry today deals with new therapeutic areas that are more complex and involve more complicated biological pathways than in, for example, infection diseases or cardiovascular disorders. Central nervous system (CNS) research and cancer research, illnesses derived from changes on the molecular and cellular levels of the human biological organism, are more complicated to map and explore in detail, and consequently the lack of comprehensive theoretical understanding of these diseases and disorders complicate the development of adequate therapies. Life science ventures thus face two challenges in competing with both less risky technology-based ventures and the buyout venture markets. Given these difficulties, it is little wonder that both venture capital investors and representatives of the innovation system rely on the entrepreneur, the knight of faith of the contemporary capitalist economic system, and his or her almost mysterious ability to create biovalue and to transform it into economic value. Amidst a world of scientific rigor and the calculative practices and judgment of investor capitalism, there is an element of charisma and an entrepreneurial spirit that lies at the very heart of the capitalist economy. The life science entrepreneur thus remains a heroic figure, an actor who staunchly maintains faith and hope, even when the chances of success do not look too assuring.

Notes

2 Corporate Governance and the Supply of Commercial Human Capital

1. Economic sociologists and management scholars such as Healy (2006) and Anteby (2010) have persuasively argued that even though markets are not “naturally occurring” sites for economic transactions as proposed by neoclassical economic theory, markets cannot, on the other hand, be assumed to be dysfunctional, poorly operating, or to “inevitably corrupt” (Healy, 2010: 121), simply because markets are embedded in social relations (see, for example, Dobbins, 1994; Greif, 1994). Instead, there is a “morality of markets” (Anteby, 2010) that defines what are legitimate and appropriate behaviour and practices for the market participants. These morals are embedded, for instance, in what Dobbins speaks of as “political culture” (1994) and Greif addresses as “cultural beliefs” (1994). Healy, addressing gift economies and market solutions to the supply of blood, therefore suggests that there is nothing inherently exploitative about “commodified exchanges” (i.e., market transactions): “Commodified exchanges may be exploitative, but market exchange does not automatically make it so. Both gifts and market systems depend on their specific institutional realization of their effects. The choice is not between morally worthwhile gift giving and morally evil markets” (2010: 124). As a consequence, economic sociologists suggest that rather than the market imposing predefined and “transcendental economic laws” (Dobbin, 1994: 222) that are universally applicable, rational behaviour is “socially produced” (Dobbin and Dowd, 2000: 651): that is, it is learned rather than being innate and is principally the outcome of navigating in dense institutional and cultural domains. While neoclassic economic theorists declare a firm belief in the rationality of the market as being a “spontaneous order” that most effectively translated information into prices, economic sociologists take a more agnostic view, suggesting that markets work more or less effectively under varying conditions and the influence of social beliefs (Fourcade and Healy, 2007). Economic sociologists are thus rendering the “rationality of markets” an empirical question rather than making it an axiom for a theoretical framework.
2. The influence of such stock repurchases has not been a marginal phenomenon in the economy. “In 1987, repurchases amounted to 1.6% of average market capitalization, and total payout amounted to 3.8%; in 2007, repurchases mounted to 4.6%, and total payout amounted to 6.3%. The dollar amount of annual repurchases increased eighteen-fold from 1987 to the peak year of 2007,” Bratton and Wachter report (2010: 686).
3. A complementary view would be to consider economic theory as being not so much representative and embedded in foundationalist ontologies and epistemologies but as being performative. Pickering advocates a performative

epistemology that is based on “a vision of knowledge as part of performance rather than an external controller of it” (2010: 25). While performative epistemologies have informed a variety of fields of research, it is particularly suitable for the study of economic theory, economic practices, and economic systems. Since individual economic actors (finance market analysts, executives, everyday consumers, etc.) all share the predicament, Mackenzie suggests, of having “quite limited powers of memory, information-processes, and calculation,” there is always a demand for the “simplifying concepts” presented in economic theory (e.g., “implied volatility,” “purchasing power parity,” and so forth) as well as what Mackenzie calls the “material means of calculation,” the tools for evaluating finance assets (2006: 265) (see, for example, Lenglet, 2011; Buena and Garud, 2007; Buena and Stark, 2004). These concepts, models, theorems, and heuristics are then not neutral descriptors of an external economic system but rather serve to produce the economic system *per se*, and are therefore “constitutive of economic action” (*ibid.*). Economic theories and tools derived therefrom are thus performative. In addition, as Esposito explains, economics needs to always be formulated from within the economic system, and as there cannot be any external vantage point for the observers of the economy, what has been called second-order observations play a key role in economic systems (2012: 108). “The operators decide not only on the basis of what they know and what they want, but also on the basis of how others will observe their decisions and how they will act. They recognize that it is the behavior of others, that will ultimately determine whether their decision is right or wrong,” Esposito says (*ibid.*: 111). Zuckerman here uses the term “the principle of self-recursion” to denote how market analysts are not concerned with value *per se* as much as with value perceived by others. “If financial returns are based on buying at a low price and selling high, and if prices are determined by the prevailing valuation, market participants should rationally focus their energies on anticipating trends in conventional opinion rather than on trying to determine the objective value of assets,” Zuckerman says (2012: 234).

As a consequence of the influence of such second-order observations, the perceived expected future value of an asset, rather than the value *per se*, and certainly not the value of underlying assets and their possible “user-value,” information shortage is, Esposito emphasizes, not a deficiency of markets but of its constitutive principle. Information shortage is an operationalization of uncertainty, and without uncertainty, “the economy could not function or exist” (2012: 110); “in a world of rational and efficient markets, one would not be able to earn or invent anything, because any novelty would be neutralized in advance by the perfect distribution of information,” Esposito argues (*ibid.*). That would be a Parmenidean world of absolute stillness. The innate uncertainty in markets and its derived perceived lack of information cannot be overcome with “greater knowledge or better techniques” as “imperfect information is the physiological condition and reason of markets” (*ibid.*).

As an effect of this view of markets (see also Akerlof, 1970), economic theory is performative, as it fails to map the territory that is by definition not capable of being explored, while on the other hand, such theories provide tools that engender action: “Performativity is the rule and

meaning of economic action” (ibid.: 111). In addition, “economic operations generate the reality in which they operate and the unpredictability they face as a result,” Esposito states (ibid.: 112). One of the key consequences is that economic action and assets – for example, behaviour, objects, or institutions – are precisely what are defined as such within the domain of economics. Economics is then the performative theory of economic action; it may work more or less well, but it can never claim to be rooted outside of its own domain. This performative and heterodox view of economics is helpful as it evades unnecessary complications regarding truth and rationality and other foundationalist issues, while it saves the possibility of economic action and its desirable consequences: that of a functioning and relatively stable economic system. Economic theory can still accomplish things and enjoy the highest prestige as an operative system of practices, not entirely different from that of the legal system that no longer are expected in modern, democratic states to rest on the commandments of God, on religious scriptures, but on conventions and agreements. What is at stake though – which may be a complicated issue to negotiate – is economists’ claim to work in a scientific discipline in the Newtonian “hard science” tradition, but that is quite another matter.

3 The Methodology of the Study

1. Mowery stresses that in the post-World War II period, defense-related federal R&D investment has accounted for nearly half of the total national R&D spending during, for example, the late 1950s and early 1960s (2013: 8). Defense-related share of federal R&D spending peaked in 1987 at nearly 70 percent (still below the 1959 figure at 84 percent), and thereafter the share was in decline to its lowest point in 1999 at 54 percent of the federal R&D budget. The declining defense-related research funding “contributed to a shift in the disciplinary composition of federal R&D spending away from fields such as physical science in favor of biomedical fields of research,” Mowery proposes (ibid.: 30).

5 The Corporate Governance of Life Science Companies

1. In the pharmaceutical industry, so-called me-too drugs are modifications of commercially successful drugs. Critics (e.g., Busfield, 2006; Angell, 2004) frequently claim that pharmaceutical industry invests too many resources imitating already established therapies, and that this excludes the search for new and innovative drugs.

6 Promoting Life Science Venturing and Innovations

1. In the 2006–2014 period, Sweden had a centre-right government including one conservative party, one Christian-Democratic party and two liberal parties.

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