SOCIAL CAPITAL INHERITANCE AND RESOURCE CO-OPTATION IN CORPORATE SPIN-OFF FIRMS

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Sarja/Series A-4:2012

Turun kauppakorkeakoulu
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ISBN 978-952-249-197-8 (nid.) 978-952-249-198-5 (PDF)
ISSN 0357-4652 (nid.) 1459-4870 (PDF)

Uniprint, Turku 2012

ABSTRACT

This dissertation explores the inheritance of social capital between incumbent firms and corporate spin-offs during the spin-offs' initial development phase. We set out to elaborate the social capital and spin-off theory by investigating the the social capital inheritance process and assessing its impact on spin-offs' resource acquisition.

We develop a theoretical model of social capital inheritance and resource co-optation. The theoretical propositions are tested by correlation analysis, multiple regression analysis, analysis of variance and path analysis. The sample consists of 156 firms, including 57 corporate spin-offs. Data was collected in 2006 by means of a mail survey of companies created in Switzerland between 1999 and 2005 in high technology sectors.

We find that corporate spin-offs inherit social capital from their mother companies when they are created in industrially or technologically related business areas. Social capital inheritance allows spin-offs to co-opt resources from the network in their early stages of development, thus helping them overcome the liability of newness. Furthermore, we find that mother companies play an important role in providing spin-offs with resources. Finally, we find significant differences in the development of firm-level social capital in the early stages of spin-offs and *de novo* start-ups: where spin-offs rely heavily on the inheritance process, *de novo* start-ups derive their early firm-level social capital from their founders' experiences.

This study contributes to the literature on social capital by introducing and developing the concept of social capital inheritance and its antecedents. We also bring theoretical and empirical arguments to the discussion on the resource acquisition impact of social capital. Managerial implications are discussed in the form of different strategies for leveraging social capital as a spin-off and as a *de novo* start-up.

ACKNOWLEDGEMENTS

I wish to extend my deepest gratitude to my thesis supervisor, Professor Pia Arenius, who guided me through the difficult process of writing this work and who stuck with me through times of doubt. Without her insight, determination and availability to discuss and direct my study, this thesis would never have been completed.

My thanks go also to my opponent, Professor Bart Clarysse, Chair in Entrepreneurship at the Imperial College London (UK) and to my pre-examinors, Professor Annaleena Parhankangas of the University of Illinois at Chicago, College of Business Administration (USA), and Professor Rögnvaldur Sæmundsson, of the Reykjavik University School of Business (Iceland), for taking the time to review and comment on my work.

I would also like to thank all the respondents who took some of their valuable time to answer my survey.

I am indebted to Professor Bernard Surlemont and Dr. Fabrice Pirnay, of the Center of Entrepreneurship and SME Research of the University of Liège, for first sparking my interest in strategic management research and the field of entrepreneurship when I was writing my engineer's dissertation. Their inspiration encouraged me to embark on this doctoral journey.

Thank you also to Professors Benoît Leleux, Georges Haour and Thierry Volery for offering me the opportunity to participate in three editions of the Global Entrepreneurship Monitor Switzerland report and giving me my first taste of serious research. I am grateful to Professors Colin Johnson and Frédéric Nlemvo and to Hélène Wacquier for a fascinating research project on entrepreneurial finance in the hospitality industry.

This study received partial funding from the Paillard and Fernand Lazard foundations.

On a more personal note, I wish also to express my thankfulness to my friends Andrés Garzón, Marco Lalos and Kristian Sund, for helping keep things in perspective.

Before closing, I would like to thank my family for their support and to express my loving thanks to my wife Dominique, who stood by me and lived with this project for many long years. This would not have been possible without you.

London, 22 April 2012.

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1 INTRODUCTION

The purpose of this chapter will be to provide some background information on the field of research and to identify the research gap and objectives. We will discuss the scope and limitations of this study, describe the chosen research method, and conclude with an overview of the structure of the dissertation.

1.1 Background

1.1.1 Social capital and its sources

Definitions of social capital abound in the literature. The general concept is that social relations engender a certain amount of goodwill (Adler and Kwon, 2002), and that this goodwill is valuable for a variety of purposes, such as obtaining resources and information (Starr and MacMillan, 1990), spotting opportunities (Burt, 1995) or increasing firm legitimacy (Stuart et al., 1999).

For the purposes of this study, social capital will be defined as the sum of resources embedded within, and accessible through the network of relationships established by an individual or organization (Nahapiet and Ghoshal, 1998). Like these authors, we consider three dimensions within the concept of social capital: (1) the structural dimension, (2) the relational dimension and (3) the cognitive dimension.

The structural dimension of social capital refers to the configuration of network ties between actors, e.g. presence or absence of ties (Scott, 1991), extensity of the network (Lin et al., 2001) or whether ties created for one purpose can be reused for another (Coleman, 1988). The relational dimension of social capital covers the assets embedded within individual ties, such as for example trustworthiness (Fukuyama, 1995), legitimacy (Delmar and Shane, 2004) or obligations and expectations (Coleman, 1990). Finally, the cognitive dimension refers to shared representations and systems of meaning, allowing better understanding between actors (Nahapiet and Ghoshal, 1998).

We will adopt an external perspective on social capital. In other words, we will concentrate on social capital between companies, as opposed to an internal perspective which would imply focusing on social capital between units or individuals within a single company. For this reason, we will limit our study essentially to the structural and relational dimensions of social capital and leave aside the cognitive dimension, which is more relevant in an internal perspective.

There are different accounts of how social capital originates. Coleman (1988) places it in the interconnectedness, or closure, of actors within a community. In his view, communities which are characterized by a strong density of ties between their members are able to achieve more than communities not so endowed. Burt (2000a, 1995) takes the opposite view and states that the source of social capital lies in the presence of "structural holes", i.e. the lack of connections between dense network pockets. Actors who would be in a position to bridge those structural holes would reap substantial benefits in the form of non-redundant information and the ability to spot opportunities to act as brokers between the otherwise disconnected networks.

1.1.2 Research gap

The literature discussing the origins of social capital has so far concentrated mostly on network configurations that are conducive to individuals or communities having social capital. As we mentioned above, Coleman (1988), representing one stream of the social capital literature, writes that individuals have social capital when they hold outstanding obligations towards many individuals in their community and when community norms favor the repayment of those obligations, making them enforceable. Communities that are characterized by a dense network of such obligations between individuals have high social capital. In another stream of the social capital literature, Burt (2000b) writes that social capital originates in opportunities, which arise through "structural holes" between dense pockets of network relations. Individuals that are able to bridge otherwise disconnected networks can act as information and resource brokers and this network configuration creates value for them.

Neither of these perspectives provides a complete explanation of how social capital comes to exist at the firm level, and particularly how it originates in new ventures. This gap in our understanding of social capital is an interesting object of study, because social capital is generally recognized in the literature as a performance enhancer for firms. Nahapiet and Ghoshal (1998) go so far as to write that social capital constitutes one of the key determinants of organizational advantage. One reason that makes social capital a key asset for new ventures is that it facilitates resource mobilization and acquisition through networks of contacts (Hambrick and MacMillan, 1984). In particular, social capital allows firms to acquire resources at a much lower cost than market cost, by tapping into underutilized resources of network contacts (Starr and MacMillan, 1990). Social capital also conveys legitimacy and information benefits, making firms more easily aware of opportunities, but also giving them credibility towards other network actors (Stuart et al., 1999). These benefits are important for all types of firms, but social capital plays a particularly useful role in the case of new or internationalizing firms, since it can help them

to overcome the liability of newness or foreignness (Arenius, 2002; Stinchcombe, 1965).

We believe corporate spin-offs offer an interesting setting in which to approach the question of how social capital originates in new ventures. By "spin-offs", we mean: new ventures founded by former employees of a mother company or founded around a technological innovation developed inside the mother company. The spin-off literature has already described the transfer of resources between mother companies and their spin-offs. In particular, the literature points to evidence that spin-off firms put into practice knowledge and routines inherited from mother companies (Agarwal et al., 2004; Cantner et al., 2006; Dahl et al., 2003; Klepper, 2002; Wenting, 2008). By exploiting the knowledge thus inherited from their mother companies, spin-offs can produce more efficiently than *de novo* start-ups (Klepper and Sleeper, 2005). This is arguably one of the reasons behind the growing body of evidence in the literature that spin-offs tend to have better performance and lower failure rates than *de novo* start-ups (Tubke et al., 2004). Klepper (2002) and Klepper and Sleeper (2005) develop a biological metaphor of spin-offs, in which they are assimilated to the biological offspring of their mother companies. Under this metaphor spin-offs would start out life with a heritage of resources and capabilities provided by their mother companies (their "DNA"). This original endowment of resources and capabilities inherited from an established firm helps spin-offs overcome their liability of newness, but also has an imprinting effect on their early life and development, as evidenced by spin-offs having initial products and market focus that closely resemble those of their mother companies.

We have the intuition that a similar mechanism of inheritance may be at work with regards to the origin of social capital in spin-offs as has been observed with knowledge and capabilities. To continue using the biological metaphor, we suspect that the "lineage" of a new venture can have an effect on how it is perceived by the other firms in its environment and that all ventures are not born equal in terms of social capital endowment. The notion of "borrowing" social capital is present in Burt (1998a). The idea is that legitimate members of a population build their own social capital, whereas illegitimate members need to "borrow" it if they wish to be accepted by the population. The viewpoint we are adopting in this dissertation is that new members of a population might be automatically endowed with non-zero social capital, depending on their descent, or in other words, that their social capital might have been inherited rather than borrowed. We argue that this is the case for spin-off firms.

While several authors have studied the utilization by spin-off firms of knowledge and resources acquired from their mother companies, the links of the spin-off literature with the research on social capital have received relatively little attention so far. In one example, Sedaitis (1998) finds evidence that new ventures' lineage

has an impact on their initial network configuration, which in turn affects their access to resources, initial client base and eventual performance. Spin-offs' social capital appears to be more immediately relevant and usable to their industry, which a potential drawback of excessive network homogeneity which can lead to spin-offs isolating themselves from contacts outside their initial network. This study not only covers spin-offs in a very particular historical and political context, but also focuses mainly on the role of new venture founders as vehicles of social capital transfer. We believe that other mechanisms beyond transfer of personnel may be at play in the origin of spin-offs' social capital.

The first theoretical contribution in this dissertation will be to investigate the process by which social capital can be inherited from a mother company to a spin-off, and the factors influencing this inheritance.

Resource acquisition by companies is at the heart of a large stream of literature, known as the Resource-Based View, which holds that differences in resource endowments of firms, when deployed by their managers, may result in organizational rent and improved performance (Amit and Schoemaker, 1993; Baum et al., 2000; Carmeli and Tishler, 2004; Hitt et al., 2001). However, new ventures, especially in high technology sectors, are affected by a "liability of newness" and are in a particularly high need of acquiring resources quickly and at affordable costs (Aldrich and Fiol, 1993; Hambrick and MacMillan, 1984). For this reason, resource co-optation by leveraging social capital can be a particularly valuable strategy for high technology spin-offs, as it allows them to acquire more resources than their financial constraints would normally allow.

A number of authors have studied the impact of social capital on the performance of firms, generally considering it as an asset, but occasionally also as a liability (Gargiulo and Benassi, 1999, for example). The second theoretical contribution we seek to make here is to study the impact of social capital inheritance on the early resource acquisition by new ventures, as a possible asset in overcoming new ventures' liability of newness.

This dissertation is expected to have managerial implications regarding the circumstances under which a spin-off constitutes a recommended form of pursuing certain entrepreneurial opportunities, and the circumstances under which such opportunities would be better left to be pursued by *de novo* start-ups.

1.2 Research Questions

As discussed in the previous section, we believe there is a gap in the current understanding of the origin of social capital in new ventures, and that this gap can be addressed at least in part by looking at how spin-offs acquire their social capital in the early stages of their development. We have the intuition that, along with other

types of resources such as knowledge as well as capabilities, spin-offs are able to inherit social capital from their mother companies. In this dissertation, we seek to elaborate on the literatures of social capital and spin-offs by investigating whether this inheritance of social capital exists and if so how it takes place. Consequently, we formulate our first set of research questions as follows:

1. Do corporate spin-offs inherit social capital from their mother companies, and if so how? What factors affect the level of inheritance? Which dimensions of social capital are at play?

The social capital literature describes strategies that individuals and firms can use to leverage their social capital to obtain resources from their network (Hambrick and MacMillan, 1984; Starr and MacMillan, 1990; Stuart et al., 1999; Uzzi, 1999). Resource acquisition is important for the development of firms, particularly in their early life stages when they are most vulnerable, with low resources, limited experience and capabilities, low credibility towards customers, suppliers and its own employees, products designs that are still evolving and output of inconsistent quality and markets that are still unproven or underdeveloped (Hannan and Freeman, 1984; Sorensen and Stuart, 1999; Stinchcombe, 1965). In order to reduce their vulnerability, new ventures need to seek to acquire the resources needed to achieve their objectives, and secure them at the lowest possible cost (Hambrick and MacMillan, 1984). This is where social capital inheritance, by providing access to resources, can provide precious support for newly established corporate spin-offs. Consequently, we formulate our second set of questions as follows:

2. How does social capital inheritance affect resource acquisition by corporate spin-offs in their early stages of development? Does social capital inheritance favor spin-offs' resource acquisition, and if so how?

1.3 Scope

The body of literature on social capital and resource acquisition is extensive and stretches beyond the scope of this research. In order to answer the research questions enumerated above, we will limit ourselves to a particular setting. Specifically, we will study the inheritance of social capital in the context of the creation of high-technology corporate spin-off companies in Switzerland.

To further delineate the scope of this research, we define high-technology corporate spin-off companies as distinct commercial companies created by former employees of an incumbent company (the "mother company") within one year of leaving this company or created around a technical innovation developed inside the mother company within high technology industries.

We define "high technology industries" by referring to the EUROSTAT classification of industry sectors and include the "high technology", "medium-high technology" and "knowledge intensive" sectors. These correspond to the following NACE codes: 24.4 (Manufacture of pharmaceuticals, medicinal chemicals and botanical products), 30 (Manufacture of office machinery and computers), 32 (Manufacture of radio, television and communication equipment and apparatus), 33 (Manufacture of medical, precision and optical instruments, watches and clocks), and 35.3 (Manufacture of aircraft and spacecraft).

We have chosen corporate spin-offs as a setting to study inheritance of social capital for the diversity of avenues for social capital inheritance that are available to them. Spin-offs, unlike other kinds of start-ups, are created with a well-identified network tie to their mother company, which simplifies isolating the effect of social capital inheritance from the mother company. We suspect that spin-offs can inherit social capital through the transfer of individuals who have appropriated this capital from the mother company (Knoke, 1999), much in the same way that they can inherit technological and market knowledge and pioneering know-how (Agarwal et al., 2004). Based on previous research on how a new venture's associations in the network affect third parties' perceptions of its legitimacy, we also believe that spin-offs may be able to inherit social capital by actively publicizing and leveraging their connection to the mother company in the network to gain access to, and legitimacy toward, other network actors (Blau, 1964; Burt, 1987; Podolny and Stuart, 1995; Stuart et al., 1999).

Finally, our choice to focus on high-technology companies is explained by the need to maximize the proportion of observed spin-offs in our empirical sample. There is limited but consistent evidence that corporate spin-offs are relatively more frequent in more knowledge-intensive industries, such as semiconductors, lasers, disk drives and other high-technology sectors (Agarwal et al., 2004; Burton et al., 2002; Franco and Filson, 2000; Garvin, 1983).

1.4 Method

In this dissertation, we will develop a model of social capital inheritance and resource acquisition by high-technology corporate spin-offs. The hypotheses of this model will be tested on empirical data mainly using correlation analysis, multiple regression, analysis of variance and path analysis.

No secondary sources of data could be identified that could serve the purpose of this research. For this reason, two alternative methods of data collection were considered: (1) surveying known groups of corporate spin-offs (e.g. through science parks, corporate venture funds, spin-off associations), and (2) surveying all newly-created firms in a number industries to identify spin-offs and *de novo* start-ups.

The first option offered the advantage of a smaller survey population and hence reduced cost for a high proportion of companies that would meet our selection criteria. On the other hand, the clear disadvantage of this method would be selection bias. Indeed, we would only be surveying spin-offs that publicly identified themselves as such and were placed in a very particular context, such as a science park. Furthermore, this method would also impede any comparison between corporate spin-offs and *de novo* startups, a comparison that falls within the examination of social capital inheritance as a source of competitive advantage.

As a consequence, we opted for surveying all firms in created in high-technology industries in Switzerland between 1999 and 2005 in order to identify spin-offs as well as *de novo* start-ups. The questionnaire contained items for distinguishing corporate spin-offs from *de novo* start-ups and collected data relevant to both types of companies using a skip pattern. The main disadvantage of this method, was that no reliable estimate of the proportion of spin-offs among new firms was available before beginning the study (anecdotal evidence suggested rates ranging between 1.5 and 55%), forcing us to survey a large number for companies to ensure that we received enough responses from spin-offs. This drawback was deemed acceptable when compared to the sample selection bias problems posed by alternatives such as limiting ourselves to a "known" population as would be the corporate spin-offs in a specific science park.

1.5 Structure of the dissertation

This dissertation will be divided in two parts.

In the first part we will cover the theoretical aspect of this research. This will begin with a review of the literature streams upon which this study will be based, namely the literature on social capital and, to a lesser extent, the resource-based view of strategic management. In the following chapter, we will derive a set of propositions and develop a model of inheritance of social capital and its influence on resource acquisition.

The second part of this dissertation will present the empirical test of the model. We will give a detailed description of the chosen method and describe the data collection and sources. Next, we will present the results of the study and end with a discussion of its theoretical and managerial implications, as well as pointing out avenues for further research.

The structure of this dissertation is illustrated in Figure 1.1.

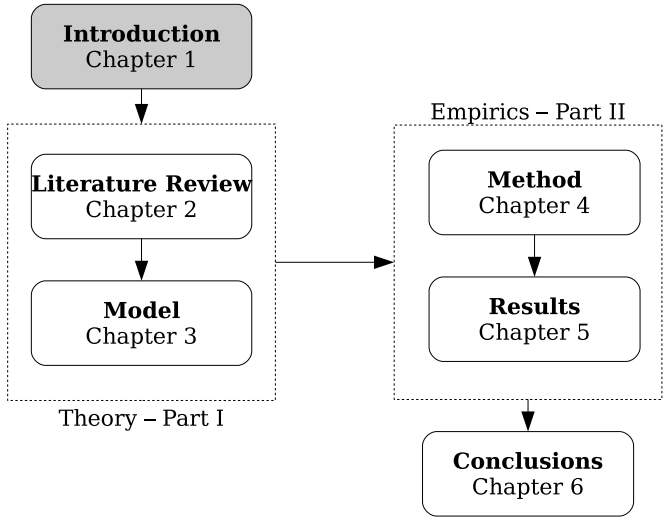

Figure 1.1: Structure of the dissertation

Part I

THEORY

2 LITERATURE REVIEW

The purpose of this chapter is to provide the reader with an overview of the literature streams that this dissertation is based upon.

First, we will discuss the existing literature on social capital. After defining social capital and discussing some of the key distinctions in the literature, we will examine the mechanisms behind social capital creation, review key related theoretical streams that underpin these mechanisms and finally discuss the economic benefits that social capital can yield to its holders.

The second part of this chapter will give an overview of the literature on spin-offs. The emphasis will be placed on the links between spin-offs literature and social capital literature.

2.1 Social Capital

2.1.1 Introduction

The concept of social capital has been gaining popularity in several research streams for the past 30 years. Two things are most striking about social capital: firstly, the fact that it has been used with success in disciplines as diverse as political science, economics and sociology; secondly, that the notions underlying this common term seem to differ considerably from one author to the next.

The basic intuition behind social capital is that social relations generate goodwill, that is: "sympathy, trust and forgiveness offered us by friends and acquaintances", and that this goodwill has value (Adler and Kwon, 2002). That said, social capital can be analyzed from multiple viewpoints. In the following sections, our discussion will aim to provide a broad overview of the existing literature, and answer the following questions:

- What is social capital? Defining social capital, including a review of alternative definitions, a discussion of its characteristics and an overview of its constituent dimensions (section 2.1.2).

- Where is social capital located? Discussing the location of social capital, or in other words the different levels at which social capital can be studied: individual level, organization level and the social level (section 2.1.3).

- How is social capital created? Reviewing the mechanisms behind social capital creation and strategies that can be deployed to develop social capital (section 2.1.4).

- Why is there social capital? Reviewing the theoretical concepts that underpin social capital and explain its key mechanisms (section 2.1.5).

- So what? Reviewing economic benefits of social capital (section 2.1.6).

2.1.2 Defining social capital

The term 'social capital' means "many things to many people" (Narayan and Pritchett, 1997, p.2). Social capital, as an umbrella concept, has been applied to address vastly different research questions in fields as diverse as economic development (e.g. Feldman and Assaf, 1999), political science (Jackman and Miller, 1998) and organizational studies.

In their review of the social capital literature, Adler and Kwon (2002, p.23) give the following generic definition of social capital:

> "Social capital is the goodwill available to individuals or groups. Its source lies in the structure and content of the actor's social relations. Its effects flow from the information, influence, and solidarity it makes available to the actor."

Discussions of social capital in the literature may broadly be classified in two groups: those analyzing the concept from an external viewpoint, and those adopting an internal perspective (Adler and Kwon, 2002). While these two categories are not mutually exclusive (and indeed, some authors fall in between the two), they differ in their focus. Internal definitions are those primarily concerned with social capital at the community or the population level. They adopt a "macro" perspective. External definitions, on the other hand, focus essentially on social capital at the individual, or "micro" level.

The key question in distinguishing between these two views is: 'who do the benefits accrue to?'. Internal definitions are concerned with benefits accruing to groups or communities as a result of the social capital within the community. External definitions focus on benefits for individual actors resulting from their own social capital.

In the following sections, we will provide a brief discussion of the main definitions of social capital in the internal and external perspectives.

Aside from the internal/external dichotomy between visions of social capital, another distinction can be made between authors who consider social capital merely

as a *means* to access resources and those who view it as a *resource* in its own right. This distinction will be examined next.

We will conclude this section on the definitions of social capital with a discussion of its key dimensions.

Internal definitions of social capital

Probably the most influential work on social capital from an internal perspective is that of Coleman (1988). Coleman recognizes serious defects in both the sociological and the economic perspectives. Sociologists often see actors as overly socialized, in the sense that they are only defined by the environment and their social ties. Sociological theories often lack an engine of action for the actors. Economists on the other hand adopt an "undersocialized" perspective, in which actors' goals are arrived at independently, and fail to take into consideration the social context in which the actors are embedded. Consequently, Coleman sets out to import the economists' concept of rational action into the field of social analysis, while still retaining the notion of social organization. It is in this context that Coleman (1988, p.98) defines the concept of social capital: each actor is rational and has control over a certain number of resources, social capital being one particular kind of resource.

> "Social capital is defined by its function. It is not a single entity but a variety of different entities, with two elements in common: they all consist of some aspect of social structures, and they facilitate certain actions of actors —whether persons or corporate actors— within the structure. Like other forms of capital, social capital is productive, making possible the achievement of certain ends that in its absence would not be possible."

Going by the above definition, social capital is an umbrella concept which refers to varying social structures, provided these social structures fulfill one function, namely to facilitate actions. In other words, social capital can be inferred in very different situations, and stem from various sources. Coleman (1988, p.98) documents the case of the wholesale diamond market in New York City, in which social capital stemming from the closeness and the diversity of ties linking individuals to their community allows the market to operate more efficiently. In another case (Coleman, 1988, p.99), social capital originating in the normative structure of the society in Jerusalem allows families to leave their children unattended in the streets, with confidence that they will be "looker after" by any adults in the vicinity.

If the concept of social capital can cover a variety of social relations, one must ask what it is exactly about those relations that could constitute useful resources

for the economic actors. Coleman (1988) defines different kinds of social capital, which we will discuss next.

Obligations, expectations and trustworthiness: When an actor does something for another and expects them to reciprocate in the future, they hold an outstanding obligation, which functions as a form of "credit slip". When an individual holds a large number of these obligations towards many individuals in the community, which they will be able to reclaim as need arises, they can be thought of as having substantial social capital. The value of this individual-level social capital, however, is contingent on the trustworthiness of the social environment, i.e. the likelihood that outstanding obligations will actually be repaid. This relationship is illustrated in Figure 2.1. Individual-level social capital, or in other words, the number of outstanding obligations upon which an actor can draw, can be increased by investing resources for the benefit of other actors.

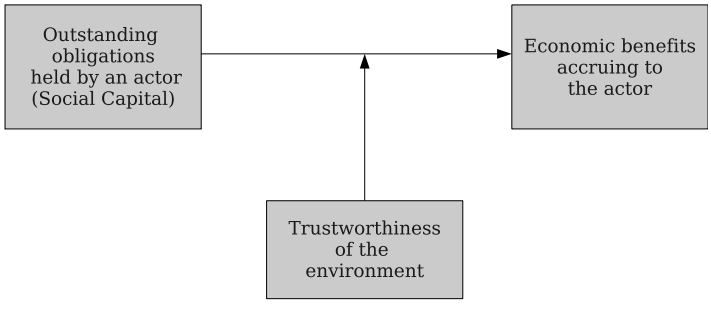

Figure 2.1: Outstanding obligations, individual-level social capital and environment trustworthiness

At the community level, social capital is determined on one hand by the density of outstanding obligations between its members, and on the other hand by the trustworthiness among the members to repay their obligations. Communities in which members are "constantly doing things for each other" and in which there is a high propensity to repay obligations can accomplish more than communities in which members are more self-sufficient or more prone to adopt a free-rider attitude. In practice, community-level social capital increases the accessibility and usefulness of tangible resources available within the community.

Access to information: Information is the indispensable requisite for opportunity recognition and action. As happens with all valuable resources, information gathering is an expensive and time-consuming process. However, social ties which are maintained for other purposes can provide another form of social capital, by also

enabling inexpensive access to information. The value of these social ties does not lie in the value of the outstanding obligations they provide, as was the case earlier, but in the value of the information which they make available. This type of social capital is particularly important from an entrepreneurial perspective, as the value of the same information may vary from one recipient to the next (Kirzner, 1973). One person's casual piece of information, which they will pass on without batting an eye, could turn out to be another person's opportunity.

Community norms and sanctions: In societies where effective norms exist, these may constitute another form of social capital available to actors. For example, if a society has very strong norms that prevent crime, people will be able to walk around the streets at night, which they might not do so easily in other societies. Community norms make possible certain actions, and thus constitute social capital. On the other hand, the same community norms that enable certain actions may hamper others. Some of these actions may be undesirable (e.g. criminal activities), but desirable actions (e.g. innovation) can also be stifled by community norms.

Network closure and the emergence of social capital: Social capital emerges whenever there are social relations and structures. However, Coleman (1988) writes that certain social configurations are especially prone to facilitate the creation of social capital. Such is the case of *network closure*. The notion of network closure is illustrated in Figure 2.2. Community (a) is an open structure, in which actor A has relations to actors B and C, these two having no contact with each other but rather outside the network (symbolized by D and E). A has the power to impose negative externalities on B and C, for instance by not fulfilling his obligations towards them. As B and C have no possibility to coordinate their actions, they have a very limited power to control A's behavior. In community (b), by contrast, which is characterized by network closure, B and C can act together to sanction undesirable behavior by A. Thus in community (b), it is much less likely that any actor will act contrary to the others' interests.
In a community without closure, the development of reputations, as well as the implementation of effective community-wide sanctions towards transgressors, are severely hampered. Thus, network closure encourages the emergence of social capital in the form of enforceable community norms, but is also important in guaranteeing the trustworthiness of social structures, without which obligations and expectations cannot develop.

The concept of network closure as an essential source of social capital underlies the work of Walker, Kogut, and Shan (1997). In their definition, social capital is "*a means of enforcing norms of behavior among individual or corporate actors [thus*

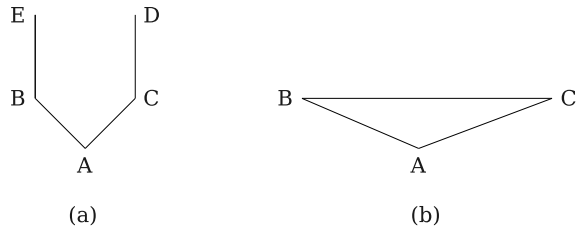

Figure 2.2: Networks without closure (a) and with closure (b)

acting] as a constraint, as well as a resource." In their view, the mechanism that underlies social capital is reputation. In tightly-connected networks, or in other words, networks characterized by closure, acceptable norms of behavior emerge easily, and actors deviating from those norms are quickly spotted and cut off from the network. This creates a strong incentive for actors to engage in acceptable and predictable behavior. This behavior fosters a climate of trustworthiness and facilitates cooperation and risk-taking within the network.

Social capital vs other forms of capital: According to Coleman (1988), social capital can be compared to other forms of capital. Like other forms of capital, social capital is a productive asset, and it can be invested in. Like human and physical capital, social capital is not completely fungible, in that it may be specific to certain activities. Thus, the same type of social capital which could be valuable in certain circumstances could be useless or even counter-productive when applied elsewhere. But social capital differs fundamentally from other forms of capital in that it stems from the social structure of relations, and it does not reside within the actors themselves.This makes social capital even less tangible than human capital.

Coleman's work focuses very strongly on the benefits of social capital at the community level. In this respect, it is very close to the viewpoints of authors such as Putnam (1995, p.67), who defines social capital as "*features of social organization such as networks, norms and social trust that facilitate coordination and cooperation for mutual benefit*", or Fukuyama (1995, p.10) who defines it as "*the ability of people to work together for common purposes in groups and organizations*". It is easy to see why this perspective on social capital is of interest to researchers in economic development. In their literature review for the World Bank Social Capital Initiative, Feldman and Assaf (1999, p.iii) write: "*Social capital refers to the internal social and cultural coherence of society, the norms and values that govern interactions among people and the institutions in which they are embedded.*

Social capital is the glue that holds societies together and without which there can be no economic growth or human well-being. Without social capital, society at large will collapse, and today's world presents some very sad examples of this."

External definitions of social capital

External definitions of social capital focus on relations between actors, be they individuals or organizations, and much less on the community level. The center of interest here is the benefits accruing to the actors, not to the community.

Probably the most prominent example of this stream, Burt (2000b) defines social capital as "*friends, colleagues, and more general contacts through whom you receive opportunities to use your financial and human capital*". Burt's vision builds upon Granovetter's concept of the "strength of weak ties". The value of social capital comes from opportunities, which arise through "structural holes" between dense pockets of network relations.

Figure 2.3 illustrates the concept of structural holes. If an actor A is connected through weak ties to two otherwise disconnected networks (contacts B and C), the opportunity exits from him to act as an intermediary, brokering information and resources between the two groups. This particular network configuration creates value for the actor who happens to be so well-placed. Structural holes are much more likely to occur when network pockets are only connected through weak ties, according to Granovetter (1973). If instead the connections were strong, alternative ties would progressively develop between other members of the network pockets, thus eliminating the structural hole.

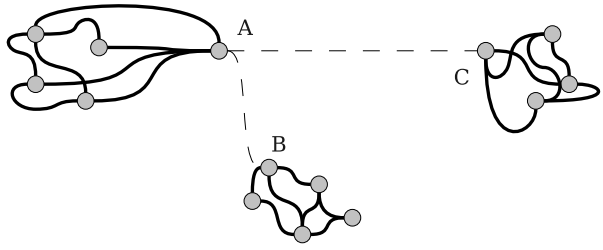

Figure 2.3: Structural holes and weak ties

Information benefits and contact redundancy: Networks allow the flow of information between actors. Network ties can be characterized by the amount of novel information that they can potentially provide. The probability that information in a network will flow from one individual to the next is dependent on

the strength of the tie between them. Consequently, two individuals connected by strong ties will share much of the same information and provide the same network benefits. They are said to be redundant by cohesion (Burt, 1995). A second type of redundancy is structural equivalence. Two contacts are said to be redundant by structural equivalence if they share the same contacts, thus providing indirect access to the same actors.

Both types of redundancy are illustrated in Figure 2.4. A structural hole exists when contacts in a network are non-redundant, thus having and providing access to different sources of information. Because maintaining network ties is a time and resource-consuming task, an actor can only maintain a limited number of them, thus the incentive to concentrate on those ties which are non-redundant in order to maximize information benefits.

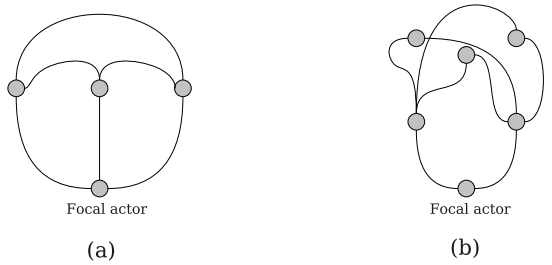

Figure 2.4: Redundancy by cohesion (a) and by structural equivalence (b)

Control benefits —the *tertius gaudens*: The presence of structural holes in an actor's network not only provides them with information benefits. In addition to those, the focal actor gains control benefits, that is to say that they find themselves in the position of the *tertius gaudens* or "the third who profits" from the disunion of others. There are two ways in which a focal actor can benefit from being the *tertius*: in the case where two contacts are interested in the same relation (e.g. when two buyers want to buy the same good) and when dealing with conflicting demands (e.g. a subordinate who must strike a balance between the conflicting demands of two or more superiors). In the first case, the *tertius*'s strategy will be simple: to play both actors' bids against each other in order to get the best deal. In the second case, the strategy will be to make both contacts aware of their conflicting demands and let them resolve the issue between themselves.

Network closure vs. structural holes: Burt's work is strongly at odds with the work of authors such as Coleman (1988). The network closure argument posits that

the source of social capital lies in the tightness of the connections between members of a network. The structural holes argument, on the other hand, contends that the source of social capital resides in certain actors' ability, due to their position, to act as brokers between otherwise disconnected parts of a network.

Walker et al. (1997) write that firms having abundant social capital at their disposal are able to free more resources, which may then be invested in creating new network relations. However, these new relations may be developed in two mutually-exclusive ways. Firstly, the firms may choose to strengthen the existing network of relations by developing ties inside the network. The rationale for this would be to preserve the value of their social capital. Tie development in this case would happen in a path-depended way. On the other hand, though, some firms may also choose not to develop ties within their existing network, but outside it, in order to try and exploit entrepreneurial opportunities stemming from structural holes.

To some extent, the difference between the network closure argument and the structural holes argument can be traced back to the difference in internal and external focuses. Coleman (1988)'s perspective underlines the value of cohesiveness inside a community or an organization, whereas Burt (2000a, 2004, 1995, 1998b, 2000b) explores the idea that structural holes in the focal actor's external linkages can yield competitive benefits.

Social capital as a means to access resources

Aside from the distinction between internal and external definitions of social capital, some authors consider social capital as a means to access resources, while others consider it a resource in its own right. Among the authors who adopt the first perspective, we can cite Knoke (1999, p.18), who writes: "*[social capital is] the process by which social actors create and mobilize their network connections within and between organizations to gain access to other social actors' resources.*" Similarly, Portes (1998, p.6) defines social capital as "*the ability of actors to secure benefits by virtue of membership in social networks or other social structures.*"

In this perspective, the focus is not placed on social capital itself, but on the resources that become available through its use. In the words of Burt (1995, p.11), the question asked is "who" (or what) you reach through your network, not "how" you reach it (i.e. the value of the network's structural configuration).

From the above definitions it appears that social capital in this perspective is not seen as an identifiable object in itself, but as a 'process' of creating and mobilizing assets (the network connections), or as an 'ability' to derive benefits from those assets. Semantically, these definitions fall very close to the concept of capability, which Amit and Schoemaker (1993, p.35) define as a firm's capacity to deploy resources.

In this perspective, social capital could be defined as the capability to deploy a certain number of social resources, such as network connections, legitimacy, shared norms and other such resources as might emerge from membership in social networks or structures. Defining social capital as a capability, however, is a departure from the metaphor of 'capital', since all other forms of capital are considered resources. In the next section, we discuss social capital definitions that consider social capital as a resource.

Social capital as a resource

A number of authors think of social capital as a resource. The source of social capital lies in the social structure or the social relations in which actors are embedded. Examples of this view are:

- Baker (1990, p.619): "a resource that actors derive from specific social structures and then use to pursue their interests; it is created by changes in the relationships among actors."
- Woolcock (1998, p.153): "the information, trust and norms of reciprocity inhering in one's social networks."
- Coleman (1988, p.98): "Like other forms of capital, social capital is productive, making possible the achievement of certain ends that in its absence would not be possible."

Other authors go even further and not only see social structure as the source of social capital. They also combine in their definition the source and the value of social capital, i.e. the resources made available through the network structure:

- Bourdieu (1985, p.248): "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition."
- Nahapiet and Ghoshal (1998, p.243): "the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit."
- Burt (1995, p.12): "Social capital is at once the resources contacts hold and the structure of contacts in a network."

All of these definitions have in common that social capital is seen as a resource. In the more restrictive definitions, the source of the resource is the structure of social

contacts. The broader definitions add another layer to the concept of social capital by integrating its source with its value, i.e. those resources held by contacts in the network.

This last set of definitions shows that it is not necessary to think of social capital as a capability to explain how it could provide access to resources. For one, the resources which are embedded in the network can be thought of as part of the concept of social capital. But even this step is not necessary. Indeed, there is no impediment for one resource to enable access to other resources. A prime example of this would be financial capital. If we think of social capital as a resource, without necessarily including in that definition assets embedded in the network, social capital can be applied to acquire other resources.

In this dissertation, we choose to adopt the view that social capital is a resource. The most important and distinctive characteristics of social capital as a resource are the following.

Exhaustibility and depreciation: Contrary to many other types of resources, usage of social capital does not exhaust it. On the contrary, regular usage of social capital is necessary to avoid its depreciation. Social capital requires regular maintenance. Network ties which are left unmaintained and unused for long periods of time become loose and unreliable. For this reason, and because of time constraints, actors can only viably maintain a limited number of network ties at any one time. Finally, not only does social capital not decrease with use, but in certain circumstances it may even increase when used. This is the case for strong network ties, such as friendship. On the other hand, it is possible to diminish or destroy social capital by abusive use.

By-product of other activities: Social capital is created as a by-product of social interactions. This resource is created when actors engage in, and maintain, social ties. The purpose of those ties need not be the creation of social capital in itself. Social ties are appropriable: that is to say that they may be used (to some extent, at least) for purposes other than those for which they were created Coleman (1988).

Path-dependency: Social capital develops in a path-dependent way. The existing contacts in an actor's network strongly influence the contacts that this actor is likely to establish in the future. Whom you know largely determines whom you will get to know. People get used to dealing with the partners they know well. While this facilitates trust and cooperation with those partners, it also means that less time is available for discovering contacts outside the established network. Thus, contacts

not only provide actors access to more contacts, but they also isolate them from contacts not in their own network.

Collective good: Social capital has elements of a collective good, in the sense that it is not the sole property of the actor that benefits from it (Coleman, 1988). This is especially true when one adopts an internal perspective. Social capital is owned jointly by the members of a relationship. It can be used non-rivalrously, i.e. one's usage of social capital does not diminish its availability to the others. However, contrary to public goods, the use of social capital is excludable, that is to say others can be prevented from accessing a network.

Rigidity: Is it possible to modify existing social capital? Certainly, at least to some extent. Network structure can be modified by creating new ties, severing others, reducing or increasing the strength of existing ties, or choosing to promote indirect ties to direct ties, or vice-versa. However, the fact that it is possible to modify social capital does not imply that this is easily or rapidly achieved. It is difficult and costly to pull out of established social ties (Gargiulo and Benassi, 1999). The more productive those ties have been in the past, the harder it will be to reduce their prominence, or to sever them altogether.

One reason for this is *relational inertia*. When people are used to working with long-term partners, the strength of their bonds will act as a cognitive filter for the information and perspectives they receive, effectively locking them out from the outer world (Grabher, 1993). They may not even realize anymore that other contacts might better fit their needs. Furthermore, creating new ties involves important, and uncertain, initial investments which may appear daunting when compared to the comfort of existing, tried and true network ties. Actors are all the more reluctant to give up existing ties because of this.

A second reason to the rigidity of social capital is the norm of reciprocity. Reciprocity is not just repaying one favor with another. Since the value of social transactions is difficult to assess, actors may have different perceptions on whether the "accounts are settled" (Blau, 1964). But even if accounts are perceived to be settled, there still remains an expectation of ongoing behavior towards existing relations. Failure to reciprocate, even if the expected benefits of doing so are low, may result in strong damage to an actor's reputation inside a community, affecting the ability to create new ties. There is a strong social stigma associated with being seen instrumentalizing social relations and severing them as soon as they cease to be useful.

Dimensions of social capital

Social capital is usually considered as a multidimensional concept, both in internal and in external definitions. Using an internal approach, Leana and Van Buren (1999) distinguish the following dimensions:

- **Associability**: willingness and ability of the members of an organization to subordinate their individual interests and actions to the collective goals and actions.
- **Trust**: generally defined as the "willingness to be vulnerable" (Leana and Van Buren, 1999, p.542), trust is an essential element to ensure that actors within an organization are willing to share information and resources.

In an external perspective, Nahapiet and Ghoshal (1998) distinguish three dimensions of social capital.

- The **structural dimension** refers to the social interaction ties between actors in a network. The structure of ties in an actor's network provides advantages for the actor, in the form of resources, information or brokerage opportunities (Granovetter, 1992).
- The **relational dimension** of social capital comprises assets that are embedded in the social ties, such as trust and trustworthiness.
- The **cognitive dimension** of social capital is defined as the shared code or a shared paradigm in a social system; it forms the foundation of a community's or of a firm's self-perception. Burt (1997) calls this the "public good" aspect of social capital, while for Anderson and Jack (2002) the cognitive dimension is part of the context in which network actors become embedded.

The dimensions of social capital are not independent of one another. On the contrary, they interact in several ways (Tsai and Ghoshal, 1998).

Gabarro (1978) described an interaction between the relational and the structural dimensions. He noted that over time, frequent interaction between actors made the parties more likely to perceive each other as trustworthy. Stronger interaction ties positively affect trust and trustworthiness levels in a relationship (Nelson, 1989). For this reason, the structural dimension of social capital reinforces the relational dimension.

The relational dimension is also linked to the cognitive dimension (Leana and Van Buren, 1999). Common values and a shared vision help to develop trust in a relationship. They also encourage actors to work together to attain collective goals

rather than acting in a self-interested or opportunistic way. In this way, relational social capital serves to reinforce cognitive social capital.

2.1.3 Levels of social capital

Social capital can be analyzed at different but interrelated levels: community, firm and individual (Leenders and Gabbay, 1999). This distinction is one of "locus of efficiency" (Grandori and Soda, 1995). It is not always made explicit by authors, which can lead to some confusion.

At the community level, as we have already discussed, social capital is defined as the amount of outstanding obligations within the community (Coleman, 1988; Putnam, 1995). Social capital at the community level finds its sources in the normative structure of the community, the level of trustworthiness within the community and in the degree of network closure that characterizes the community. Communities with higher levels of social capital are able to "achieve more" and function more efficiently. Community-level social capital enhances the availability and usefulness of resources owned by community members.

The firm level is constituted by the "community of firms" that a firm interacts with, such as other firms in the industry and across the value chain. Firm-level social capital is defined as the amount of outstanding obligations that a firm holds vis-à-vis other firms, and the access to information provided by its network. The firm's social capital finds its sources in the structure of the firm's network of contacts (including any structural holes present in the network) and the resources it possesses and which can be invested to create outstanding obligations. Firms derive a number of economic benefits from their social capital, namely the ability to co-opt resources and legitimacy more easily and cheaply than would be possible in the absence of social capital.

At the individual level, social capital is defined as the outstanding obligations held by the individual vis-à-vis others, and the availability of information provided by the network of contacts. The sources of individual-level social capital are the structure of the network of contacts (including any structural holes) and the resources available to the individual and which may be used to help others in order to create outstanding obligations.

The three levels of social capital are not hermetically isolated from each other. Not only are there interactions between different levels, but the literature also mentions instances in which one level of social capital can reinforce or act as a substitute for another.

For example, the factors which constitute sources of social capital at the community level, and in particular the trustworthiness of the environment, reinforce the economic benefits accruing to both firms and individuals in the exercise of

their own social capital. The degree of trustworthiness of the community that firms and individuals are embedded in determines the ultimate value of the outstanding obligations held by individuals and firms (Coleman, 1988). Holding a large number of outstanding obligations can only yield access to resources or legitimacy if those obligations are actually honored, and this will depend on the community's trustworthiness.

Also, although individual-level social capital is distinct from firm-level social capital, it can also yield benefits at the firm level (Leenders and Gabbay, 1999). By calling on his personal social capital, the entrepreneur can for example secure the usage of facilities for their firm, establish contacts and credibility with prospective customers and suppliers or recruit key employees. Individual-level social capital is routinely used by entrepreneurs as an initial substitute for firm-level social capital during their firm's start-up phase. Firms in this phase, which have no past performance history, very little in term of current operations and often no comparable companies, pose a real challenge to outside stakeholders wishing to establish the firm's value or credibility. In order to establish this credibility, start-up firms often rely on the successful track record and network of their managers (Damodaran, 2001).

Individual-level social capital is not only an early substitute, but also a source of firm-level social capital. A number of authors in the social capital literature even go so far as to consider firm-level social capital primarily as an aggregate of individual-level social capital (Burt, 1995; Pennings et al., 1998) or as an appropriation by the firm of its members' social capital (Leenders and Gabbay, 1999). At any rate, previous research has suggested individual-level social capital, and entrepreneurs' embeddedness in their local social context, as a major source for a new venture's firm-level social capital (Arenius, 2002; Colombo and Grilli, 2005; Davidsson and Honig, 2003; Jack and Anderson, 2002; Shane and Khurana, 2003; Witt, 2004). One mechanism by which individual-level social capital can act as a source for firm-level social capital is that the economic benefits accruing to the firm through its management's individual-level social capital feed back into the firm's creation of social capital. As resources are gathered by the firm, it gains the ability to invest them in the creation of its own social capital. As business relations are established by the entrepreneur in the name of the firm, the firm begins to develop its own network.

The benefits of social capital can accrue to both individuals and firms, but also across individual and firm levels. Thus, individual and firm-level considerations are important in the study of social capital and firms' start-up phase.

2.1.4 Strategies for developing social capital

As discussed earlier, the generic strategy for the creation of individual-level social capital, or in other words, the number of outstanding obligations upon which an actor can draw, can be increased by investing resources for the benefit of other actors (Coleman, 1988).

Starr and MacMillan (1990) identify a number of specific strategies by which an actor may build up his social capital:

- **Sharing information:** while Burt places emphasis on the self-interested exploitation of structural holes, Starr and MacMillan (1990) point out that by agreeing to introduce two otherwise disconnected parties who could clearly benefit from being in contact, an actor can gain significant goodwill from those parties. This goodwill can then be leveraged for the benefit of the actor who did not take advantage of his position.

- **Solving problems or giving favors:** an obvious way to develop social capital is to solve problems for others or to do them favors. In so doing, feelings of gratitude and moral obligations are created, which can be called upon later.

- **Receiving help or favors:** a less obvious but very interesting way to create social capital is to allow others to offer their help or to do favors for us. People often develop a sense of responsibility towards those they have offered advice or help in the past, and often feel the moral obligation to offer more help in the future.

- **Allowing people to appear in a good light in front of others:** by creating opportunities to allow individuals to display their competence in front of others, one can engender significant social goodwill

All of these strategies require the actor to invest time and attention into building his social capital. The advantage of an actor with an existing stock of social capital, for example one developed in previous occupations, lies in the substantial gain of time and effort compared to an actor starting to build social capital from zero. On the other hand, the disadvantage for the individual who has an existing stock of social capital is the loss of flexibility, as he is constrained by the social capital that he has available. If this social capital does not fit his needs, the advantage is lost. Even worse, the individual may be inclined to try and use his social capital although it is not adapted, which could be counter-productive.

2.1.5 Related theories and concepts

Social capital literature does not exist in isolation. Many of the mechanisms underlying social capital creation and utilization have been described in other strategic management and sociological theory streams. In the following paragraphs, we will give a brief overview of some of these key related theories.

Interpersonal exchange

The theory of social capital finds its roots the theories of interpersonal exchange, which are largely based on neoclassical economic theory. According to these theories, the process guiding actors' behavior is, like in the neoclassical model, largely rational and profit-maximizing. Individuals are thought to invest their time and energy in creating and exchanging social goods in hopes of reaping profits in the future (Homans, 1958). Transactions of social goods, however, differ significantly from ordinary transactions as seen by the neoclassical model. Instead of being carried out through explicit agreements, transactions of social goods merely create unspecified, "diffuse" future obligations and feelings of gratitude, trust or friendship, the value of which cannot be estimated with precision (Blau, 1964). These obligations and feelings play a large part in making social capital a valuable resource that can yield economic benefits to its holder.

Economic sociology

Economic sociology (e.g. Etzioni, 1988; Swedberg, 1987) steps away from the neoclassical model. The economic actor is no longer seen as an isolated profit maximizer, but rather as being connected to other actors in society in a variety of ways. Actors are not assumed to be necessarily rational. In addition to limitations to actors' rationality caused by cognitive limits of human information processing (e.g. Cyert and March, 1963), decision making is thought to be characterized by a tension between rational choice and moral obligations. In other words, an actor will constantly try to conciliate the rational choice with what he perceives to be "right", "fair" or "moral". This will often lead actors to take decisions which from a strictly rational and self-interested point of view would not seem justified, or which might even seem contrary to their own interests. Consequently, venture managers who are skilled at utilizing social transactions will be able to obtain resources at conditions much more favorable than would be conceivable under neoclassical assumptions (Starr and MacMillan, 1990), because their counterparts will not be solely seeking to maximize their own profit, but will also consider other, less rational, arguments. This again contributes to making social capital an economically beneficial resource.

Network structures: strong ties and weak ties

Granovetter (1973) proposed the analysis of network structures as a means for bridging the gap between the micro and macro levels of sociological theory. Concretely, he studied the macro consequences of one particular type of micro-level interaction: the strength of dyadic ties between actors. The strength of a tie between actors is defined as a combination of the amount of time, the emotional intensity, the degree of intimacy and the reciprocal services which characterize the tie.

Having classified ties as "strong", "weak" or "absent", Granovetter (1973) predicts that individuals linked by strong ties to each other will tend to have ties to the same group of individuals. The reason for this is that the stronger the tie, the higher the proportion of time spent together, and thus the higher the probability that both individuals will be meeting the same people. On the other hand, if two individuals are linked by a weak tie, there is a higher probability that they both will know people unknown to the other. Consequently, Granovetter goes on to add, weak ties are more likely to provide the focal individual with novel information than strong ties. The reason lies in that individuals linked by weak ties will have contacts outside the network, whereas individuals linked by strong ties will not.

Empirically, Granovetter (1973) found that men looking for new jobs almost never had received the information about a potential position through close contacts. If the information had reached them through a personal contact, this was most often a distant or long-forgotten acquaintance. This is what Granovetter (1973) calls the "*strength of weak ties*".

Considered from the point of view of social capital, Granovetter (1973)'s work is an illustration of how carefully-managed networks of contacts can provide economic benefits to venture managers, e.g. information.

Embeddedness

Sociology and anthropology often tell an account of man as being "oversocialized", i.e. solely obedient to established systems of norms and values, internalized through socialization, and lacking any independent engine for action (Wrong, 1961). On the other extreme, economics usually favor a vision of rational and atomized individuals acting purely in the pursuit of self-interest, a view critics have described as "undersocialized".

Granovetter (1985) pointed out that both perspectives, paradoxically, have something in common: they both adopt an atomized account of action and decision. In the "undersocialized" view, this atomization results from the pursuit of narrow self-interest. In the "oversocialized" account, the same atomization occurs by way of the internalization of socially imposed norms of behavior. Neither perspective takes

into account the influence of the individual's ongoing social relations.

Granovetter (1985) proposes an alternative approach to action and decision making: *embeddedness*. Economic action is seen here as embedded in social structure. In this view, an actor's external ties exist on a continuum ranging from arm's-length, purely market-based exchange, to relational exchange, depending on the degree to which they are embedded in social relations.

Embedded relations have the potential to influence an actor's economic decision making, because maintaining the social tie becomes an important concern, often superseding even economic interest (Hite, 2005). Consequently, social relations in which economic transactions become embedded prompt trust and affect the way transactions are conducted (Granovetter, 1985), and have a varying degree of impact on resource valuation and asset allocation (Uzzi, 1997, 1999).

Empirically, Coleman (1988) documented the fact that in closely-tied communities of diamond traders, diamonds worth huge sums were exchanged or entrusted on a simple handshake. The reason for this trust lied in the fact that the traders shared a large number of social and religious ties, meaning that malfeasant behavior would be spotted, publicized and sanctioned immediately.

Taking the concept to the firm level, Uzzi (1999) described how firms that embedded their commercial transactions with their banks in social attachments were able to obtain lower interest rates on their loans. Embedded ties offer the advantage that partners are willing to share private information and resources. On the other hand, exclusive reliance on embedded ties puts the actor at risk of cutting themselves from public market information, more readily available through arm's-length ties.

These examples provide good illustrations of mechanisms through which social capital can yield economic benefits to its holder, as the preservation of social ties becomes an objective for actors that supersedes short-term economic self-interest, making possible transactions at better conditions than would be possible in a purely rational market.

Institutional theories

Institutional theories emphasize the influence of non-tangible or cultural elements, such as symbols, myths, cognitive systems, coalitions and normative beliefs, over the life of organizations. According to this view, cultural, historical and institutional frameworks constrain managerial action, and organizational choices are not solely the result of rational analysis (Carmona et al., 1998).

Organizations are members of organizational fields, which include competitors, distributors, owners and suppliers (Dimaggio and Powell, 1983). The concept of organizational field places the emphasis on the influence of the institutional envi-

ronment over the organization. Scott (1995, p.33) defines institutions as "cognitive, normative, and regulative structures and activities that provide stability and meaning to social behavior". A central point of institutional theories is that organizational action is constrained by rules set by institutions, that define the limits of what is deemed acceptable, legitimate behavior. In some cases, these rules can gain legal status. Institutional rules infuse organizational decision making with an appearance of rationality (Meyer and Rowan, 1977).

Institutional theory, especially in its earlier versions (e.g Selznick, 1949), places strong emphasis on conformity as the usual organizational response to institutional demands. An organization that conforms to such demands gains legitimacy in society and can earn rewards in the form of enhanced access to resources and chances for survival (Carmona and Macías, 2001). "New" institutionalists (e.g Covaleski and Dirsmith, 1988; DiMaggio, 1988; Meyer and Rowan, 1977) have criticized the "old" institutional theory's emphasis on conformity as sole organizational response. Oliver (1991) establishes a typology of five possible responses to institutional pressure, ranging from passive conformity to proactive manipulation.

Institutional theories have been used to explain the emergence, diffusion, similarity and change of organizational forms as the result of of environmental pressures.

The characteristics of the industry that a firm operates in, for example, can determine the type of administration that is most rational to the firm. Stinchcombe (1959) cites the case of the construction industry, which is characterized by constant variation in location, design, and volume of production, as well as by strong seasonality. In this industry, bureaucratic administration and centralized planning *à la* Weber would make no sense. Instead, firms operating in this industry opt for "craft administration", which minimizes administrative control and relies on professional operating standards and the "empirical lore" of the craftsmen.

Organizational forms may also emerge under the influence of governments or professional institutions. DiMaggio (1991) studied the case of U.S. art museums and the emergence of the "educational museum" model as the result of sponsorship policies of philanthropic entities such as the Carnegie Corporation and of norms disseminated at the national level by the American Association of Museums.

Environmental influences are central to the question of organizational isomorphism, or in other words: why certain organizational forms, strategies and processes tend to become dominant across populations of organizations.

Population ecologists, such as Hannan and Freeman (1989, 1984), propose that the more efficient organizational forms will become prevalent through a process of natural selection and that the other, less efficient, forms will progressively be eliminated from the landscape. A central hypothesis to population ecology is that organizations have a very difficult time adapting their structure, and thus become

less competitive when the environmental conditions change (Hannan and Freeman, 1977).

Institutional theories offer a different explanation to the diffusion of organizational forms. First of all, institutional theorists differ from population ecology on the hypothesis of organizational adaptation and believe that organizations can indeed adapt their structure to conform to institutional pressures. Dimaggio and Powell (1983) cite three processes by which organizational forms will diffuse through a population: coercive isomorphism, mimetic isomorphism and normative isomorphism.

In the case of coercive isomorphism, organizational isomorphism results from pressures from larger organizations upon which the organization is dependent, or from societal expectations (Dimaggio and Powell, 1983). Coercive isomorphism can for instance be the result of government mandates, different regulations (financial accounting standards, contract legislation…), or cultural expectations. Meyer and Rowan (1977) argue that organizations adopt certain formal structures based on institutional expectations. Common examples of such expectations are firm functions (sales, production, accounting…) or university departments. Failure to adopt those institutionalized organizational models would not necessarily diminish the efficiency of organizations, but would cause incomprehension and raise claims of negligence from the institutional environment. Coercive isomorphism is a question of maintaining legitimacy towards the institutional environment.

Mimetic isomorphism occurs when organizations intentionally imitate one another. Imitation among organizations is common when organizations are faced with uncertainty. The mechanisms through which organizations copy each other and through which organizational models diffuse through the population are the migration of employees, and the action of consulting firms providing similar advice to several organizations (Carnegie and Parker, 1996; Dimaggio and Powell, 1983).

Normative isomorphism occurs when organizations indirectly adopt the norms and values of other organizations. Normative isomorphism originates in professions. Employees with similar educational backgrounds will approach situations in similar ways. Therefore, norms developed in the educational experience will find their way into organizations. Firms hiring graduates from the same educational backgrounds will be infused with those norms, leading to firm isomorphism. Also, inter-hiring of employees between firms will reinforce normative isomorphism.

The positive effect of isomorphism lies in that it provides legitimacy (Dimaggio and Powell, 1983), defined as “endorsement of an organization by social actors” (Deephouse, 1996, p.1025). On the negative side, isomorphism can inhibit innovation and promote the continued existence of inefficient organizational forms (Jones, 2003, Ch.11). To minimize these negative effects, organizations may adapt

to institutional pressures ceremoniously, but buffer their technical core from those ceremonial obligations in order to preserve their efficiency (Meyer and Rowan, 1977).

Institutional theories have also find applications in explaining the way innovations are diffused and adopted throughout a population. Tushman and Anderson (1986) write on the way incremental and disruptive technological change occurs, how this affects environmental conditions and how firms adapt to it.

In the context of this dissertation, institutional theories are interesting to explain the legitimacy dimension of social capital, and how an organization can be perceived as legitimate or illegitimate by the other organizations in the network.

Resource-Based View

Since its inception, the resource-based view has been the cause of heated academic debate as to its validity as a paradigm (see Barney, 2001; Priem and Butler, 2001a,b). This debate has not yet been closed, but the resource-based view has nonetheless spawned a substantial stream of literature and it has made a significant impact in the field of strategy in over the past decade. A full coverage of the resource-based view falls well beyond the scope of this literature review, so we will limit ourselves to outlining the main theoretical propositions.

The resource-based view holds that variability in organizational performance can be explained by heterogeneous endowments of organizational resources (Barney, 1991; Peteraf, 1993; Pralahad and Hamel, 1990; Wernerfelt, 1984). The two core assumptions underlying the resource-based view are that (1) resources are not distributed homogeneously across firms, and (2) the transfer of resources between firms is difficult and costly (Priem and Butler, 2001a). Thus, when a firm possesses a resource that is valuable, rare, difficult to imitate and non substitutable by other rare resources, it can derive a competitive advantage.

Focusing on the linkages between the industry analysis framework, the resource-based view of the firm, behavioral decision biases and organizational implementation issues, Amit and Schoemaker (1993) showed that organizational rent stems from imperfect and discretionary decisions to develop and deploy selected resources and capabilities, made by boundedly rational managers facing high uncertainty, complexity, and intrafirm conflict.

Most empirical studies of the resource-based view have looked at the link between one or several resources and firm performance. More recently, some attention has been drawn towards the causal “black box” linking resources and performance (Hansen et al., 2004).

Recent studies have attempted to bring empirical support to the theoretical propositions of the resource-based view of strategic management. Most of these studies

have focused on testing the link between one given resource and firm performance (e.g. Hitt et al., 2001; Waldman et al., 2001). More recently still, in a step forward from previous empirical studies, Carmeli and Tishler (2004) found significant impact on firm performance by six independent intangible organizational resources and the interactions among them. Moving in a different direction, Hansen et al. (2004, p.1279) proposed that the gap between the 'theoretical utility' and the 'practical utility' of the resource-based view could be narrowed by operationalizing it differently and more consistently with Penrose (1959). Hansen et al. (2004) distinguish between the productive resources that a firm has and its administrative decisions, which configure the resources and turn them into services that may result in competitive advantage.

In this thesis we propose to inform recent advancements in the resource-based view literature with the insight of social capital. Carmeli and Tishler (2004) argued that it is not only *which* resources the firm has that influence its performance, but also the *fit* between those resources. Hansen et al. (2004) have in turn argued that it is not so much the resources the firm has, but rather *how* it administers them that drives performance. We suggest that both the firm's resource acquisition and administrative decisions are strongly influenced by its social capital. By inheriting social capital, a spin-off may accelerate its acquisition of resources and inform its administrative decisions with more and more accurate information.

2.1.6 Economic benefits of social capital

As we have already mentioned in the previous sections, a common thread in social capital literature is that, if leveraged, social capital can yield economic benefits to those who hold it. We will now give a more formal overview of these economic benefits. In the interest of brevity, and because it is the focus of this dissertation, we will concentrate on the economic benefits of social capital at the firm level, that is to say benefits accruing to the firm, regardless of whether they find their sources in the usage of community-level, individual-level or firm-level social capital.

The economic benefits of social capital for the firm are twofold. Firstly, social capital allows the firm to obtain resources faster and more cheaply. Through social capital, the firm obtains resources that would probably not be available otherwise, or at least not at conditions which it could afford. Secondly, social capital allows the firm to build the legitimacy it needs to convince external and internal stakeholders to do business with it.

Resource acquisition and legitimacy building are valuable for all firms, but this is particularly true for new ventures. During the initial stages of its existence, a firm is faced with many difficulties, which the literature refers to as the "liabilities of newness" (Stinchcombe, 1965). It lacks knowledge about its environment. Because

it has no track record, it has no legitimacy with its customers and suppliers, and even with its own employees (Stinchcombe, 1965). It lacks production experience and its production routines are not in place (Sorensen and Stuart, 1999). Consequently, it lacks the ability to achieve consistent levels of output quality (Hannan and Freeman, 1984). It lacks financial and human resources, which renders its position extremely perilous in case of a prolonged period of poor performance. Consequently, a new firm is at higher risk than an established organization of disbanding (Levinthal, 1991), leading stakeholders and outsiders to be wary of engaging in business with it.

This liability of newness is accentuated further in the case of technological new firms. Indeed, in addition to the disadvantages listed above, technological new ventures often require substantial investments in order to fund their early-stage development technologies, which are highly speculative, while revenues will only accrue at a much later stage, if at all, and are difficult to evaluate (Aldrich and Fiol, 1993).

In order to break out of this uncomfortable situation, the new firm has to obtain the resources it needs for its development, but given its financial constraints, it must do so as parsimoniously as possible: seeking the bare minimum resources needed to achieve its objectives, and securing them at the lowest possible cost (Hambrick and MacMillan, 1984). This is where social capital, by providing access to resources, becomes invaluable to the new firm.

Aside from obtaining resources, the new firm must also develop its legitimacy, i.e. secure the support of its customers, distributors and suppliers. The liabilities of newness evoked above mean that these powerful external actors will have justifiable doubts as to whether the new venture is likely to survive very long, and thus will question the wisdom of providing their patronage. The new firm must create the impression that it has a reasonable chance of succeeding.

Social capital and resource co-optation

There is abundant empirical evidence that social capital, for example in the form of previous working relationships, voluntary connections and kinship or community ties, plays an important role in allowing new ventures to acquire resources (see for instance Birley, 1985; Johannisson, 1987; MacMillan, 1983).

Social capital allows firms to acquire resources at a much lower cost than market cost, by tapping into underutilized resources of network contacts (Starr and MacMillan, 1990). These authors list a number of social strategies that entrepreneurs can use to co-opt resources in this way.

- **Borrowing:** From an entrepreneurial standpoint, ownership of resources is

much less important than access to resources. Borrowing allows a firm to use certain resources for a certain time (or maybe periodically) under the premise that they will eventually be returned to their owner. Borrowing means that the firm need not cover the fixed cost of the resources, and usually not even the variable costs. Borrowing can take different forms, some of them bordering on the unethical or even illegal. Starr and MacMillan (1990) cite the example of an intrapreneur who routinely charged early expenses for his projects to accounts of other divisions of the firm employing him, reasoning that by the time the accounting irregularity was discovered, the project would have generated the revenues to repay the accounts.

- **Begging:** Begging is a way of securing resources without needing to return them, by appealing to the owner's charity, goodwill or moral values. In this case, the owner of the resources is cajoled into donating them without receiving any material remuneration in exchange, even though he recognizes that the resources have value.

- **Scavenging:** Scavenging strategies involve putting to use resources which others do not intend to use or see no value in. Usually, persuading the owner of the resources to part with them, even though they have little value to him, will require a dose of social ability.

- **Amplifying:** Resources have different values to different actors. Amplifying strategies involve extracting more value out of a resource than is perceived by its original owner. The price demanded for an asset depends on the value that the owner perceives. Hence, entrepreneurs who have a different perception of the resource's value can obtain them for a fraction of their potential cost. These strategies are based on the exploitation of market inefficiencies.

By using any, or a combination of these strategies, firms can leverage their social networks to obtain resources at a fraction of their market cost. In so doing, firms reduce not only the cost of start-up, but also the risk (by reducing the initial investment substantially), and they increase their potential return on assets (by bringing down the need for assets).

Social capital and legitimacy co-optation

New ventures have no track record and often exploit technologies which are at too early a stage to properly evaluate their potential. Thus, direct measures of the quality of the new venture are not readily available. Stuart et al. (1999) write that when

faced with such uncertainty about the quality of a new venture, third parties will rely on the prominence of the firms that the new venture is affiliated with in order to decide whether they should do business with it. An actor's reputation is partly constructed through the identities of his associates (Blau, 1964). Generally speaking, third-parties' perceptions about the quality of an individual, a firm or even an innovation are affected by prominent endorsements. For example, Burt (1987) showed that physicians' perceptions of a new drug evolved positively once prominent doctors in the community had chosen to adopt it. Similarly, in the corporate context, Podolny and Stuart (1995) found that uncertain technological innovations were more likely to be widely accepted once they had been adopted by high-status organizations.

Stuart et al. (1999) identify three mechanisms that affect third parties' perceptions of a new venture's quality based on the new venture's associations. These mechanisms are discussed below.

- **Reciprocal relationships:** Relationships can affect the reputation of both parties involved. If a relationship exists between a prominent organization and a new venture, the prominent organization stands to lose much more in terms of reputation than the new venture if the new venture were to be low-quality. Because more is at stake for them in terms of reputation, prominent organizations will deploy more efforts to avoid association with low-quality partners. Therefore, when such an organization has established a relationship to a new venture, third parties may assume that sufficient due diligence has been carried out.

- **Quality certification:** If the prominent organization has chosen to establish a relationship with the new venture, this signals that it perceives its quality to be high. Third parties may consider that a prominent organization's evaluative capabilities are strong and thus decide to trust its judgment about the quality of the new venture. The difference to the previous mechanism is that this one does not assume that an occasional low-quality relationship can damage a prominent organization's reputation.

- **Perceived reliability:** If we assume that prominent organizations avoid relationships with unreliable partners, the existence of a relationship between a new venture and a prominent organization is a strong signal of the new venture's reliability. Furthermore, this signal is more likely to be noticed in the community at large if the new venture is associated to a prominent organization than if it is associated with a run-of-the-mill organization, because actions of prominent organizations draw more attention from the community. The new venture's partnership will draw attention to it and provide a

strong signal of its reliability, inciting third parties to give the new venture their patronage.

Burt (1998a) writes that legitimacy helps the firm in two ways. Firstly, stakeholders will be more inclined to believe that the firm understands their needs and objectives, and thus will be more able to meet those needs. Secondly, a firm which is regarded as legitimate within a population or group will have a reputation to keep. If it does not act according to the group's expectations, its valuable reputation will be tarnished. As the firm stands to lose in this perspective, stakeholders will find it easier to trust it.

2.2 Spin-offs

This thesis studies the inheritance of social capital the particular setting of corporate spin-offs. Having given an overview of the social capital literature in the preceding pages, we will now turn to the spin-off literature. Our overview will first focus on defining the spin-off phenomenon, as the term 'spin-off' is used in sometimes very different contexts. Second, we will cover the main antecedents of spin-off formation identified in the literature. Third, we will examine the development paths that are described in previous spin-off studies and lastly we will describe the economic advantages or disadvantages of spin-offs, both for the spin-offs themselves as well as for their mother companies.

2.2.1 Definition of spin-offs

There is some confusion in the literature surrounding the use of the term "spin-off" (Mustar, 2000; Parhankangas and Arenius, 2003). This term (and also sometimes "spin-out") is often used to describe phenomena which are not necessarily identical. Some studies apply this term to new ventures (for example Cooper, 1970, 1971; Roberts, 1991; Roberts and Wainer, 1968) whereas in other studies, the term is used to label corporate divestment of mature businesses, which we believe is a rather different phenomenon (e.g. Ito, 1995; Ito and Rose, 1998; Semadeni and Cannella, 2011; Woo et al., 1992). In this thesis, we are interested in the first kind of spin-offs.

Even within the context of new ventures, the term "spin-off" can designate different types of organizations. A look at the existing literature shows that the differences between definitions employed can be substantial. The following list illustrates commonly-found definitions.

- Garvin (1983, p.3): "New firms created by individuals breaking off from existing ones to create competing companies of their own."

- Sire (1988, p.2): "*L'essaimage consiste en la création ou la reprise d'une entreprise par un des salariés avec le soutien de son employeur.*" (Spinning-off consists in the creation or the buyout of a firm by an employee, with support from his employer.)

- Parhankangas and Kauranen (1996, p.6): "A spin-off firm is an independent firm the founder of which has left his previous job to start up a business of his own to exploit an idea deriving in some way from his previous employment."

- Sapienza et al. (2004, p.817): "[To be a technology-related spin-off firm, the firm has] to exploit technological competencies developed internally within the parent firm and to be active in industrial manufacturing or in technical services."

In the broadest sense, a phenomenon can be considered as a spin-off if it simultaneously fulfills the following criteria (Pirnay, Surlemont, and Nlemvo, 2003):

- Occurring within an existing organization, usually referred to as the "parent organization" (or in the case of corporate spin-offs, the "mother company")

- Involving one or several individuals, regardless of their status within the parent organization

- These individuals leaving the parent organization in order to create a new organization

Ndonzuau et al. (2002) and Pirnay et al. (2003) consider that key elements in defining spin-offs are the transfer of knowledge between the parent organization and the new organization. This knowledge can be either codified or tacit.

Codified knowledge is embodied in such items as publications, reports, computer programs or technical equipment. Because it relies on explicit and formalized information, it can easily be transferred independently of the human brain that produced it (Callon, 1999).

Tacit knowledge refers to personal knowledge accumulated by individuals in the course of their activities. This type of knowledge takes various forms, such as capabilities, expertise or experience. Because it is not formalized, it is much more difficult to transfer independently of the individual in which it is embodied (Blankenburg, 1998).

Several typologies of spin-offs exist in the literature. University spin-offs have been studied by several authors. Pirnay et al. (2003) examine the existing literature on university and research-based spin-offs and establish a classification based

on the following dimensions: (1) status of the founders within the university (researchers or students); (2) the nature of knowledge transferred from the university to the new venture (mostly codified technical knowledge, leading to product oriented spin-offs, or mostly tacit knowledge, leading to service-oriented spin-offs) and (3) university attitude towards entrepreneurship ("pull" spin-offs, when entrepreneurs are pulled out of their university by the promise of an attractive business opportunity, or "push" spin-offs, when the university plays an active role in encouraging the creation of the spin-off).

In the context of corporate spin-offs, Lindholm (1994) establishes a classification based on the transfer of ownership between the mother company and the new organization. *Divestment spin-offs* are those in which a formal transfer of majority ownership happens between the mother company and the spin-off, for example in the case of a management buyout of a former corporate division. *Entrepreneurial spin-offs* are those in which no formal ownership transfer happens, for example in the case when one or several individuals simply leave the mother company to found a new venture.

In synthesis, most definitions of new venture spin-offs (as opposed to corporate divestment of mature businesses) fall somewhere along the following dimensions: (1) Type of mother organization, be it a university or research institution, or a private company; (2) Status of the spin-off founders: students, researchers or professors in the case of university spin-offs, any employee or only senior management level employees in the case of corporate spin-offs; (3) Origin of the core business idea or technology: whether knowledge transfer has to occur between the mother company and the new organization for it to be considered a spin-off; (4) Mother organization attitude: whether it is necessary for the mother company or university to approve of the foundation or even have an ownership stake in the new organization for it to be considered a spin-off; (5) Founding mechanism: whether formal ownership transfer between the mother organization and the new organization is required to consider it a spin-off; (6) Area of activity of the new organization: whether it should be active in the same industry as the mother company to be considered a spin-off.

In this dissertation, we consider spin-offs from private corporations (1), that are either founded by any employees of the mother company who leave their former position (2) or are based on technology developed at the mother company (3). We do not require formal mother company support (4) or restrict our definition to any type of founding mechanism (5) or area of activity of the spin-off (6).

2.2.2 Antecedents of spin-off formation

Several authors write about what "triggers" the formation of spin-off firms, or in other words the events that cause employees to leave their current employer to start their own business.

A finding often referred to in the literature is that employees leave out of frustration with their employers. This is oftentimes about being unable to pursue an idea or innovation, or after having their requests to pursue a new market rejected by management (Garvin, 1983; Klepper and Sleeper, 2005). Frustration can also occur after a change in company management that leads to difference of opinion about the company's strategic direction (Brittain and Freeman, 1986).

Personal history also influences future spin-off founders' decision to start a spin-off. Founders of spin-offs are typically well educated and experienced employees of incumbent companies active in similar markets and with similar technologies (Cooper, 1984, 1986). Studying university spin-off formation, Krabel and Mueller (2009) find empirical evidence indicating that the entrepreneurial activity of university researchers depends heavily on their patenting activity, their personal entrepreneurial experience, and their personal opinion about the benefits of commercializing research, as well as close personal ties to industry.

Availability of resources to the embryonic spin-off is another important factor behind the decision to launch an independent venture. In the context of the spin-off of business units of incumbent companies, Parhankangas and Arenius (2003) link spin-off creation to the resource dependence theory, which states that organizations enter into resource exchange relationships in order to secure critical resources. Before the separation of the spin-off from its mother company, at a point when the future spin-off is still only a unit within the mother company, mutual dependence on each other's resources is a motivation for intra-firm resource sharing. However, the resource needs of the mother company and the future spin-off are susceptible to change over time. This can lead to a resource mismatch which makes the relationship less fruitful. As the mother company sees less interest in supplying resources to the future spin-off, this can trigger the actual separation of the spin-off, when its managers decide to circumvent the mother company's unwillingness to provide it with the necessary resources for its development by starting an independent company.

The availability of unserved or underserved niche markets is another antecedent of spin-off formation. Economic theory holds that entry by new competitors into an industry is a response to incumbents earning high profits. However, industry entry by spin-offs seems to be driven by different factors than than entry by *de novo* start-ups. For example, Brittain and Freeman (1986) do not find a link between the rate of spin-off entry in the semiconductor industry and the overall rate of entry, exit, or

market growth in semiconductors. Instead, Klepper and Sleeper (2005) theorize and find empirical support for the idea that spin-offs respond to other types of market developments, in particular the availability of unexploited niche markets, much more than the prospects for new entrants into the overall industry. López Iturriaga and Martín Cruz (2008) also find that the most common reason for spin-off creation is the appropriation of residual rents.

There is anecdotal evidence in the literature that spin-offs are more common in relatively new industries (Garvin, 1983). Garvin argues that this is due to a lesser degree of knowledge codification in younger industries, and therefore a relatively higher proportion of tacit knowledge, which is transferred through the movement of employees across organizations. This leads to a relatively higher degree of spin-off than in other industries. Also, Garvin argues, younger industries are still in a state of flux, in that industrial designs are less fixed than in more mature industries. This creates greater opportunities for new entrants to capture niche markets.

The disk drive and semiconductor industries have been comparatively well studied for spin-off formation in the literature (Agarwal et al., 2004; Brittain and Freeman, 1986; Franco and Filson, 2000). A common trend found in both industries is that companies that were early entrants, specialized, with superior technology and a wide product range have a higher rate of spin-off formation than other companies in the industry. This suggests that companies possessing superior knowledge are more likely to result in spin-offs, as knowledge can be more easily accumulated by potential spin-off founders in those companies. Also, firms with a greater technological orientation can sometimes be reluctant to commercialize all of their work, providing greater opportunities for spin-offs to capture (Klepper and Sleeper, 2005).

Several authors have looked at the geographic distribution of spin-offs. In the case of the laser industry, Klepper and Sleeper (2005) hypothesize and find support for the notion that spin-offs are more likely where there is a geographic concentration of laser producers. As spin-off founding teams can come from different companies, it is likely easier to assemble teams in such areas. Using data from the semiconductor and automotive industry, Klepper (2010) suggests that spin-off creation was one of the key forces in the formation of the Silicon Valley and Detroit industrial clusters. In both cases, an early entrant achieved exemplary performance (Fairchild Semiconductors in Silicon Valley, Olds Motor Works in Detroit) and spawned a large number of spin-off companies, which in turn went on to achieve strong performance and high levels of spin-off formation. As spin-offs did not venture far geographically, there was a build up of superior performance companies in each location. Dahl et al. (2003) describe a similar spin-off clustering process in the wireless telecommunications industry in Denmark (NorCOM).

2.2.3 Development paths of spin-offs

Parhankangas and Arenius (2003) establish a typology of corporate spin-off based on the evolution of the mother company-spin-off relationship along the spin-offs' development paths. Parhankangas and Arenius identify three distinct groups of corporate spin-offs: (1) spin-offs developing new technologies, (2) spin-offs serving new markets and (3) restructuring spin-offs. Companies in each of these groups differ in the intensity of resource sharing and knowledge transfer between the mother company and the spin-off, the timing of separation and the orientation of their subsequent product development.

Spin-offs developing new technologies are originate in the development of leading edge technologies which are new to the marketplace and which are only loosely or not at all related to the mother company's technologies. Often, the technology is so new that spin-offs actually develop scientific research assets still far from readiness for commercial exploitation. The spin-off founding team's original goal is in most cases to identify new business opportunities for the mother company, and therefore business ideas usually originate outside the mother company, with little resource sharing and technological competencies often originating in collaborations with universities. The triggering factor for spin-off formation in this category of spin-offs is usually a restructuring at the mother company, with the spin-off's project being abandoned due to the uncertainty about its commercial viability. Mother companies may take an equity stake in the new venture as an option in its development. If the spin-off is successful in broadening its capital base and bringing products to market, this success may attract the mother company's attention and spark an increase in collaboration and resource-sharing. In most cases, Parhankangas and Arenius report that spin-offs tended to integrate back into the mother company, by focusing their post-spin-off product development efforts to suit the mother company's needs and in some cases the mother company even reacquired the spin-off entirely.

Spin-offs serving new markets are largely based on the same technology as their mother companies, but cater to different markets by offering specialized product applications that match specific consumer needs. The spin-off founding team's is generally to support the mother company's core business by developing new applications that are not yet available in the market, thus giving it a competitive advantage, or to exploit the existing technology to the fullest extent possible. To this end, the future spin-off is generally granted access to the mother company's research facilities and engages in significant resource exchange with the mother company. The triggering factor for spin-off formation in this case is the increasing availability in the market of the type of applications developed by the spin-off, which makes it less critical for the mother company. As the mother company is

less willing to support to spin-off, the spin-off increasingly needs to broaden its customer base, be it by starting to sell to competitors of the mother company, or by developing new product applications catering to different market niches than those targeted by the mother company. Mother companies frequently take a partial ownership stake in the new ventures, out of desire to participate in its success or to attract other investors by sharing part of the risk. Contrary to the development path followed by the category of spin-offs described in the previous paragraph, those serving new markets do not usually integrate back into their mother companies. Instead, they usually engage in less and less resource exchange with their mother companies and completely branch out into serving different customer bases.

The last category of spin-offs identified by Parhankangas and Arenius are called restructuring spin-offs. These spin-off firms find their origin in the restructuring of former core business activities of their mother companies. As old and well established business units of their mother companies, these spin-offs typically rely on mature technologies and competencies which were once highly relevant to the core business of the mother company. However, as the mother company's line of activity evolved with time, these business units became progressively less relevant, with less and less interaction with the rest of the mother company until the point where the spin-off process was actually triggered. As mature ventures with steady cash flows, good profitability and stable procedures in place, these spin-offs exhibit a high level of autonomy from the start, so much so in fact that hardly anything changes for them after the spin-off in terms of resource sharing and interaction with the mother company, which remains low both before and after the separation.

The findings of Parhankangas and Arenius (2003) partly overlap with those of Autio (1997), who looks at the development paths followed by new technology based firms and university spin-offs, by differentiating their technological orientation. Autio establishes a classification based on their science-based or engineering-based orientation and finds that the way in which new technology-based firms embed themselves in their respective innovation systems varies as a result of this orientation.

Science-based firms offer products or services that are generally defined on the base of a natural phenomenon, and are rather generic in nature. Their business description gives the impression of a "push" technology transfer mode. Science-based firms are conceptually close to the first category of spin-offs identified by Parhankangas and Arenius (2003), in that they develop new technology, often still at very early and generic stages of development. Similarly to Parhankangas and Arenius, Autio finds that science-based firms are more prone to maintain active collaboration and resource exchange with academic mother organizations. Also, looking at the companies' external linkages, Autio finds that science-based firms tend to have a strong links to their customers' development functions, for example

often acting as external R&D providers.

Engineering-based firms on the other hand offer products and services which are more specific in nature, defined in terms of customer needs and location, and generally have a business description which gives the impression of a "pull" technology transfer mode. These firms are conceptually close to the second category of spin-offs identified by Parhankangas and Arenius (2003), in that they focus on application and refinement of existing technologies. Engineering-based firms have lower interaction with their mother organizations, and are more strongly focused on external customers, often linked to their customers' replication-intensive functions, for example seeking to increase their productivity through refinements of basic technologies.

Whatever their technological orientation, Autio (1997) suggests that new, technology based firms can be seen as unique bundles of technological resources within their innovation systems. Their goal is not necessarily to achieve organic growth, but instead to maintain technological leadership. An illustration of this can be seen in the development path of the first category of spin-offs described by Parhankangas and Arenius (2003), which forego potentially broader customer bases for the comfort of integrating back into their mother companies and the guarantee of being able to develop their technology. This suggestion is in line with the finding by Roberts and Hauptman (1986) that technological sophistication of a spin-off's products does not necessarily result in high economic performance.

2.2.4 Economic benefits of spin-offs

There is a growing body of evidence in the literature that spin-offs tend to have better performance and lower failure rates than *de novo* start-ups (Tubke et al., 2004). Furthermore, there is evidence that the performance level of mother companies has a positive effect on the performance of their spin-offs. This evidence indicates that spin-off firms put into practice knowledge and routines inherited from mother companies (Agarwal et al., 2004; Cantner et al., 2006; Dahl et al., 2003; Klepper, 2002; Wenting, 2008).

Spin-offs exploit knowledge their founders acquire during the course of their employment at the mother company (Klepper and Sleeper, 2005). The knowledge that spin-offs inherit through their founders is often of a tacit nature, and therefore difficult to imitate by competitors (Teece et al., 1997). Knowledge transferred through the spin-off founders during the creation of the spin-off is a key contributor to the spin-off's technological sophistication (Roberts and Hauptman, 1986). This knowledge allows spin-offs to overcome part of the liability of newness that start-ups are faced with in their initial stages (Stinchcombe, 1965). Even if the transfer of knowledge from the mother company to the spin-off is imperfect, the

spin-off still has an advantage over *de novo* start-ups of some initial experience of how to operate in its industry (Klepper, 2001). Freeser and Willard (1990) point out that previously acquired knowledge is particularly important in high tech fields, because the rate of technological change is presumably too quick for would-be entrepreneurs to learn the skills before entering the industry, and they must therefore possess them *a priori*. This knowledge is largely acquired by entrepreneurs in the course of their employment at mother companies, and there is evidence that spin-offs pursuing business models that are related to that of their mother companies' in terms of technology and target market have higher survival rates than unrelated spin-offs (Cooper and Bruno, 1977). By exploiting the knowledge thus inherited from its mother company, a spin-off is capable of producing more efficiently than *de novo* start-ups. This allows spin-offs to capture opportunities in niche markets that would be too small to be profitably exploited by either *de novo* start-ups or by larger incumbent firms with higher cost bases. The relationship between inherited knowledge and performance is not straightforward, however. Sapienza et al. (2004) find that partial knowledge overlap between the mother company and its spin-off leads to stronger spin-off growth, whereas too little or too high knowledge overlap leads to less growth.

While several authors have studied the utilization by spin-off firms of knowledge and resources acquired from their mother companies, the links of the spin-off literature with the research on social capital have received less attention so far. Sedaitis (1998) compares the formation of alliances by newly-formed spin-offs and *de novo* start-ups in the context of the creation of commodity exchanges in the early years of post-Soviet market reform. The exchanges described by Sedaitis are either founded by former employees of State-run distribution organizations, in which case they are considered as spin-offs, or by entrepreneurs from different backgrounds seeking to exploit the opportunity created by market liberalization, in which case the new ventures are labeled as *de novo* start-ups. Sedaitis firstly compares the founding teams of spin-offs and *de novo* start-ups, finding that spin-off founders have greater homogeneity in their professional and educational backgrounds, as they predominantly come from the same or related former State-run organizations in the distribution industry. Founders of *de novo* start-ups have a more mixed background, both in terms of former employment and in terms of education. Sedaitis argues that spinoff founders' greater homogeneity leads to shared codes of behaviors, professional practices and norms. The normative isomorphism that follows from this common background leads to a shared vision and vocabulary about how the new business should be run, resulting in spin-offs having a smooth and orderly founding process, with clear hierarchy and delegation of responsibilities. By contrast, *de novo* start-ups experienced often chaotic and conflictual founding processes, with founding teams that did not know each other well, leading to difficul-

ties in the emergence of a shared vision and organizational routines. Aside from greater internal network density (i.e. most founders generally knew each other for several years), spin-off teams also had greater external network homogeneity, a consequence of the strong tie mechanism (Granovetter, 1973). Spin-off founders also had strong ties to a number of key players in relevant positions in the industry, from their previous employment. For the spin-offs, this meant that their founders' social capital was immediately relevant and could very quickly be leveraged to obtain necessary resources to begin the operation. Spin-off founders' experience and reputation in the industry also meant that spin-offs were in a good position to attract the best potential members to their newly-founded exchanges. In social capital terms, spin-offs benefited from their strong network of inter-firm ties and were able to draw on resources, information and trust of potential partners (Granovetter, 1985; Uzzi, 1996). But this network configuration, Sedaitis writes, proved to be a double-edged sword. Whereas spin-offs generally experienced an easier founding process and initial resource and patronage acquisition, *de novo* start-ups achieved greater performance a few years into operation, with greater diversity of exchange membership and traded goods, and a greater overall volume of exchange transactions. Sedaitis suggests two reasons for this. First, that *de novo* start-ups had greater network heterogeneity, which may have been a disadvantage in the initial resource acquisition phase, but which had the advantage of less network tie redundancy and therefore access to a greater variety of potential partners; in other words, higher probability of structural holes (Burt, 2000a). Second, that because of their lack of embeddedness in the 'old system', *de novo* start-ups had greater appeal to potential partners who precisely wanted greater flexibility and to break away from the old State-run structures. The historical and political context in which Sedaitis's spin-offs operated is quite unique, and therefore we believe that the findings on the relative performance of spin-offs and *de novo* start-ups cannot be necessarily generalized. However, Sedaitis brings evidence showing that new ventures' lineage has an impact on their initial network configuration, which in turn affects their access to resources, initial client base and eventual performance. Spin-offs' social capital appears to be more immediately relevant and usable to their industry, which the potential drawback of excessive network homogeneity which could lead to spin-offs isolating themselves from contacts outside their initial network.

We have concentrated so far on the economic benefits accruing to spin-offs. We could imagine that these economic benefits would translate into disadvantages for the mother companies. Indeed, spin-offs are sometimes characterized as profiting from the efforts and research of their mother companies (Anton and Yao, 1995). Some employers go to great lengths to discourage the formation of spin-offs by their employees (Jackson, 1998, pp. 211-238). Perhaps counterintuitively, McKendrick et al. (2009) find that spin-off formation not only does not hurt mother companies

in the long term, but that in fact mother companies of technologically sophisticated and successful spin-offs tend to outperform companies that had no spin-offs. McKendrick et al. do find some evidence supporting the conventional wisdom that the loss of key staff and subsequent disruption in routines can hurt mother companies in the short term. However, they suggest that spin-offs can trigger a technological realignment for the mother company, helping it avoid obsolescence. Furthermore, they find that a successful spin-off has a positive effect on the mother company's reputation in the labor market as an entrepreneurial and desirable employer. Spin-offs typically do not pose a serious competitive threat to their own mother companies. Although they frequently service narrow niches that overlap with their mother companies' markets, they are generally too small to pose a serious threat and tend to diversify over time into other markets. Also, spin-offs tend to pursue technological opportunities that their mother companies would have been able to pursue, but chose not to. In so doing, spin-offs can have a positive effect on their industry's diversity and rate of technological change (Klepper and Sleeper, 2005). Moreover, by diffusing part of the mother company's technology, spin-offs can contribute to the adoption of the mother company's technological standards by the wider industry and to shaping to technological paradigm in ways that if exploited correctly can eventually lead to the generation of longer term rents for the mother company (Boisot, 1995; Debackere et al., 1994).

3 MODEL

In this chapter we present the theoretical propositions that will be tested in the empirical part of the dissertation. We present first an overview of the theoretical model, then discuss the individual hypotheses in detail.

3.1 Model

In this dissertation, we develop a model, the core of which is formed by inheritance of social capital and resource co-optation.

We argue that spin-offs inherit social capital, both of the structural and of the relational sort and that inherited social capital increases resource co-optation by the spin-off from its network. In the operationalizations sections in the following chapter, we will distinguish between two dimensions of resource co-optation: quantity of resources co-opted and "cheapness" of the resources co-opted.

Social capital inheritance by the spin-off is predicted to be driven by the following variables:

- Mother company support to the spin-off
- Relatedness between the spin-off's and the mother company's activities
- Number of years spin-off founders worked at the mother company
- Ownership stake held by the mother company in the spin-off

In addition, due to the availability of the social capital inheritance mechanism, we argue that corporate spin-offs will rely less on their founders' experiences to derive their firm-level social capital than *de novo* start-ups, which do not have access to firm-level social capital inheritance.

The support offered by the mother company to the spin-off is predicted to be positively influenced by the degree of relatedness between its activities and those of the spin-off.

We predict that spin-offs do not only co-opt resources from the network at large, but that the mother company can serve as an important provider of co-opted resources. The amount of resource co-optation that occurs from the mother company will be driven by the mother company's attitude (or support) towards the spin-off.

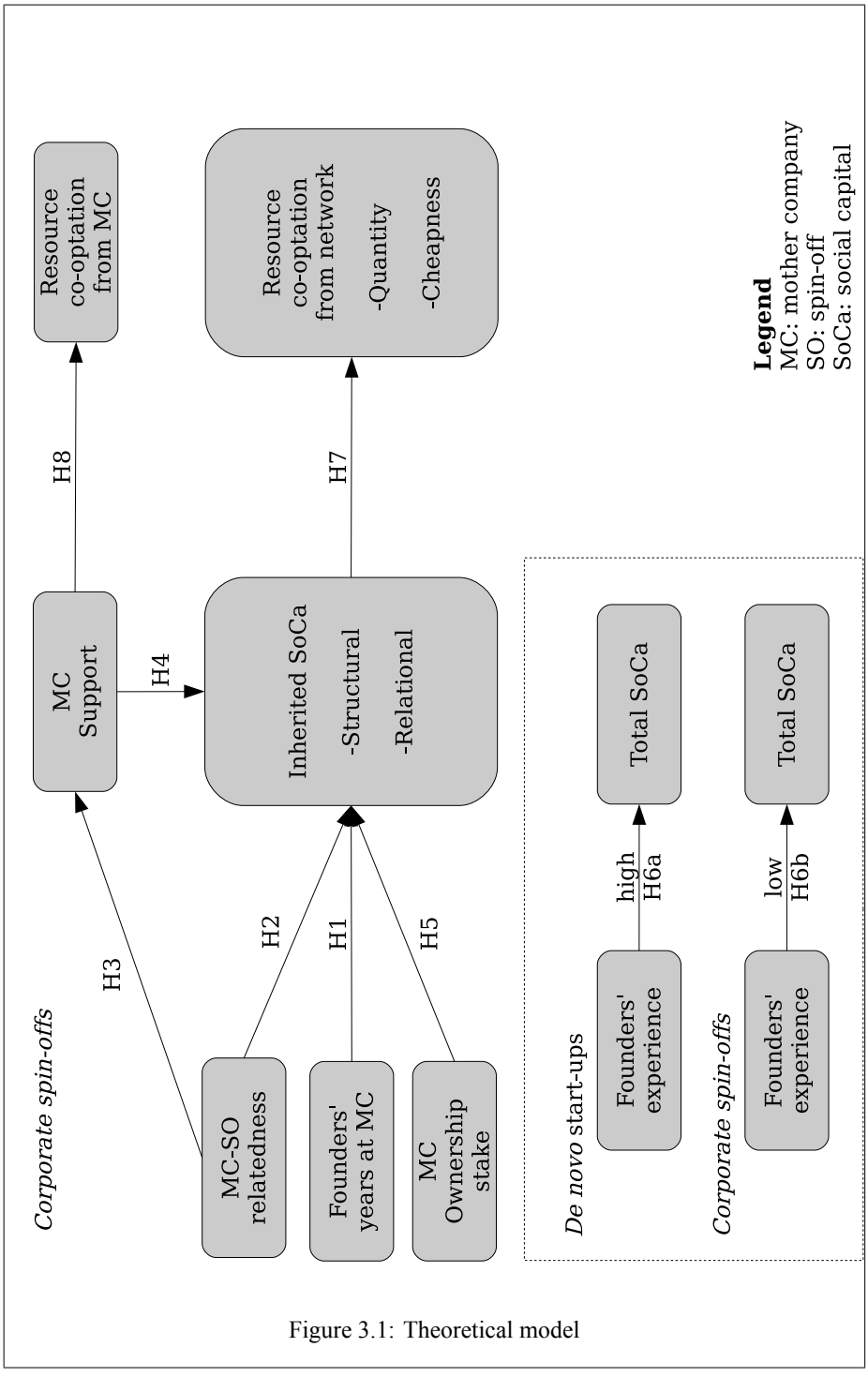

Figure 3.1: Theoretical model

Figure 3.1 depicts Hypotheses H1 through H8, which we will be testing in the second part of this dissertation. Arrows linking two boxes indicate a positive causal relation. Hypotheses 6a and 6b are depicted separately, as they involve testing not only corporate spin-offs but also *de novo* start-ups.

3.2 Hypotheses

In this section we spell out and justify the main hypotheses of our model. Our hypotheses are grouped in two sets, corresponding to our initial research questions: the drivers of the inheritance of social capital and the impact of social capital inheritance on resource acquisition.

3.2.1 Inheritance of social capital

Studies on spin-offs make up a small, but growing, stream of literature. Some authors have studied the process of spin-off creation and environmental factors that affect spin-off creation and success (Clarysse et al., 2001; Heirman and Clarysse, 2004; Ndonzuau et al., 2002). Others have focused on resource transfers and resource sharing between parent company and spin-off (Aldrich and Pfeffer, 1976; Parhankangas, 2001).

In the latter stream of research, the emphasis has generally been placed on the transfer of knowledge and experience between parent company and spin-off. The main mechanism of transfer identified is the migration of staff from parent company to spin-off.

There has long been some evidence that previous experience of company founders matters and that company know-how may originate in older companies (Stinchcombe, 1965). Spin-off founders act as a vehicle through which resources and routines are inherited by spin-offs (Almeida and Kogut, 1999). Personnel transfers allow spin-offs to capitalize on knowledge and discoveries made when founders were employed by the parent company (Bhide, 2000). Agarwal, Echambadi, Franco, and Sarkar (2004) have argued that when a spin-off is generated, it inherits knowledge from its mother company, and in particular technological and market pioneering know-how. Klepper and Sleeper (2005) note that knowledge inherited by spin-offs from parent companies has a strong imprinting effect on the nature of the spin-offs.

Knowledge is more likely to be embodied in human than physical capital. Because knowledge is appropriable, it is easily transferred between parent companies and spin-offs through their founders (Klepper and Sleeper, 2005).

We argue that inter-organizational inheritance is not limited to knowledge. Organizational norms and values, for example, may be transferred from one organization to another. Dimaggio and Powell (1983), for example, showed that inter-hiring of

employees between firms reinforces normative organizational isomorphism. Similarly, social capital may also be appropriated by individuals and used for other purposes and in other contexts than those for which it was created (Adler and Kwon, 2002; Coleman, 1988; Putnam, 1995).

When spin-off founders leave the parent company, they naturally do not forget the network of contacts they had created during the course of their previous employment. On the contrary, those contacts are likely to form a substantial part of the contacts that the founders bring into the new company. Entrepreneurs have been shown to rely heavily on their informal networks of contacts (Birley, 1985; Tjosvold and Weicker, 1993) and it is reasonable to assume that that spin-off founders will not be any different in this regard. This individual-level social capital that is transferred through the founders will serve as a major source of firm-level social capital for the newly-founded spin-off. Consequently, the more spin-off founders originate from the parent company, the higher the overlap between the spin-off's initial social capital and the parent company's social capital.

Individual-level social capital is created and accumulated over time. It takes time and repeated interactions for networks of contacts to be established and for mutual trust to emerge. Spin-off founders that have spent a long time at the parent company will have accumulated more social capital there and will take more social capital with them into the spin-off.

This leads us to formulate our first hypothesis as follows:

Hypothesis 1: The more personnel is transferred between the mother company and the spin-off at the time of the spin-off's founding, and the longer this personnel has worked at the mother company, the higher the inheritance of firm-level social capital by the spin-off from its mother company.

Another important element that will determine the amount of social capital that can be inherited by the spin-off is the relatedness between its activities and those of the mother company.

As discussed in the previous chapter, social capital is rigid (Coleman, 1988). It is difficult and costly to pull out of established social ties (Gargiulo and Benassi, 1999). On the other hand, creating new network ties is a costly and risky undertaking. The perceived cost of abandoning existing ties increases if those ties have been very productive in the past. Furthermore, actors are affected by relational inertia. When they are used to working with long-term partners, the strength of their bonds acts as a cognitive filter for the information and perspectives they receive, effectively locking them out from the outer world (Grabher, 1993). When a spin-off is created in a related line of business to that of its mother company, the perceived advantages of relying on the existing network of contacts will outweigh any poten-

tial benefits of abandoning these ties in favor of new ones. Consequently, the more related the line of business of the spin-off is with the mother company's, the more the spin-off will tend to rely on the network ties established by its founders during their previous employment. On the contrary, if the spin-off is engaged in an entirely unrelated field, the perceived cost of allowing previous network ties to weaken will be lower and the spin-off will rely less heavily on the inherited contacts.

The notion of relatedness is akin to that of absorptive capacity. Relatedness between two organizations facilitates knowledge transfer, because it implies common prior knowledge (Cohen and Levinthal, 1990). Acquiring knowledge in a familiar area is significantly easier than acquiring knowledge in an area that is entirely unknown. For this reason, linkages where common knowledge exists can be used more efficiently to exchange knowledge and resources, making them more attractive to establish and maintain. Higher relatedness also increases the likelihood of common interests for both organizations to engage in mutually benefitting exchanges, and a common language to facilitate such exchanges (Inkpen, 1998). Therefore, the higher the relatedness between the spin-off and the mother company, the more efficiently it will be able to leverage the mother company's existing network. Also, the higher the relatedness, the more likely the spin-off will be to have common interests with the network actors and the more likely it will be to share a common language to engage in relationships of its own with the same actors as the mother company.

As discussed earlier, institutional theories also provide insight on the way relatedness acts to increase social capital inheritance. Companies which engage in related lines of business are affected by similar environmental pressures. They consequently tend to adopt similar organizational forms, a process known as coercive isomorphism. Dimaggio and Powell (1983) write that organizational isomorphism offers the benefit that organizations enjoy greater legitimacy, because they are seen as conforming to socially-endorsed patterns. This leads us to argue that a spin-off in a related area of business will tend to inherit relational (and cognitive) social capital, as it is perceived as more legitimate by the rest of the network for being more "similar" to the mother company.

For the reasons cited above, we formulate our second hypothesis as follows:

Hypothesis 2: The higher the relatedness between the mother company's activities and the spin-off's activities, the higher the inheritance of social capital by the spin-off from its mother company.

So far, we have implicitly assumed that the process of social capital inheritance happened independently of the mother company's actions. We now lift this assumption and consider the impact that the mother company's attitude towards the new spin-off may have on the spin-off's social capital inheritance.

We turn firstly to the factors influencing the degree of support that the mother company offers its spin-off.

It is unlikely that the degree of support that a mother company is willing or able to provide the spin-off is the same regardless of the industry in which the spin-off is created. We argue on the contrary that the strength of the tie between the mother company and its spin-off will be positively influenced by the relatedness of the two companies' activities.

A degree of overlap between the spin-off's and the mother company's knowledge bases improves the likelihood of knowledge and resource exchange between both firms (Sapienza et al., 2004). Consequently, a spin-off created in an entirely unrelated industry would receive less support from its mother company than a spin-off created in an industry closer to the mother company's. Furthermore, a spin-off in a related line of business will be affected by organizational isomorphism and thus enjoy greater legitimacy and mutual understanding with its mother company (Dimaggio and Powell, 1983).

This leads us to formulate our next hypothesis:

Hypothesis 3: The higher the relatedness between the mother company's activities and the spin-off's activities, the higher the degree of support the mother company can offer the spin-off.

As discussed earlier, Granovetter (1973) writes that actors linked by strong ties will share a higher number of network connections than actors linked by weak ties. The stronger the tie between these actors, the lower the probability that a structural hole will exist between them (Burt, 1995), or in other words, the higher the network closure. Coleman (1988) writes that network closure encourages the emergence of social capital, in the form of reputations, and the development of enforceable community norms which guarantee the trustworthiness of social structures. The emergence of these norms and the necessity to develop and preserve reputations act as a strong incentive for actors to engage in acceptable and predictable behavior. This in turn creates a climate of trustworthiness and facilitates cooperation, resource exchange and risk-taking within the network (Walker et al., 1997). Consequently, a stronger tie between the mother company and the spin-off will provide the spin-off with higher relational social capital towards the rest of the network.

As an incumbent, the mother company is a well-established actor in its network. Arenius (2002) writes that newly-created organizations can benefit from a founding organization's social capital if it is highly associated with the founding organization, or in other words if it is highly connected to it in people's minds. As discussed in the previous chapter, new entrants' perceived association with respected incumbents allows them to capitalize on the incumbents' legitimacy (Stuart et al., 1999). If an

incumbent establishes a relationship with a new entrant, it signals to other actors in the network that it considers the new entrant trustworthy and reliable enough to risk its reputation and its time in that relationship. The signal is even stronger if the mother company actively supports or endorses the spin-off's operation with its own contacts or if it "introduces" the spin-off to other actors on the network. Similarly, a financial investment in the spin-off by the mother company will reinforce the spin-off's credibility towards potential partners, as well as ensuring a longer-term commitment of support from the mother company towards its spin-off. As a result, a degree of support from the mother company which is "publicized" towards the network, for example by an equity stake, will provide the corporate spin-off with increased social capital.

For these reasons, we argue that the strength of the tie linking the mother company to its spin-off has a positive impact on its inheritance of social capital and we formulate our next two hypotheses as follows:

Hypothesis 4: The higher the degree of support offered the spin-off by the mother company, the higher the inheritance of social capital by the spin-off from the mother company.

Hypothesis 5: The higher the ownership stake held by the mother company in the spin-off, the higher the inheritance of social capital by the spin-off from its mother company.

Two metaphors play a central role in this dissertation: *social capital*, or in other words applying the term "capital" to a social construct, and *inheritance* of social capital, which is a term rooted in life sciences.

The metaphor of *social capital* was discussed extensively in the first part of the thesis, as well as the similitudes and differences between social capital and what is normally considered "capital". Coleman (1988) writes that social capital, like other forms of capital, is a long-lived productive asset, which can be developed through investment. Social capital, at least to some extent, is "constructible" through deliberate actions (Evans, 1996). Like other forms of capital, social capital can yield disutilities or benefits for the focal actor and for others (Adler and Kwon, 2002; Gargiulo and Benassi, 1999). Social capital is also "convertible" (Bourdieu, 1985). It can be converted into other kinds of capital, procuring economic or other advantage, albeit to a lesser degree than economic capital, which is the most liquid and convertible form of capital identified by Bourdieu. Like other forms of capital, social capital can compensate the lack of resources or augment available resources' efficiency, for example by reducing transaction costs (Lazerson, 1995). Social capital, like human or physical capital, but unlike financial capital, requires periodic

maintenance to preserve its value. Unlike physical and human capital, however, social capital does not have a definite rate of depreciation.

An important difference that sets social capital apart form many other forms of capital is that it does not diminish with use, but like human capital or knowledge tends to grow and develop when employed (Adler and Kwon, 2002). Further, social capital is not the exclusive property of those who benefit from it and has therefore a "public good" component (Coleman, 1988). Social capital can be used non-rivalrously. In other words, one actor's use of social capital does not diminish its availability for others. This is especially true when adopting an internal perspective of social capital, that is when we consider the social capital of an entire network (Adler and Kwon, 2002).

The metaphor of social capital *inheritance* is grounded in these last two characteristics of social capital. Because social capital has a "public good" component and because it does not diminish with use, unlike economic capital it can be shared by two or more agents without being diminished. In this sense, social capital is very much comparable to knowledge, which is often described in the literature as "sticky" (von Hippel, 2005). Indeed, the concept of "knowledge inheritance" is discussed in the literature on the knowledge-based view of the firm, and in particular by Agarwal et al. (2004). This metaphor of inheritance emanates originally from the field of biological evolution and covers similar meaning to that which is ascribed to it in that field. Biological evolution metaphors have been used in the past in the literature to analyze organizations (Aldrich and Martinez, 2001), industrial competitive structure (Nelson, 1995) and business strategy (Barnett and Burgelman, 1996). The metaphor has been expanded further into the study of spin-offs, where Klepper and Sleeper (2005, p.1291) describe inheritance of knowledge as the "*industrial counterpart to genes*".

But what is the distinction between inheritance and transfer of social capital? This discussion ties into the broader topic of the sources of social capital. As we mentioned in the previous chapter, there is previous theoretical and empirical coverage of new firms deriving firm-level social capital from their founders' individual-level social capital (see also Arenius (2002) for a discussion).'Inheritance' is semantically close to 'transfer'. However, in this dissertation we wish to make a distinction between both terms, to emphasize the fact that we are studying a transfer relation that is particular in three ways.

Firstly, this transfer occurs in a very specific dyad of companies: that of a mother company and its spin-off, not a randomly-chosen *de novo* start-up which has no identifiable heritage from another firm at the time of its founding. The theoretical consequences of this particular "mother-daughter company" setting, or more generally speaking of spin-off formation, is still a very new topic in management research (Klepper, 2001) and this thesis seeks to contribute theoretical and empirical

developments to this research stream.

Secondly, the transfer that is studied in this dissertation is, as pointed out above, non-destructive. The mother company does not have to 'lose' social capital for the spin-off to inherit it.

Thirdly, and most importantly, we are analyzing here the inheritance process as more than the mere transfer of founders from mother company to spin-off. Founders have been theorized and shown to be important agents of resource and knowledge transfer between firms and social capital literature has also theorized individual-level social capital as a source of firm-level social capital (Arenius, 2002; Colombo and Grilli, 2005; Davidsson and Honig, 2003; Jack and Anderson, 2002; Shane and Khurana, 2003; Witt, 2004). More generally, founders have been the focus of a substantial stream of research in entrepreneurship literature (Barringer et al., 2005; Colombo and Grilli, 2005; Shane and Khurana, 2003, for example). However, we also argue that looking at founders' career paths from one firm to the next only gives us the individual-level part of the social capital inheritance process. The study of firm-level social capital requires a firm-level focus.

In keeping with this view, we argue in this dissertation that social capital inheritance has individual-level and firm-level components. Corporate spin-offs, which have a well-defined connection to a mother company at the time of their founding, are in a position to inherit firm-level social capital from their mother company. As we have hypothesized above, this inheritance will be furthered or hindered by a number of firm-level antecedents (relatedness, mother company support, mother company ownership). On the other hand, if we consider *de novo* start-ups, which do not have a relation to a mother company at the time of founding, these would not have the option of inheriting firm-level social capital. This is not to say that *de novo* start-ups are created without any social capital. *De novo* start-ups will rely heavily on the individual-level social capital brought in by their founders to derive their firm-level social capital. Our first hypothesis states that the same process will take place in corporate spin-offs. However, this individual-level social capital will not be the only source available to spin-off, because spin-offs do have a mother company to inherit firm-level social capital from. Consequently, we hypothesize that individual-level social capital will be a less important source of social capital to corporate spin-offs than to *de novo* start-ups.

Ideally, we would like to measure not only the firm-level social capital of the firms in our sample, but also the individual-level social capital of their respective founders to test this hypothesis. However, the probability of receiving a complete set of responses from a sufficiently large number of firms is so low that we must instead look for a more readily measurable proxy. Founder experience is one such proxy, which apart from offering the advantage of relatively straightforward measurement, is well understood in the literature to be a strong driver of individual-

level social capital (Coleman, 1988; Simard and West, 2003; Stinchcombe, 1965). Industry-specific experience, in particular, is an important antecedent to individuals' social capital formation (Bourdieu, 1985; Eisenhardt and Schoonhoven, 1996; Patzelt et al., 2007), but we choose not to limit ourselves to this type of experience only.

Our next hypothesis will be formulated in two parts:

Hypothesis 6a: The higher the experience of their founders, the higher the firm-level social capital of *de novo* start-ups.

Hypothesis 6b: Founder experience will have less positive impact on firm-level social capital of corporate spin-offs than for *de novo* start-ups.

3.2.2 Resource co-optation

We now turn to the our hypotheses on the effect of social capital inheritance on firm resource co-optation.

As discussed in the previous chapter, social capital allows companies to procure more resources and at better conditions than would normally be available to them. Through social capital, network partners become more willing to share knowledge, private information and resources. In the previous literature review, we mentioned several examples of how social capital enables firms to acquire resources. Coleman (1988) described how social ties which are maintained for other purposes can provide valuable social capital by enabling inexpensive access to information. At the firm level, there is evidence that firms that embed their commercial transactions with their banks in social attachments are able to obtain lower interest rates on their loans (Uzzi, 1999). Walker, Kogut, and Shan (1997) find that firms that have abundant social capital at their disposal are able to leverage more resources. Starr and MacMillan (1990) describe four strategies which allow companies to tap into underutilized resources of network contacts using their social capital: (1) borrowing, (2) begging, (3) scavenging and (4) amplifying.

As we have seen, the notion of access to resources is implicit in several definitions of social capital. For example:

- Bourdieu (1985, p.248): "the aggregate of the actual or potential resources which are linked to possession of a durable network of more or less institutionalized relationships of mutual acquaintance or recognition."

- Nahapiet and Ghoshal (1998, p.243): "the sum of the actual and potential resources embedded within, available through, and derived from the network of relationships possessed by an individual or social unit."

- Burt (1995, p.12): "Social capital is at once the resources contacts hold and the structure of contacts in a network."

Tsai and Ghoshal (1998) and Yli-Renko, Autio, and Sapienza (2001) also describe how firms can increase their resource acquisition by harnessing external social capital. As an example of this process, Yli-Renko et al. (2000) found that increased external social capital of an organization positively affected the organization's resource accumulation. In particular, the authors found that new technology-based firms with higher external social capital (measured as contacts of management) showed increased organizational knowledge.

Social capital inheritance provides a stock of social capital that can be leveraged in the spin-off's early resource acquisition process. The more contacts the spin-off has ties to and enjoys some legitimacy with, the larger the pool of resources that will be available to it and the higher the chance that some of those resources may be acquired at favorable conditions. In that sense, social capital inheritance counteracts the spin-off's liability of newness.

This leads us to formulate our following hypothesis as follows:

Hypothesis 7: The higher the social capital inherited by the spin-off, the higher the resource co-optation from the network.

Another factor that can help the spin-off overcome its initial resource constraints is the mother company's direct intervention. Depending on the mother company's attitude and support towards the spin-off, it is ideally placed to provide resources at favorable conditions. This can take numerous forms, such as for example access to production facilities or laboratories, partial financing of prototypes, allowing in-house experts to advise the spin-off or allowing the founders to remain employed at the mother company in its very early stages. Consequently, we formulate our next hypothesis as follows:

Hypothesis 8: The higher the degree of support offered the spin-off by the mother company, the higher the resource co-optation from the mother company.

Part II

EMPIRICS

4 METHOD

The present chapter contains a discussion of the methodological aspects of the empirical phase of this dissertation. We will first discuss the operationalizations of the key variables in the model. Then we will describe the procedure used for identifying a study sample, the data collection instrument and the implementation details of the study. Third, we will describe the statistical methods that will be used to analyze the collected data. Fourth we will provide an overview of the dataset using descriptive statistics. Fifth, we will assess the validity of measurements. Sixth, we will conduct bias tests to assess whether our data suffers from any significant biases due to the data collection method. Finally, we will test the assumptions underlying the statistical methods that we use.

4.1 Operationalizations

In the following paragraphs, we will describe the operationalizations used to measure the theoretical constructs of our model. For each construct, we will first give the theoretical references for each operationalization, followed by the questionnaire items and lastly by the definition of the aggregate indicator that will be used in the hypothesis testing phase.

4.1.1 Corporate spin-offs

In the context of our study, we analyze high technology spin-offs. For this reason, we consider that knowledge transfer between the mother company and the spin-off to be an important component of the spin-off phenomenon. In order to capture both codified and tacit knowledge transfer, while at the same time seeking to ensure a sufficiently broad panel of cases, we choose to define spin-off firms as companies that were created by the transfer of people from an incumbent firm and/or the transfer of a technological innovation from an incumbent firm.

We do not require that the incumbent firm be supportive or aware of the spin-off firm, as this would leave out any hostile or competitive spin-offs. Indeed, this is a dimension we want to measure in our model as part of the relation to the mother company. This dimension also captures to a large extent the distinction made by some authors between “pull” and “push” entrepreneurship, or in other words whether the spin-off is being created as a response to an opportunity, or rather as a

convenient way for the mother company to downsize part of its activities (Pirnay, 2001, p.13).

We do require that spin-offs are independent from the mother company in their strategic decision-making (McGrath, 2001), regardless of the degree of ownership held by the mother company in the spin-off. The degrees of strategic independence and of ownership will both be measured.

In our survey questionnaire, the two following filter questions were included to identify corporate (and university) spin-offs from other start-ups:

- "Was your firm founded by employees of an existing company or university that left their jobs to join this new firm?"
- "Was your firm founded to commercialize a technology, innovation or concept (*e.g. a patent, prototype, software...*) that was developed within an existing company or university?"

4.1.2 Inherited social capital

As discussed in the previous chapter, in this dissertation we focus on the structural and relational dimensions of social capital. We leave aside the cognitive dimension, as it is mostly applicable to an internal perspective of social capital.

Inherited structural social capital: The structural dimension of social capital was operationalized as the extensity of network ties (Lin et al., 2001). We measured the amount of network ties regularly utilized by the focal firm as well as the strength of those ties. Inheritance was operationalized as the proportion of network contacts that had been established while the spin-off founders were working for the mother company.

In order to measure the extensity of network ties, we used a "resource generator" instrument, based on Lin et al. (2001). Respondents were asked how many firms they knew that could provide them with 10 strategic resources. They were then asked how many of those firms they had a strong tie with. Finally, they were asked with how many of those firms the tie had been established at the time the respondents were working at the mother company, or in other words how many contacts had been inherited. The resource generator thus yields three measures, for each of the 10 resources in our questionnaire: (1) Overall extensity of network (weak and strong ties combined), (2) Number of strong ties and (3) Proportion of inherited ties. The latter is the measure of inherited structural social capital, while the first two provide a measure of total structural social capital for comparison.

The aggregate indicator of inherited structural social capital, labeled *RESGENIN* (for "resource generator - inherited contacts"), is defined as the sum of the number

of inherited contacts capable of providing each of the 10 strategic resources cited above.

$$RESGENIN = \sum_i (H_i) \; ; \; i = 3, 6, 9, 12, 15, 18, 21, 24, 27, 30 \tag{4.1}$$

We calculate an indicator of total structural social capital, labeled $RESGENSU$, in a similar way, this time adding the total number of contacts capable of providing each of the 10 strategic resources.

$$RESGENSU = \sum_i (H_i) \; ; \; i = 1, 4, 7, 10, 13, 16, 19, 22, 25, 28 \tag{4.2}$$

Inherited relational social capital: The relational dimension of social capital will be operationalized as the pragmatic and moral legitimacy derived by the spin-off from its affiliation with the mother company. The measurement items are based on Stuart et al. (1999), Suchman (1995) and Aldrich and Fiol (1993) and use a 7-point Likert scale:

"Our relationship to our parent company was beneficial when:"

- "…negotiating with potential investors" (I_1)
- "…negotiating with potential customers" (I_2)
- "…gaining access to expertise from outside the firm" (I_3)
- "…becoming eligible for subsidizing" (I_4)
- "…dealing with key stakeholders: it helped our proposals to be seen in a more positive light" (I_5)
- "…dealing with key stakeholders: it helped our proposals to be taken more seriously" (I_6)

The aggregate indicator for relational social capital, labeled $INHLEGIT$ ("inherited legitimacy"), is defined as the mean of all the above items:

$$INHLEGIT = \frac{\sum_{i=1}^{n} (I_i)}{n} \; ; \; n = 6 \tag{4.3}$$

4.1.3 Founder experience

As discussed in the previous chapter, founder experience is a proxy in our model for individual-level social capital. We measure total experience of the corporate spin-offs and *de novo* start-ups top management team. Founder experience is measured along three dimensions:

- Total years of experience in the industry of their new firm (T_1)
- Total years of experience in other industries (T_2)
- Total years of academic education (T_3)

We asked respondents to indicate the total number of years of experience of the firm founders along each of these three dimensions.

4.1.4 Resource co-optation

Resource co-optation is defined as obtaining resources below market price through the use of social mechanisms (Starr and MacMillan, 1990). We measured two dimensions of this construct: (1) quantity: a significant amount of a resource was obtained through the network of contacts and (2) "cheapness" of the resource acquisition (i.e. to what extent the resource was obtained below market price). The list of resources that were measured was based on the lists of resources presented in Barney (1991), Wernerfelt (1984) and Steffensen et al. (1999), and is the same list used in the "resource generator" developed to measure social capital:

- Technology / use of intellectual property rights (J_1 and J_2)
- Client referrals (J_3,Q_3 and J_4,Q_4)
- Qualified personnel (J_5,Q_5 and J_6,Q_6)
- Use of facilities (J_7,Q_7 and J_8,Q_8)
- Use of equipment (J_9,Q_9 and J_{10},Q_{10})
- Technical expertise (J_{11},Q_{11} and J_{12},Q_{12})
- Strategic expertise (J_{13},Q_{13} and J_{14},Q_{14})
- Organizational expertise (J_{15},Q_{15} and J_{16},Q_{16})
- Financial resources (J_{17},Q_{17} and J_{18},Q_{18})
- Use of brand names (J_{19},Q_{19} and J_{20},Q_{20})

Resource co-optation was measured from two sources: (1) the network of contacts at large and (2) the mother company. For each of the above mentioned resources, respondents were asked to rate the following statements on 7-point Likert scales:

- "Our network of contacts / our parent company has provided us with the use of significant amounts of this resource."

- "This resource was obtained below market price / It would have been more costly to obtain this resource on the market."

Aggregate indicators of the amount of resource co-opted and of resource "cheapness" were computed for the network at large ($NETCOQT$ and $NETCOCH$) and for the mother company ($MCCOQT$ and $MCCOCH$).

The indicators of amount of co-opted resources were labeled $NETCOQT$ ("network co-optation - quantity") and $MCCOQT$ ("mother company co-optation - quantity"). They were defined as the sums of the co-optation scores on the quantity dimension for each strategic resource:

$$NETCOQT = \sum_i (J_i) \; ; \; i = 1, 3, 5, 7, 9, 11, 13, 15, 17, 19 \tag{4.4}$$

$$MCCOQT = \sum_i (Q_i) \; ; \; i = 1, 3, 5, 7, 9, 11, 13, 15, 17, 19 \tag{4.5}$$

The indicators of resource cheapness were labeled $NETCOCH$ (for "network co-optation - cheapness") and $MCCOCH$ (for "mother company co-optation - cheapness"). They were defined as the sums of the scores on the cheapness dimension for each strategic resource:

$$NETCOCH = \sum_i (J_i) \; ; \; i = 2, 4, 6, 8, 10, 12, 14, 16, 18, 20 \tag{4.6}$$

$$MCCOCH = \sum_i (Q_i) \; ; \; i = 2, 4, 6, 8, 10, 12, 14, 16, 18, 20 \tag{4.7}$$

4.1.5 Relatedness

Following Tsai (2000), we focus here on relatedness at a strategic rather than operational level. Previous studies often consider SIC or NACE classifications to measure relatedness between organizations. Because of the way these classifications are structured and SIC/NACE codes collected, relying exclusively on them we run the risk of excluding firms that are in fact strategically related.

Relatedness between the activities of the spin-off and those of the mother company was operationalized along the following dimensions: (1) Industrial relatedness (Fan and Lang, 2000), and (2) Technological relatedness (Autio et al., 2005; Markides and Williamson, 1996).

Industrial relatedness: Industrial relatedness refers to the overlap between the spin-off's and the mother company's activities. The measurement instruments were developed based on Fan and Lang (2000) and refer to how complementary the activities of both companies are (i.e. they can procure inputs jointly, share marketing and distribution). The questionnaire contained the following items (7-point Likert scales):

- "We shared the same suppliers with our parent company" (L_1)
- "We shared the same customers with our parent company" (L_2)
- "We shared a distribution network with our parent company" (L_3)
- "Our product/service was a substitute for the product/service of our parent company" (L_4)
- "Our activities were complementary to those of our parent company" (L_5)

An indicator of industrial relatedness, labeled $INDRELM$, was defined as the mean of the above items:

$$INDRELM = \frac{\sum_{i=1}^{n}(L_i)}{n} \; ; \; n = 5 \tag{4.8}$$

Technological relatedness: Technological relatedness measures were constructed based on Autio et al. (2005) and refer to the spin-off's utilization of the same technology as the mother company for its product or service, or a development of that technology. The questionnaire items, using a 7-point Likert scale, are the following:

- "We used similar technology to that of our parent company" (L_6)
- "The technology we used was a development of technology used by our parent company" (L_7)

The indicator of technological relatedness, named $TECHREL$, was defined as the means of the two items above:

$$TECHREL = \frac{\sum(L_6, L_7)}{2} \tag{4.9}$$

4.1.6 Mother company support

Mother company support refers to the dyadic social capital between the mother company and the spin-off. Both the structural and the relational dimensions were measured. The structural dimension referred to the frequency and strength of contacts between mother company and spin-off. The relational dimension referred to trust, trustworthiness and closeness in the relations. For completeness, we also measured the cognitive dimension of the dyadic social capital, measuring elements of mutual understanding between mother company and spin-off.

The questionnaire contained the following items, using a 7-point Likert scale:

- "We trusted the parent company to treat us fairly" (O_1)
- "The mother company would take unfair advantage of us if given the chance" (O_2^* reverse-coded)
- "The parent company would follow through on the promises and commitments it had made to us" (O_3)
- "The parent company had a reputation for trustworthiness (following through on promises and commitments) in the industry" (O_4)
- "We used to have close social relationships with the people from our parent company" (O_5)
- "We used to spend a lot of time with people from our parent firm on social occasions" (O_6)
- "In this relationship, both parties understood and accepted one another's goals" (O_7)
- "Misunderstanding were rare in our relationship with the parent company" (O_8)

The aggregate indicator of mother company support, termed $MCSUPM$, was defined as the mean of the respective items:

$$MCSUPM = \frac{\sum_{i=1}^{n}(O_i)}{n} \; ; \; n = 8 \tag{4.10}$$

4.1.7 Founders' years at the mother company

The total number of years spent by spin-off founders at the mother company was measured directly (i.e. asking respondents to write a number). By definition, this indicator also integrates the number of founders transferred from the mother company to the spin-off. The questionnaire item wording was the following:

"How many years in total did your company founders work at the parent company?" (M_2)

4.1.8 Ownership stake of mother company

The ownership stake of the mother company in the spin-off was measured as the percentage of the spin-off's shareholders' equity held by the mother company at the time of the creation of the spin-off. It was measured directly (i.e. asking respondents to write a number) with the following questionnaire item:

"What was the percentage of equity that the parent company owned in your company when it was created?" (K_5)

4.2 Data Collection

In the following pages, we describe the steps taken to collect the survey data for the statistical analysis. We first describe the sampling process and then turn to the survey instrument.

4.2.1 Identifying the sample

Unlike academic spin-offs, which mother organizations and public institutions are eager to publicize widely, corporate spin-offs are rather difficult to identify. In the process of collecting data for our study, we contacted several potential secondary data providers, including specialized media, corporate venture funds, spin-off associations, science parks and Europe-wide as well as national-level public entrepreneurship promotion bodies. Unfortunately, none of these sources were able to provide a representative and sufficiently unbiased sample.

Having eliminated secondary sources as a viable avenue to obtain a sufficiently large and unbiased sample of corporate spin-offs and mother companies, we turned to the option of carrying out a general population survey.

The survey would be carried out in the following phases: (1) obtaining a list of companies created in the past 5 years, possibly in a few specific sectors (e.g. high-tech sectors) (2) random sampling of a manageable subset of that population, (3) surveying the subset to identify corporate spin-offs to be included in the study sample.

The immediate advantage of this approach, compared to secondary sources, lied

in the higher representativity of the sample of corporate spin-offs. This advantage needed to be weighed against the potentially high cost of constructing the sample in this manner. The central question in assessing the feasibility of this option is the proportion of corporate spin-offs in the general population of start-ups. The lower the proportion, the higher the ratio between cost and final sample size.

Heirman and Clarysse (2004) carried out a similar survey on research-based startups in the general population of newly-created firms in high-technology sectors in Flanders, Belgium. They estimated that only 3.75% of new firms are research-based startups (RBSU). Of those RBSU, only 28% were corporate spin-offs, and 24% were university spin-offs. The intersection of those two groups amounts to only 1.05% of newly created firms in high-tech industries. The question is what proportion of corporate spin-offs is contained in that intersection, i.e. how many corporate spin-offs are not research-based. If the proportion of corporate spin-offs in the general population is the same as among RBSU, we could expect up to 28% of useful responses in a general population survey. On the other hand, if corporate spin-offs are much more common among RBSU than in the general population of companies, such a survey could prove uneconomical as we could only expect a very small number of useful responses, as low as 1.05% if it turns out that all corporate spin-offs are also RBSU. In other terms, if being a research-based start-up has a very low positive correlation with being a corporate spin-off, we can expect a proportion near 28% in the general population of start-ups. On the other hand, if as we expect, being a research-based start-up has a strong positive correlation with being a corporate start-up, we will be looking for a much smaller proportion of firms in the general population.

The study on the impact of corporate spin-offs on European competitiveness carried out by the European Commission (Moncada-Paternò-Castello et al., 1999, p.110) suggests that the average proportion of corporate spin-offs among the general population of newly-created firms in the EU is 12.9%. The estimated proportion varies considerably from one country to the other, with a minimum of 6% for the United Kingdom and a maximum of 27% for Spain. The authors of the report stress the fact that these figures are not derived from a survey, but only from expert estimates based on scarce information, and may therefore differ considerably from reality. Also, part of the variation in the estimates is due to differing definitions of corporate spin-offs. The definition used in the UK considered only spin-offs supported by their parent organizations, whereas the Spanish definition included any employee that left a company in order to create their own business. For Sweden, an estimated 20% of start-ups are thought to be corporate spin-offs, with this proportion reaching an impressive 50% if only new technology-based firms (NTBFs) are considered. This number seems high, but it is directionally consistent with the 28% found by Heirman and Clarysse (2004) among research-based start-ups.

Despite the risk of not obtaining a sufficiently large sample, we chose to follow the survey approach, because of its high representativity appeal. In order to maximize the number of corporate spin-offs in our final sample, we chose to focus on high-technology sectors[1].

Companies included in our study should be aged no more than 5 years and no less than 3 years. We set the 5-year limit in order to maximize the amount of social capital variance that can be explained by inheritance —an event we believe has maximum effect in the early stages of the venture— and to limit recollection bias. On the other hand, we take firms that are at least 3 years old in order to allow some time for effects to become observable.

In order to identify a list of companies suitable for a "general population survey", we used the Dun & Bradstreet database to obtain a comprehensive list of 11,000 companies created in Switzerland between 1999 and 2005 in high-tech sectors. From this database, we selected a random sample of 2,100 firms.

4.2.2 Instrument

The main survey instrument was a paper-based questionnaire mailed to the companies identified as described above.

The questionnaire design process followed the recommendations in Dillman (2006) and de Vaus (2002). In particular, the following measures were taken to maximize the response rate and to avoid biased responses.

An academic endorsement cover letter was sent together with the questionnaires, explaining the objectives and importance of the research and assuring respondents of the confidentiality of the data they provided.

Extensive review and testing of the questionnaire wording was carried out by external reviewers. Vague concepts were avoided and wording was always concrete, with examples provided where confusion was possible. Every effort was made to ensure that no double-barreled questions were included.

The questionnaire was professionally translated into German and French, then translated back into English by a separate set of native speakers, in order to ensure the accuracy of the translation. The questionnaire was tested in the original design language (English), as well as in German and French on native speakers not involved in its design or in the research project.

In addition, post-hoc verifications of questionnaire responses were carried out,

[1] Eurostat (2006, p.118) defines high-technology sectors as NACE codes: 24.4 Manufacture of pharmaceuticals, medicinal chemicals and botanical products; 30 Manufacture of office machinery and computers; 32 Manufacture of radio, television and communication equipment and apparatus; 33 Manufacture of medical, precision and optical instruments, watches and clocks; 35.3 Manufacture of aircraft and spacecraft

in order to ensure as much as possible that item comprehension was good and that respondents had not been confused by the questionnaire instrument.

The survey was carried out using a three-wave design, with the last reminder including a replacement questionnaire and response envelope. Self-addressed, paid return response envelopes were sent with the first and last survey waves. Respondents could also return the questionnaire by fax or e-mail (a dedicated fax number and e-mail account were set up at the academic institution).

In addition, a companion website was hosted by the academic institution, providing additional background information as well as a facility to replace lost questionnaires and ask any questions regarding the study, methodology, data confidentiality and anonymity of the study results.

Our survey design only contemplates collecting responses from a single respondent from each surveyed firm, as it would be practically infeasible to collect data from more than one respondent. This implies that we run the risk of introducing common method bias. To mitigate this risk, a number of additional precautions were taken in designing the questionnaire, following Podsakoff et al. (2003).

Firstly, the predictor and criterion variables were clouded (psychological separation) by including items in the questionnaire about founder background and firm internationalization. The objective of this step was to obscure our research objectives for respondents, in order to avoid "second guesses". Secondly, we measured our constructs using different response formats (methodological separation). Thirdly, respondent anonymity was assured and protected.

Given that it was not possible to distinguish *a priori* between corporate spin-offs and *de novo* start-ups and that not all questions were relevant to the latter (e.g. questions about the mother company), the questionnaire included a number of skip patterns depending on the answers to a few filter questions. The use of these skip patters also had the advantage of reducing considerably questionnaire length for the respondents. The questionnaire was structured as follows:

1. Basic demographic data: company name, founding year, number of founders
2. Top management team and board of directors
3. Filter questions to identify corporate spin-offs
4. Social capital / social capital inheritance
5. Resource acquisition through social networks
6. Relations with mother company (only for spin-offs)
7. Resource acquisition from mother company (only for spin-offs)

8. Administrative items for survey follow-up

4.3 Statistical Analysis

The model described in the previous chapter was tested using correlation analysis, exploratory factor analysis, multiple regression and analysis of variance carried out under SPSS 13.0. Confirmatory factor analysis was done with AMOS 6.0. Statistical power calculations were conducted using G*Power.

We start our analysis by testing the collected sample data to identify biases caused by the collection method. To this end, we begin by comparing respondents' demographic characteristics with those of the overall surveyed sample. Next, we check measurement validity using Cronbach's alpha and Jöreskog's rho tests. Finally, we test for non-response, late response, language and response medium biases by comparing the demographic characteristics of the affected firms with those of the surveyed population, and by conducting analysis of variance to detect significant differences in the responses provided by firms responding at different dates, in different languages or using a different medium.

We then proceed to examine the correlations between the variables of our model, to gain some insight into the interactions apparent in the dataset. While correlation is no proof of causality, causality does imply correlation. Therefore, the presence and the sign of a correlation among variables can bring a first element of support to the hypothesized relations. Conversely, the absence of a correlation where a causal relation had been hypothesized would constitute evidence to reject said hypothesis.

Moving forward, we examine the causal relationships among the model variables. Multiple ordinary least-squares (OLS) regression is conducted on each dependent variable using the predictors hypothesized in the model. We test for differences in social capital sources between corporate spin-offs and *de novo* start-ups using using a combination of one-way analysis of variance (ANOVA) and multiple regression.

Finally, we test the full theoretical model using path analysis. A description of this method follows below.

Path analysis is an extension of multiple regression. It is used to test the fit of one or several causal models against an observed correlation matrix. Path analysis allows two or more causal models to be compared based on their fit to the data.

Path analysis models are normally depicted in a box-and-arrow figure in which single arrows indicate causation relation between variables (boxes). Circles usually indicate unobserved error terms.

A regression is carried out for each variable in the model as a dependent of the variables the model indicates as causes. Regression weights predicted by the model are compared with the observed correlation matrix, allowing to calculate several

goodness-of-fit statistics. Under the common procedure, the model displaying the best goodness-of-fit statistics is selected as the "best" model for advancement of theory (Klem, 1995).

The main advantage of path analysis over multiple regression is that it allows the specification of indirect effects. Under multiple regression, the relationships that can be specified are of the form A $\longrightarrow$ B. Under path analysis, it is possible to specify more complex mediated relationships such as A $\longrightarrow$ B $\longrightarrow$ C.

Path analysis: assumptions

Path analysis relies largely on the same assumptions as multiple regression. The following are the main requirements to carry out a path analysis (based on Kline, 1998).

- **Linearity**: relationships among variables are linear (or variables are linear transformations).
- **Additivity**: no interaction effects may be specified between variables; if such an effect is necessary, variables may be defined as interaction crossproduct terms.
- **Proper specification** of the model is required for interpretation of path coefficients. Path analysis, like structural equation modeling, is particularly sensitive to specification error, which occurs when a significant causal variable is omitted from the model. In this case, path coefficients shown in the model will reflect the shared covariance with the unmeasured variables and therefore should not be interpreted in terms of direct and indirect effects. Another case of error arises when antecedent variables are incorrectly specified as dependent variables. It should be noted that although the interpretation of regression coefficients may be incorrect under specification error, the relative model fit of different models can still be correctly compared.
- **Recursivity**: recursive models are those in which there is no "feedback loop", or in other words, where all arrows point in the same direction. Recursive models offer the advantage of never being underidentified.
- **Model identification**: underidentified (or undetermined) models are those in which there are not enough structural equations to solve for the unknowns.
- **Multivariate normality**: this is a critical assumption in path analysis, and structural equation models in general. Specifically, Maximum-Likelihood (ML) estimation demands that data be multivariate normal. Non-normal

data leads to a number of problems, including over- and underestimated model fit statistics and potentially unreliable regression significance statistics (Byrne, 2001; Marsh et al., 1988; Maruyama, 1998; McCallum et al., 1992).

- **Low multicollinearity**: high levels of multicollinearity result in inflated standard errors of the b coefficients.

- **Residual (unmeasured) terms** may not be correlated with any of the variables in the model other than the one they cause. In particular, it is assumed that for any endogenous variable, its disturbance term is uncorrelated with any other endogenous variable in the model.

- **Identical sample**: the same sample must be used for all regressions in the path model; this can be achieved in two ways:

  (1) listwise deletion: where some observations are missing for some variables and not others, the data set is reduced so that there are no missing values for any of the variables included in the model;

  (2) data imputation: the missing values can be estimated through several methods; AMOS by default uses maximum likelihood estimates of missing values (Arbuckle, 2006).

- **Sample size**: a sufficient sample size is needed to assess significance. Kline (1998) recommends 10 times as many cases as there are parameters in the model. Models with fewer than 5 times the number of parameters may not be sufficient to test the significance of model effects.

Path analysis: model fit

In line with common practice (Byrne, 2001; Hu and Bentler, 1999; Perrinjaquet et al., 2007), we test the fit of our model to the data using a variety of indices. Specifically, we follow the testing approach developed by Messner et al. (2004) and use the following fit indices: (1) Chi-Square; (2) Goodness-of-Fit Index (GFI); (3) Comparative Fit Index (CFI) and (4) Root Mean Square Error of Approximation (RMSEA).

Model Chi-Square: The model Chi-Square test checks whether the observed variance/covariance matrix is significantly different from the variance/covariance matrix predicted by the model. A Chi-Square with a significant p-value (below .05) shows that there is significant difference between the observed and predicted variance/covariance matrix, and thus can be interpreted as an indication of poor fit

of the tested model to the data. In that sense, Chi-Square can be thought of as a "badness-of-fit" indicator.

Goodness-of-Fit Index —GFI: Known as the Jöreskog-Sörbom GFI, the Goodness-of-Fit Index is calculated as GFI = FML/FO, where FO is the fit function when all model parameters are zero.

GFI can be interpreted as the percentage of observed covariances explained by the covariances implied by the model. It is often compared to R-square in multiple regression, although this comparison is not entirely exact (as R-square deals with error variance, whereas GFI is concerned with error in reproducing the observed variance-covariance matrix).

GFI values range from 0 to 1, but the index can yield meaningless negative values under rare circumstances. By convention, a model with a GFI above .9 is generally considered as fitting the data well. GFI values under .8 are usually considered poor (Bentler, 1990).

GFI is somewhat sensitive to sample size. A large sample size tends to increase GFI score. Conversely, large values of df (degrees of freedom) relative to sample size tend to underestimate model fit.

Comparative Fit Index —CFI: The Bentler Comparative Fit Index compares the existing model fit with the null model, which assumes the variables in the model are uncorrelated (also known as the "independence model"). In other words, CFI compares the covariance matrix predicted by the model to the observed covariance matrix, and then compares the null model (consisting of a null covariance matrix) with the observed covariance matrix, to assess the percent of lack of fit which is removed by going from the null model to the tested model.

One advantage of CFI, which it shares with RMSEA (discussed below), is that it is among the measures least affected by sample size (Fan et al., 1999). CFI values can range between 0 and 1, a CFI close to 1 indicating very good fit. By convention, a CFI value equal to or greater than .9 is required to accept the model, indicating that 90% of the covariation in the data can be reproduced by the given model. CFI is is computed as follows:

$$\frac{1 - Max(Chisq - df, 0)}{Max[(Chisq - df), (Chisqn - dfn), 0]} \tag{4.11}$$

where $Chisq$ and $Chisqn$ are model Chi-Square for the tested and null models respectively, and df and dfn are the corresponding degrees of freedom.

Root Mean Square Error of Approximation —RMSEA: This measure of fit is based on the non-centrality parameter. RMSEA asks the question: "How would

the model, with unknown but optimally chosen parameter values, fit the population covariance matrix if it was available?" (Byrne, 2001). It is given by the following formula (Steiger, 2000):

$$\sqrt{\frac{\frac{c^2}{df-1}}{N-1}} \tag{4.12}$$

where c^2 is the value of Chi-Square, N the sample size and df the degrees of freedom of the model. If c^2 is less than df, then RMSEA is set to zero. Models with an RMSEA of .05 or less are generally considered to have a good fit. Models for which RMSEA is less than or equal to .08 are considered adequate. By convention, models whose RMSEA is .10 or more are considered to fit the data poorly (Browne and Cudeck, 1993).

This index computes average lack of fit per degree of freedom. For this reason, it can be argued that RMSEA corrects for model complexity to some extent, because df is in its denominator. It is a frequently-used measure of fit, in part because it does not require comparison with a null model and thus does not positing as plausible a model in which there is complete independence of the variables (as is the case with CFI). RMSEA is one of the fit indices that is least affected by sample size (Fan et al., 1999).

Path analysis: multivariate normality and bootstrapping analysis

As mentioned in the previous section, multivariate normality is a critical assumption in path analysis, and structural equation models in general. Specifically, Maximum Likelihood (ML) estimation demands that data be multivariate normal (Byrne, 2001; Maruyama, 1998). Because this assumption is rooted in large-sample (i.e. asymptotic) theory, multivariate normality is a concern when dealing with small samples, but not only: West et al. (1995) note that in practice most data sets fail to meet the multivariate normality assumption.

Failing to meet the multivariate normality assumption leads to several problems. Non-normal data inflates Chi-squared values, potentially leading to reject or excessively modify a theoretically sound model (McCallum et al., 1992). This is compounded by the fact that Chi-squared values can also be inflated when sample sizes are small, even if data is multivariate normal (Byrne, 2001). Some fit indices, in particular the Comparative Fit Index (CFI), can be moderately underestimated when data is non-normal (Marsh et al., 1988). Standard errors can also be underestimated, with the potential consequence of regression paths and factor-error term covariances that appear to be significant when that may not be the case in the real population (Byrne, 2001).

In running our path analyses, we will address the issue of multivariate normality, firstly by assessing the normality of our variables individually, and at the multivariate level using Mardia's multivariate kurtosis indicator (Mardia, 1970). As a second step, we will check the data for outliers, using the Mahalanobis multivariate distance indicator (Arbuckle, 2006). Finally, we will evaluate the robustness of our model estimates using a statistical procedure known as "bootstrapping" (Efron and Tibshirani, 1993; West et al., 1995; Yung and Bentler, 1996; Zhu, 1997). This procedure is recommended in the literature when faced with non-normal data or small samples in structural equation modeling (e.g. MacKinnon et al. (2002); Schneider et al. (2005); Shrout and Bolger (2002)).

Bootstrapping is a resampling procedure which considers the original sample as representing the population. A large number of random subsamples are taken from the original sample, with replacement. For each subsample, the path analysis model is re-run, and the results are recorded and used to assess the stability of parameter estimates and indices of fit (Kline, 1998; Yung and Bentler, 1996). Bootstrapping analysis provides intervals of confidence for the model parameter estimates, as well as an assessment of overall model fit using the Bollen-Stine corrected p-value, which is robust to non-normal data (Arbuckle, 2006; Bollen and Stine, 1992).

4.4 Descriptive Statistics

In this first section, we begin by giving a general description of the sample of companies that responded to our questionnaire. We will cover the following aspects: (1) Response rate; (2) Demographic characteristics and (3) Descriptive statistics of model variables.

4.4.1 Response rate

A random sample of 2,100 firms were surveyed, out of a total population of 11,000 firms (database provided by D&B). From this sample, 118 questionnaires were returned as undeliverable and 20 companies explicitly refused to respond (i.e. they either sent an empty questionnaire back or a note asking to be removed from our mailing list). We received 204 responses, amounting to a 10.3% response rate.

Of these 204 responses, 177 proved usable, amounting to an effective response rate of 8.9%. The remaining responses were either too incomplete to be used, or fell outside our sampling criteria. For instance, some companies had been created outside our 1999-2005 date range and had been included in the D&B database as the result of a change in their entry in the registry of commerce.

A further 21 firms were selected out of the final sample, having been identified as self-employed persons and not companies in the regular sense of the word. Therefore, the final sample (hereafter referred to as "overall sample") comprised 156 firms.

This result can be considered somewhat disappointing, given the relatively large base sample surveyed. As we have mentioned, there is very little empirical evidence on which to estimate the proportion of corporate spin-offs in the general population of firms, some empirical studies suggestion proportions as low as 1% (Heirman and Clarysse, 2004) and some as high as 28% (Moncada-Paternò-Castello et al., 1999, p. 110). The consequences of this difficulty in estimating the actual proportion of corporate spin-offs and the trade-off to be reached in balancing sample representativity and the risk of not obtaining a sufficiently large sample are discussed in the previous chapter. As discussed, the alternative would have been to study a sample of known corporate spin-offs and a number of options to this effect have been described in the previous chapter. However, since all those potential sources raised substantial sampling bias issues, the approach of a general firm population survey was adopted, despite the risk of an unknown usable response rate.

In order to ensure ex-post representativity of the sample, the collected firm data will be compared in the next sections along the information dimensions available (language, industry and company age) to the general population of newly-created firms (i.e. the total database of companies provided by D&B), as well as the population of 2,100 surveyed firms. Companies identified as spin-offs are also compared demographically to the total sample of responding companies. Ideally, we would also like to compare our sample of spin-offs to other samples of known Swiss high tech corporate spin-offs. However, to the best of our knowledge, this is the first empirical study of Swiss corporate spin-offs, making this last comparison impossible at the time of this writing.

4.4.2 Demographic characteristics

In the following pages, we will describe the overall sample along the following dimensions: (1) Number of spin-offs; (2) Industry; (3) Company age; (4) Response language and (5) Response medium.

Number of spin-offs

The overall sample included 57 corporate spin-offs (36.5%) and 6 academic spin-offs (3.8%). The number of *de novo* startups was 93 (59.7%).

The distribution of corporate and academic spin-offs and *de novo* start-ups is illustrated by Table 4.1.

Table 4.1: Overall sample: number of corporate and academic spin-offs and *de novo* start-ups

Type	Frequency	Percent	Cumulative Percent
Corporate spin-off	57	36.5	36.5
Academic spin-off	6	3.8	40.3
Ordinary start-up	93	59.7	100.0
Total	156	100.0	100.0

Industry

The overall sample is largely dominated by firms active in the IT industry. NACE codes corresponding to "Data Processing", "Software" and "Data Processing Services" make up 80.2% of the sample. Among corporate spin-offs only, the industry proportions are roughly the same, with the above captioned NACE codes making up 77.2% of the sample. Table 4.2 shows the response rates by industry classification.

This is consistent with the industry distribution among the total list of 2,100 surveyed companies, where "Data Processing", "Software" and "Data Processing Services" represent 79.9% of the sample. The industry distribution is also consistent with that of the total database of 11,000 companies provided by D&B and the 2,100 firm survey sample.

Company age

Given our selection criteria, the "age" of companies included in the study, i.e. the difference between the founding date and the time of survey, ranged from 1 to 7 years. As can be seen in Table 4.3, the companies in the overall sample were quite evenly spread along this age range, only the 7-year-old companies being less represented. All age categories from 1 to 6 years made up between 15.4 and 18.6% of the sample, with 7-year-old companies making up only 3.2%.

Looking now only at corporate spin-offs, the age distribution is generally similar, with a somewhat higher proportion of 1 (21.1%), 2 (21.1%) and 5-year old companies (19.3%) and even lower proportion of 7-year-old companies (1.8%). The age distribution is also consistent with that of the total database of 11,000 firms provided by D&B and the 2,100 firm survey sample.

Questionnaire language

Questionnaires were mailed out in German or French language, depending on the postal code of each company and the language information supplied by D&B. Other language versions of the questionnaire were available upon request.

The language selection method proved reliable: in the overall sample, 18.1% of

Table 4.2: Overall sample and corporate spin-offs: industry distribution

Overall sample			
Industry	Frequency	%	Cumulative %
Pharmaceutical raw materials	4	2.6	2.6
Data Processing Equipment	5	3.2	5.8
Production of radio and TV equipment	2	1.3	7.1
Medical equipment	2	1.3	8.3
Measurement, control and nav. equipt	1	.6	9.0
Watches	3	1.9	10.9
Telecommunications	4	2.6	13.5
Software	41	26.3	39.7
Data processing services	9	5.8	45.5
Data processing	75	48.1	93.6
R&D, engineering and medical	8	5.1	98.7
Research in law, economics and soc. sciences	2	1.3	100.0
Total	156	100.0	100.0
Corporate spin-offs			
Industry	Frequency	%	Cumulative %
Pharmaceutical raw materials	1	1.8	1.8
Data Processing Equipment	4	7.0	8.8
Production of radio and TV equipment	1	1.8	10.5
Medical equipment	1	1.8	12.3
Watches	2	3.5	15.8
Telecommunications	3	5.3	21.1
Software	17	29.8	50.9
Data processing services	2	3.5	54.4
Data processing	25	43.9	98.2
R&D, engineering and medical	1	1.8	100.0
Total	57	100.0	100.0

Table 4.3: Overall sample and corporate spin-offs: company age distribution

Overall sample			
Age	Frequency	%	Cumulative %
1	29	18.6	18.6
2	27	17.3	35.9
3	26	16.7	52.6
4	20	12.8	65.4
5	24	15.4	80.8
6	25	16.0	96.8
7	5	3.2	100.0
Total	156	100.0	100.0
Corporate spin-offs			
Age	Frequency	%	Cumulative %
1	12	21.1	21.1
2	12	21.1	42.1
3	6	10.5	52.6
4	7	12.3	64.9
5	11	19.3	84.2
6	8	14.0	98.2
7	1	1.8	100.0
Total	57	100.0	100.0

respondents answered in French and 81.9% in German. This is consistent with the language proportions in the 2,100 firm survey sample and the total 11,000 firms D&B database, which were 80.4% German and 19.6% French language.

Among corporate spin-offs, 15.8% responded in French and 84.2% in German.

Response medium

Although all questionnaires were sent out in paper form, companies were offered a choice of three response media in order to facilitate responding and maximize the response rate. The available media were (1) to use the paid return envelope and mail the filled questionnaire back, (2) to fax the filled questionnaire back and (3) to download and return a questionnaire in electronic form (by e-mail). This latter method was not used by any company. In 97% of cases, responses were sent back using the paper questionnaire. This proportion remained constant in the overall sample and among corporate spin-offs, as shown in Table 4.4.

Table 4.4: Response medium: overall sample and corporate spin-offs

Type	Paper (%)	Fax (%)	Total (%)
Overall sample	97.4	2.6	100.0
Corporate spin-offs	96.5	3.5	100.0

4.5 Validity of Measurements

In the present section, we will assess the validity of the measurements carried out using our questionnaire instrument. As this is a newly-developed questionnaire, we need to check the validity and unidimensionality of the measurements. We will begin by calculating the Cronbach alpha and Jöreskog rho for the theoretical measurements constructed from multiple questionnaire items. Then, we will check for potential unintended association between some of the questionnaire items that involve related language. Specifically, as discussed in the Operationalizations section, the resource component was integrated in the operationalizations of structural and relational social capital, which could potentially lead to unintended association with the questionnaire items on resource co-optation. We will check this using factor analysis.

As described in the previous chapter, some variables used in the model are measured directly by a single entry of the survey instrument. These single-item variables are:

- Mother company's equity share in the spin-off (K_5)
- Total number of years spin-off founders worked at the mother company (M_2)

Other model variables, however, are constructed from multiple questionnaire entries and must therefore be tested for validity. Cronbach's alpha is a measure of internal consistency of a psychometric instrument. It indicates the extent to which a set of test items can be treated as measuring a single latent variable. By convention, Cronbach's alpha values lower than than .70 are deemed insufficient.

Some of the margin notes in responses to the questionnaires lead us to detect two potential question interpretation problems:

- In the items relating to the construct of Mother company support, item O_2^* ("The mother company would take unfair advantage of us if given the chance") was not translated with exactly the same negative nuance in French and in German.

- Some respondents seem to have had trouble understanding the notion of the network or the mother company providing "client references" as a resource.

Initial Cronbach alpha calculations indicated that the problem did not appear to be serious (all concerned indicators scored well above the conventional threshold of .70). Despite this, we decided to drop the offending items from the final constructs in order to avoid any unreliability due to poor wording. In summary, we amended the indicators as follows:

- Inherited contacts: we dropped the item on "client referrals", as it appeared to have been unclear, to form indicator $RESGENI2$

- Mother company support: we dropped the item on unfair treatment, because of the apparent translation inconsistency, and formed indicator $MCSUPM2$

- Network resource co-optation quantity: we dropped "client referrals", for consistency with the inherited contacts measurements, to form $NETCOQT2$

- Network resource co-optation cheapness: we dropped "client referrals" for consistency to form $NETCOCH2$

- Mother company resource co-optation quantity: we dropped "client referrals" for consistency, to form $MCCOQT2$

- Mother company resource co-optation cheapness: we dropped "client referrals" for consistency, to form $MCCOCH2$

Table 4.5 shows the final Cronbach's alphas for each variable after the above modification. All indicators exhibit satisfactory reliability, with Cronbach's alpha values comprised between .664 and .968. Only the construct of Technological relatedness

yielded a Cronbach's alpha value below the conventional threshold of .70, indicating either unreliability or multidimensionality. To explore this, we conducted a factor analysis on the two items that make up this construct. The results allow us to rule out multidimensionality, as a single-factor solution accounts for over 75% of the variance of the measured items. Cronbach's alpha is known to underestimate reliability, in particular for indicators computed from few items (Fornell and Larcker, 1981; Greene and Carmines, 1979; Novick and Lewis, 1967; Vehkalahti et al., 2006). As this construct is based on only two questionnaire items, we are not overly concerned by the marginally low result. In this case, assuming constant average correlations, one additional item would increase Cronbach's alpha to .748, and two additional items would increase alpha to .798. For these reasons, the construct will be retained for the analysis, although this caveat should be kept in mind.

Table 4.5: Construct reliability (Cronbach's alpha)

Construct	Cronbach's α
Industrial relatedness	.702
Technological relatedness	.664
Mother company support	.900
Inherited relational social capital	.804
Inherited structural social capital	.807
Net. resource co-optation quantity	.859
Net. resource co-optation cheapness	.916
Mother co. resource co-optation quantity	.947
Mother co. resource co-optation cheapness	.968

As a means to overcome the limitations of Cronbach's alpha, and specifically the underestimation of reliability, we conducted a Confirmatory Factor Analysis (CFA) in order to compute Jöreskog's rho coefficient (Fornell and Larcker, 1981; Jöreskog, 1971). This coefficient offers the advantage of explicitly taking into account measurement error on the individual items and of not being biased by the number of items in the indicators. Jöreskog's rho is computed based on the loadings of the regression paths between the individual questionnaire items and the latent variables that they are supposed to measure, the variance of the latent variable and the variance of the error terms. The higher the loadings of the individual regressions and the lower the error terms, the higher the rho coefficient. Mathematically, the rho coefficient is defined as follows:

$$\rho = \frac{(\sum_{i+1}^{p} \lambda_{yi})^2 \times var(\eta)}{(\sum_{i+1}^{p} \lambda_{yi})^2 \times var(\eta) + \sum_{i=1}^{p} var(\epsilon_{yi})} \tag{4.13}$$

where λ_{yi} is the loading of the i^{th} indicator, $var(\eta)$ is the variance of the latent variable and $var(\epsilon_{yi}$ is the variance of the error term (i.e.: $1 - \lambda_{yi}^2$).

Jöreskog's rho coefficient values range from 0 to 1 and it is common practice to accept values over 0.7 as indicating a good reliability (Fornell and Larcker, 1981; Valette-Florence, 1998). Having calculated the loading of each questionnaire item to the latent variables they were supposed the measure, we calculated a rho coefficient for each construct. The results of this analysis, summarized in Table 4.6, show that the questionnaire items load reliably on each latent construct, with all Jöreskog's rho values comprised between .720 and .938.

Table 4.6: Construct reliability (Jöreskog's rho)

Construct	Jöreskog's ρ
Industrial relatedness	.733
Technological relatedness	.720
Mother company support	.899
Inherited relational social capital	.739
Inherited structural social capital	.841
Net resource co-optation quantity	.871
Net resource co-optation cheapness	.896
Mother co. resource co-optation quantity.	.917
Mother co. resource co-optation cheapness	.938

Given these results, we are satisfied with the reliability of the measurement instrument used in our data collection. As a side note, we find this result to be quite encouraging, given that the measurement instruments are tried for the first time in this research.

Despite that satisfactory Jöreskog's rho values, it is still possible that there is unintended association between some of our constructs. In other words, questionnaire items that measure satisfactorily a theorized latent variable could equally well measure another latent variable. Specifically, the operationalizations of our structural and relational social capital constructs, based on the work of Lin et al. (2001), incorporate a resource element. It is therefore possible that respondents' answers to these items are associated in an unintended way with the answers to the items on resource co-optation.

In order to check for this possible unintended association, we conducted an exploratory factor analysis (EFA) on the questionnaire items measuring Inherited structural social capital, Inherited relational social capital, Network resource co-optation quantity and Network resource co-optation cheapness. We expected to find that 3 factors account for most of the observed variance, with items loading on factors corresponding to Structural social capital, relational social capital and resource co-optation. We used principal component analysis for extracting factors, along with a Varimax rotation algorithm.

A critical question discussed in the literature on EFA is deciding on the number of factors to extract, as the usefulness of EFA depends on distinguishing important

factors from trivial ones (Fabrigar et al., 1999; Hayton et al., 2004). Extracting the wrong number of factors can significantly alter the solution and the interpretation of the results. Extracting too few factors can lead to information loss and substantial distortion in the solution, specifically in the loadings of variables. Too many factors, on the other hand, can lead to factors with few items loading, little theoretical meaning and difficult to replicate (Zwick and Velicer, 1986). A commonly-used rule of thumb, first suggested by Kaiser (1960), is to retain factors in the EFA output with eigenvalues higher than 1. Although commonly applied, this rule is considered outdated and criticized by several authors (Fabrigar et al., 1999; Hayton et al., 2004) who instead argue that rotated solutions should first and foremost be interpretable and theoretically sensible. In our sample, the EFA produces 8 factors with eigenvalues higher than 1. This solution yields factors with very few items each and low loadings, and that do not appear to make theoretical sense.

Therefore, instead of using the Kaiser (1960) criterion, we chose to use a methodology proposed by Dunteman (1989), by seeking to verify that the data corresponds to the number of factors determined on the basis of theoretical grounds or explanatory work. Only those factors that (1) made theoretical sense and (2) were characterized by a high number of items and high loadings were deemed acceptable. Peterson (2000) notes that different researchers apply different thresholds when determining whether a given factor loading is “high” or “low”. Following an approach similar to that of Stevens (2002, p.395) and Autere (2005), we retained only factors that had at least some loadings higher than 0.8 and at least three items, or higher than 0.3 and at least four items were retained.

Using this approach, we end up with a 3 factor solution that confirms that the questionnaire items load mostly on the desired factors. Table 4.7 shows the eigenvalues and explained variance of the original 33 components. As mentioned previously, 8 components have eigenvalues above 8. The table also shows the eigenvalues and explained variance (51.0%) of the 3 selected factors, both in unrotated and rotated forms. In the rotated form, the first factor explains 22.3% of variance, the second factor explains 14.5% and the third factor 14.2%.

Table 4.7: EFA: total variance explained

Component	Initial Eigenvalues			Extraction Sums of Squared Loadings			Rotation Sums of Squared Loadings		
	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %	Total	% of Variance	Cumulative %
1	9.728	29.479	29.479	9.728	29.479	29.479	7.344	22.255	22.255
2	3.871	11.729	41.209	3.871	11.729	41.209	4.797	14.538	36.793
3	3.239	9.816	51.024	3.239	9.816	51.024	4.696	14.231	51.024
4	2.197	6.659	57.683						
5	2.056	6.231	63.914						
6	1.668	5.054	68.968						
7	1.429	4.329	73.297						
8	1.184	3.588	76.885						
9	.974	2.952	79.837						
10	.883	2.675	82.512						
11	.818	2.480	84.992						
12	.731	2.214	87.206						
13	.601	1.822	89.028						
14	.546	1.654	90.682						
15	.466	1.412	92.093						
16	.456	1.382	93.475						
17	.393	1.190	94.665						
18	.351	1.062	95.727						
19	.255	.773	96.500						
20	.197	.598	97.098						
21	.169	.512	97.610						
22	.159	.482	98.092						
23	.134	.406	98.499						
24	.126	.383	98.882						
25	.116	.351	99.233						
26	.069	.209	99.442						
27	.052	.159	99.601						
28	.046	.138	99.740						
29	.035	.106	99.846						
30	.025	.077	99.923						
31	.021	.064	99.986						
32	.003	.009	99.995						
33	.002	.005	100.000						

Extraction Method: Principal Component Analysis.

Table 4.8: EFA: rotated component matrix

Questionnaire items	Components		
	1	2	3
Net Res. Co-opt.: Strat expertise (cheapness)	.848		
Net Res. Co-opt.: Org expertise (cheapness)	.847		
Net Res. Co-opt.: Skilled Personnel (cheapness)	.817		
Net Res. Co-opt.: Tech expertise (cheapness)	.763		
Net Res. Co-opt.: Use of Equipment (cheapness)	.752		
Net Res. Co-opt.: Intellectual Property Rights (cheapness)	.723		
Net Res. Co-opt.: Use of Accommodation (cheapness)	.708		
Net Res. Co-opt.: Org expertise	.668		.475
Net Res. Co-opt.: Strat expertise	.641		.529
Net Res. Co-opt.: Use of Accommodation	.544	.345	
Net Res. Co-opt.: Use of Equipment	.530	.389	
Net Res. Co-opt.: Skilled Personnel	.516		.304
Net Res. Co-opt.: Tech expertise	.516		
Net Res. Co-opt.: Brand names (cheapness)	.514	.451	
Net Res. Co-opt.: Financial Resources	.503		
Net Res. Co-opt.: Financial Resources (cheapness)	.479	.478	
Net Res. Co-opt.: Intellectual Property Rights	.471	.410	
Net Res. Co-opt.: Brand names	.301	.300	
Rel. to mother co. was useful obtaining subsidizing		.724	
Rel. to mother co. cast proposals in more positive light		.697	
Rel. to mother co. made proposal look serious		.665	
Rel. to mother co. was useful with investors		.575	
Rel. to mother co. was useful with customers		.571	
Rel. to mother co. was useful gaining outside expertise		.549	
Struct. SoCa (inherited): Strat Expertise			.844
Struct. SoCa (inherited): Skilled Personnel			.785
Struct. SoCa (inherited): OrgExpertise			.774
Struct. SoCa (inherited): Technical Expertise			.749
Struct. SoCa (inherited): Intellectual Property			.666
Struct. SoCa (inherited): Brand names		.356	.625
Struct. SoCa (inherited): Accommodation			.436
Struct. SoCa (inherited): Equipment			.360
Struct. SoCa (inherited): Financial Resources			

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.
Loadings below .3 not shown

As summarized in Table 4.8, the first extracted factor shows high loadings from all Network resource co-optation questionnaire items (loadings range from .301 to .848). The second extracted factor shows high loadings from the Relational social capital questionnaire items (loadings comprised between .549 and .724). The third extracted factor shows high loadings from all Structural social capital questionnaire items (loadings comprised between .360 and .844) except one item ("Struct. SoCa (inherited): Financial Resources"), which loaded below our cutoff threshold of 0.3 and hence was dropped.

This pattern of loadings is consistent with our initial theoretical expectation of three factors corresponding to structural social capital, relational social capital and resource co-optation and is also in line with the results of the CFA conducted previously. We interpret this result as evidence that the questionnaire instrument is valid, in that it measures what it is intended to. This being said, Table 4.8 also shows that some questionnaire items load highly (i.e. above our .3 cutoff threshold) on more than one factor. Nine resource co-optation questionnaire items out of 11 also load highly on factors 2 (relational social capital) or 3 (structural social capital), with loadings comprised between .300 and .529. One questionnaire item out of nine on structural social capital also loads highly (.356) on factor 2. It is normal for EFA to yield loadings by all items for all extracted factors and as all items load most strongly on the factors they are expected to, this output is consistent with the operationalizations being valid. Nevertheless, as some of the loadings of items across factors are relatively high, we cannot entirely rule out some degree of unintended association. If this is the case, it could potentially inflate artificially regression coefficients between the social capital and the resource co-optation constructs in further stages of the analysis. We do not believe, however, that this is a serious issue in our data.

4.6 Bias Tests

In the present section, we will give the details of the tests that were performed on our data to rule out potential biases in the overall sample. In particular, we will cover the following sources of bias: (1) Non-response bias; (2) Language bias and (3) Response medium bias.

4.6.1 Non-response bias

In order to assess non-response bias, we will use the following approach: First, we will compare the group of non-responding firms to the overall sample included in the survey, based on the demographic information provided by the D&B database. Second, we will compare respondents with the information available on compa-

nies that explicitly refused to answer our questionnaire. Third, we will check for early/late response bias by looking for different patterns of responses among companies that replied early on in the survey versus later on.

Non-respondents

In total, 1,778 firms did not fill out our survey questionnaire. This represents 89.7% of the effective survey sample of 1,982 firms (i.e. original sample of 2,100 firms minus 118 firms for which mail was returned as undeliverable). Given this high proportion of non-respondents, we are not surprised to find that there are no differences between the overall survey sample and the non-respondents in terms of demographics (company age, language and industry).

Explicit refusals

The following are the demographic characteristics of firms that explicitly refused to answer the questionnaire (i.e. asked to be excluded from the study).

- Language distribution: German-language firms seem overrepresented, at 95% of the total versus 81.9% in the overall sample
- Company age: the average company age among explicitly non-responding firms is slightly lower, at 2.7 years versus 3.5 in the overall sample
- Industry: Software development is the leading industry code, at 57.1%, followed by Engineering/R&D services at 14.3%

Although the available demographic information on the companies that explicitly refused to respond differs slightly from the overall sample, it should be borne in mind that only 20 such cases are available, which can easily distort the picture.

Early/late respondents bias

Figure 4.1 shows the graphical representation of the response date pattern. Responses arrived in three waves, roughly corresponding to the months of June, July and August. This pattern is consistent with the dates on which the reminder waves were sent out. The response rate in July was lowest, as can be expected for this time of year.

For the purpose of testing for bias in response dates, we segmented the responses in three groups, corresponding to the response waves identified above: (1) Responses received before 1-Jul-2006; (2) Responses received between 1-Jul-2006 and 31-Jul-2006, and (3) Responses received on or after 1-Aug-2006.

We conducted a one-way ANOVA mean comparison among these groups on the model variables. Statistically significant differences between groups were flagged by the analysis. Namely, the following variables warranted closer examination: Network resource co-optation cheapness (sig.: .061); Mother company resource co-optation quantity (sig.: .022); Inherited legitimacy (sig.: .017) and Corporate spin-off (dummy, sig.: .043). Table 4.9 summarizes the results of the ANOVA analysis.

The descriptive statistics for each group show that all the significant differences seem to lie only in the responses received during the month of July. Respondents during this month reported higher values than the rest of the sample for the following variables: Net resource co-optation cheapness, Mother company resource co-optation quantity and Inherited relational social capital. Also, respondents during this month were slightly less likely to be corporate spin-offs than in the rest of the sample. Given that the number of responses in this wave is extremely low (ranging from 3.6 to 10.6% of cases, depending on the variable), we can reasonably assume that the significant differences are only a product of the low number of cases in this group.

In conclusion of this analysis, we believe that our sample does not suffer from any significant non-response or late response bias.

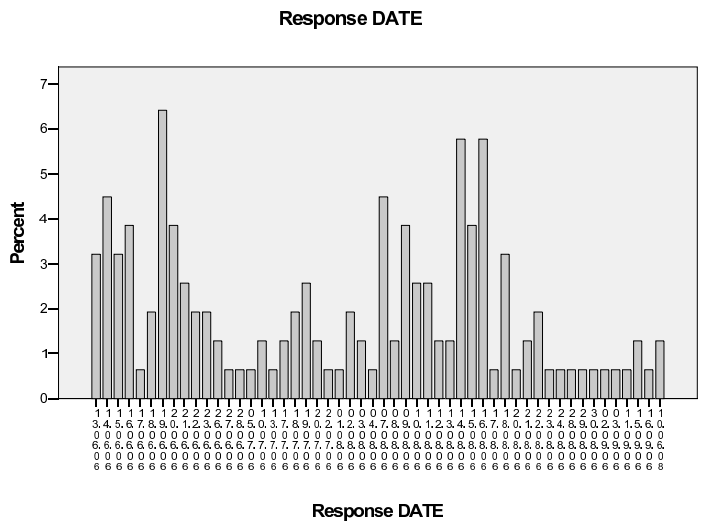

Figure 4.1: Overall sample: distribution of response dates

Table 4.9: One-way ANOVA: response dates

Variable	F	Sig.
Founding year	1.596	.206
Net resource co-optation quantity	.223	.801
Net resource co-optation cheapness	2.844	.061
Mother Co. resource co-optation quantity	4.083	.022
Mother Co. resource co-optation cheapness	1.544	.223
Total structural social capital	2.104	.126
Inherited structural social capital	.068	.935
Inherited relational social capital	4.384	.017
Corporate spin-off (dummy)	3.213	.043
Technological relatedness	.146	.865
Mother Co. support	1.425	.249
Industrial relatedness	.425	.656
Equity stake by mother company	.286	.753
Founders' years at mother company	.433	.548

4.6.2 Language bias

We ran a one-way ANOVA test on the model variables to check for significant differences in responses to French and German-language questionnaires returned by corporate spin-offs. Table 4.10 summarizes the results of this analysis. Only one model variable, namely Inherited structural capital, seems to differ significantly among both groups.

Table 4.10: One-way ANOVA: response language

Variable	F	Sig.
Founding year	.790	.375
Net resource co-optation quantity	.528	.469
Net resource co-optation cheapness	.106	.746
Mother Co. resource co-optation quantity	.731	.396
Mother Co. resource co-optation cheapness	.031	.860
Total structural social capital	.178	.674
Inherited structural social capital	15.249	.000
Inherited relational social capital	1.671	.201
Corporate spin-off (dummy)	.004	.952
Technological relatedness	2.642	.109
Mother Co. support	.277	.601
Industrial relatedness	.130	.719
Equity stake by mother company	1.867	.177
Founders' years at mother company	.187	.667

Spin-offs that answered in French reported higher amounts of inherited contacts than the others. This might be interpreted as the sign of a cultural difference. How-

ever, given the low number of French-speaking spin-offs in the sample (only 8), this result needs to be taken with caution.

Consequently, we cannot conclude that our sample is affected by any significant bias resulting from the questionnaire language.

4.6.3 Response medium bias

Corporate spin-offs responded to our survey by postal mail and fax. One-way ANOVA does not show any significant difference on model variables when grouping responses by medium, as shown in Table 4.11. However, as only two corporate spin-offs in our sample chose to respond by fax, any differences between groups would have been unlikely to be representative.

Table 4.11: One-way ANOVA: response medium

Variable	F	Sig.
Founding year	1.905	.170
Net resource co-optation quantity	.052	.821
Net resource co-optation cheapness	.089	.766
Mother Co. resource co-optation quantity	.014	.906
Mother Co. resource co-optation cheapness	.137	.713
Total structural social capital	.073	.788
Inherited structural social capital	.199	.657
Inherited relational social capital	1.805	.184
Corporate spin-off (dummy)	.317	.574
Technological relatedness	.818	.370
Mother Co. support	.652	.423
Industrial relatedness	1.030	.314
Equity stake by mother company	.333	.566
Founders' years at mother company	.028	.868

4.7 Assumptions Validation

In this section, we cover the main assumptions of the statistical methods that will be used in the next steps of the study: (1) Multicollinearity; (2) Proper specification and (3) Sample size.

4.7.1 Multicollinearity

Multicollinearity occurs when there are unacceptably high levels of correlation between the predictor (independent) variables of a regression analysis. Regression analysis requires low levels of correlation among exogenous variables. If this assumption is not met and two or more predictor variables are highly correlated, sev-

eral problems arise. It becomes difficult to isolate the effects of each predictor on the dependent variable: the beta coefficients, although unbiased, become unreliable. The R-square tends to be higher and significance coefficients lower, which increases the chance of Type II error, i.e. rejecting a relation that should in fact be accepted. Also, the sensitivity of coefficient estimates increases, making them react strongly to changes in just a few observations.

As a rule of thumb, correlations above .80 between exogenous variables can signal a problem. As a further check during regression analysis, the occurrence of high R-squared values and significant F tests of the model, in combination with non-significant t-tests of coefficients should be interpreted as a sign of multicollinearity problems.

At this point, we test for multicollinearity by examining the correlation matrix between the exogenous variables of our model. The results of this analysis are shown in Table 4.12.

Table 4.12: Exogenous variable correlations.

Variable	1	2	3	4
1. Industrial relatedness	1	*	*	*
2. Technological relatedness	.569**	1	*	*
3. Equity stake from mother co.	.162	.031	1	*
4. Founders' years at mother co.	-.084	.074	-.016	1

**. Correlation is significant at the 0.01 level (2-tailed)

Correlation between all exogenous variables is not significant, with the exception of Industrial Relatedness and Technological relatedness. A degree of correlation between these two variables is to be expected and is in fact desirable, as they represent two dimensions of a single construct (Mother Company - Spin-off relatedness). The correlation coefficient between these two variables is still well below the conventional threshold of .80, allowing us to discard a priori multicollinearity problems affecting our predictor variables.

As an additional test, we computed the Variance Inflation Factors (VIF) for the exogenous variables. The VIF of an exogenous variable i is inverse of the tolerance value, or $1/(1 - R_i^2)$, where R_i^2 is the R^2 of a regression of exogenous variable i against all other exogenous variables (Heiberger and Holland, 2004). Having run a regression of each exogenous variable against the others, we found no evidence of multicollinearity problems, all VIF values being well below the accepted threshold of 2 (Hair et al., 1998; Tabachnick and Fidell, 2001). The results of this test are reported in Table 4.13.

Table 4.13: Tolerance and Variance Inflation Factors of exogenous variables.

Variable	R Square	Tolerance	VIF
1. Industrial relatedness	0.303	0.697	1.435
2. Technological relatedness	0.283	0.717	1.395
3. Equity stake from mother co.	0.029	0.971	1.030
4. Founders' years at mother co.	0.023	0.977	1.024

4.7.2 Proper specification

As described in the previous chapter, specification of a model refers to the inclusion of all significant variables, the exclusion of extraneous variables and also to correctly specifying the direction of the causal relationships. A model that is not properly specified can display incorrect parameter estimates, not only in magnitude but sometimes even in direction.

There is no definitive statistical test for misspecification and theory is the best protection against it. In structural equation models, as a rule of thumb, poor model fit measures are an indication of incorrect specification (Byrne, 2001). In our analysis, lack of predicted correlation and non-significant regressions among a large proportion of hypothesized antecedent and dependent variables would be an indication of poor specification.

4.7.3 Sample size

Sample size is frequently an issue in social sciences research. For instance, in management research, sampling units may be firms and respondents may be top managers who are limited in number, or they could be a small subset of companies which are difficult to identify and survey in an economy.

A key concern in dealing with smaller samples is reduced statistical power, or in other words a higher probability that our tests will fail to reject a false null hypothesis. If statistical power is insufficient, the chances increase that we accept as valid a model which is incorrect (Type II error). For this reason, we choose to test our hypotheses using a variety of statistical methods, some less demanding than others in terms of sample size. In particular, we will carry out correlation analysis, ordinary least squares (OLS) multiple regression analysis and analysis of variance (ANOVA), for which the collected sample size is sufficient to ensure statistical power.

As evidence for this, we conducted post-hoc statistical power calculations on our multiple regressions. All regressions yield power results above the conventional .80 threshold (see Table 4.14).

A disadvantage of the methods cited above is that they test relationships one

Table 4.14: Post-hoc statistical power of multiple regressions

Regression	Power
Social capital $\longrightarrow$ net resource co-optation quantity	.97
Social capital $\longrightarrow$ net resource co-optation cheapness	.84
Mother co. support $\longrightarrow$ mother co. res. co-optation quantity	.99
Mother co. support $\longrightarrow$ mother co. res. co-optation cheapness	.82
Relatedness $\longrightarrow$ inherited structural social capital	.82
Relatedness $\longrightarrow$ inherited relational social capital	.93
Relatedness $\longrightarrow$ mother company support	.93

by one, instead of testing an entire theoretical model. In order to test our entire model, we will use path analysis, a method based on structural equation modeling. Admittedly, sample size poses a problem in using path analysis. As a rule of thumb for structural equation models, it is recommended to use a sample of at least 5 times the number of parameters that need to be estimated (Kline, 1998). Unfortunately, the response rate of corporate spin-offs, compounded by the inevitable issue of gaps in the dataset, is insufficient in our case to meet this criterion.

Large sample collection is a frequent problem in the field of business studies, and consequently, authors often publish findings based on small samples, even when using structural equation models. For example, Yli-Renko, Autio, and Tontti (2000) use a structural equation modeling approach to test for the effects of internal and external social capital on knowledge accumulation and international growth in a sample of 56 new technology-based firms. Despite the small sample size, they find support for their international growth model. In another study, Tsai and Ghoshal (1998) apply structural equation modeling techniques on a sample of 15 business units (45 respondents) to test for the effect of three dimensions of social capital on resource exchange and combination and on value creation. They find support for 5 of the 7 hypotheses in their model.

Despite the small sample size, we carry out a path analysis of our model. A key concern with small sample size is that it can more easily lead to non-normal variable distributions. As mentioned previously, we will address this concern in our path analyses firstly by assessing the normality of our variables individually, and at the multivariate level using Mardia's multivariate kurtosis indicator. As a second step, we will check the data for outliers, using the Mahalanobis multivariate distance indicator. Finally, we will evaluate the robustness of our model estimates using bootstrapping analysis.

5 RESULTS

In this chapter, we present the results of the statistical analysis of the collected data. The chapter will be structured as follows: we will have a first look at the dataset using analysis of model variable correlations. In the second section, we will test individual hypotheses using multiple regression and analysis of variance. We will test first our set of hypotheses on social capital inheritance and mother company support. Then we will test the hypotheses on the origin of social capital in spin-offs and *de novo* start-ups. We will conclude this section by testing our hypotheses on the antecedents of resource co-optation. In the third and final section of the chapter, we will test the full model using path analysis.

5.1 Correlation analysis of model variables

In this first section, we examine the correlations between the variables of our model, to gain some insight into the interactions apparent in the dataset. While correlation is no proof of causality, causality does imply correlation. Therefore, the presence and the sign of a correlation among variables can bring a first element of support to the hypothesized relations. Conversely, the absence of a correlation where a causal relation had been hypothesized would constitute evidence to reject said hypothesis.

Table 5.1 shows the correlations between model variables. In order to maximize data utilization, correlations have been calculated on a pairwise deletion basis. The table shows an encouraging number of significant correlations that are consistent with the hypothesized model. Both hypothesized dimensions of social capital are positively correlated, as is to be expected for two dimensions of a single construct. Both structural and relational inherited social capital are positively correlated with network resource co-optation. Dyadic social capital (mother company support) is positively associated with resource co-optation from the mother company. Industrial and technological relatedness are positively correlated with each other and with mother company support. Industrial relatedness and technological relatedness are positively correlated with relational and structural social capital inheritance, respectively, although only at the 10% level.

Table 5.1: Model variable correlations.

Variable	1	2	3	4	5	6	7	8	9	10	11
1. Industrial relatedness	1	*	*	*	*	*	*	*	*	*	*
2. Technological relatedness	.569**	1	*	*	*	*	*	*	*	*	*
3. Equity stake from mother co.	.162	.031	1	*	*	*	*	*	*	*	*
4. Founders' years at mother co.	-.084	.074	-.016	1	*	*	*	*	*	*	*
5. Inh. relational soc. capital	.266	.185	.091	-.079	1	*	*	*	*	*	*
6. Inh. structural soc. capital	.039	.251†	.192	-.096	.275†	1	*	*	*	*	*
7. Mother company support	.425**	.403**	.171	.057	.207	.068	1	*	*	*	*
8. Net resource co-optation qty.	.307*	.232†	.089	-.003	.487**	.358**	.258†	1	*	*	*
9. Net res. co-optation cheapness	.337*	.215	.039	-.136	.304*	.157	.308*	.761**	1	*	*
10. Mother co. resource co-opt. qty.	.449**	.320*	.184	-.168	.425**	.103	.639**	.462**	.538**	1	*
11. Mother co. resource co-opt. chp.	.358*	.304*	.178	.001	.290*	.160	.390**	.353*	.452**	.778**	1

†. Correlation is significant at the 0.1 level (2-tailed)

*. Correlation is significant at the 0.05 level (2-tailed)

**. Correlation is significant at the 0.01 level (2-tailed)

Relatedness measures are also correlated with resource co-optation, suggesting a common causal mechanism linking relatedness, social capital inheritance and resource co-optation. Network resource co-optation and mother company resource co-optation are positively correlated, suggesting that spin-offs rely on both avenues for resource acquisition when available and that one type of co-optation does not necessarily preclude the other.

Correlation analysis makes no assumptions about the direction or even the existence of causality in a relation, and therefore we must not pay excessive attention to these results. However, we note that the pattern of correlations found in the data is globally consistent with the core hypotheses of our model. The main predictors of social capital inheritance and mother company support are correlated with the hypothesized dependent variables. Social capital inheritance and mother company support are correlated with resource co-optation, boding well for this central piece of the model.

The correlation table also provides information about the probable relative strengths of the different relations at play, suggesting aspects to seek confirmation of in the next steps of the analysis. Relational social capital, for example, correlates more clearly with both dimensions of network resource co-optation than structural social capital. The quantity dimension of resource co-optation, be it from the network or from the mother company, correlates more strongly with social capital inheritance and mother company support, which gives us some hints about the process of resource acquisition through social capital.

Lastly, correlation analysis serves as a warning that some variables may not be found to be good predictors in the next steps of the study. Such is the case of the mother company's equity share and the number of years founders worked at the mother company before transferring to the spin-off. Given the relatively large number of predictors in the model, it was to be expected that some would prove inadequate.

5.2 Analysis of individual hypotheses

In this section, we examine the individual causal relationships among the model variables. Multiple ordinary least-squares (OLS) regression is conducted on each dependent variable using the predictors hypothesized in the previous chapter. Again, we use pairwise deletion instead of listwise deletion in order to maximize sample data utilization.

5.2.1 Antecedents of social capital inheritance

We test first our hypotheses on the impact of several antecedents on the inheritance of structural and relational social capital. Our hypotheses, spelled out in Chapter 3, were the following:

H1 : The more personnel is transferred between the mother company and the spin-off at the time of the spin-off's founding, and the longer this personnel has worked at the mother company, the higher the inheritance of firm-level social capital by the spin-off from its mother company.

H2 : The higher the relatedness between the mother company's activities and the spin-off's activities, the higher the inheritance of social capital by the spin-off from its mother company.

H3 : The higher the relatedness between the mother company's activities and the spin-off's activities, the higher the degree of support the mother company can offer the spin-off.

H4 : The higher the degree of support offered the spin-off by the mother company, the higher the inheritance of social capital by the spin-off from the mother company.

H5 : The higher the ownership stake held by the mother company in the spin-off, the higher the inheritance of social capital by the spin-off from its mother company.

Focusing first on the structural dimension of social capital, multiple regression analysis provides support to the hypothesis H2. The regression analysis shows that relatedness between the mother company's and the spin-off's activities has a significant positive impact on inheritance of structural social capital. In particular, Technological relatedness has a $Beta$ coefficient of .518 and a p value of .002. The other measured dimension of relatedness (industrial relatedness) does not seem to affect structural social capital inheritance significantly ($p = .312$). The equity stake held by the mother company in the spin-off has a positive $Beta$ coefficient of .231, and the relationship is significant at the .1 level, bringing partial support for hypothesis H5. We find no evidence of a positive relationship between personnel transfer and degree of mother company support, on one hand, and the inheritance of structural social capital, on the other (hypotheses H1 and H4), as those antecedents do not relate significantly to the inheritance of structural social capital in our sample (p values .437 and .457). The results of the first multiple regression are summarized in Table 5.2.

Table 5.2: Regression: antecedents of inherited structural social capital

R	**R Square**	**Adj. R Square**	**Std. Error**
.487	.238	.149	6.067
Variable	**Beta**	**t**	**Sig**
(constant)		.495	.623
Technological relatedness	.518	3.287	.002
Industrial relatedness	-.161	-1.005	.321
Mother company support	-.113	-.751	.457
Equity stake from mother co.	.231	1.685	.099
Founders' years at mother co.	-.106	-.784	.437

Dependent variable: Inherited structural social capital

Table 5.3: Regression: antecedents of inherited relational social capital

R	**R Square**	**Adj. R Square**	**Std. Error**
.465	.216	.125	1.331
Variable	**Beta**	**t**	**Sig**
(constant)		1.282	.207
Technological relatedness	.177	1.125	.267
Industrial relatedness	.294	1.959	.057
Mother company support	.218	1.449	.155
Equity stake from mother co.	.032	.232	.818
Founders' years at mother co.	-.074	-.541	.591

Dependent variable: Inherited relational social capital

Turning now to the relational dimension of social capital, multiple regression analysis shows a significant positive effect of industrial relatedness on the inheritance of relational social capital, providing again support for hypothesis H2. This time, it is the industrial relatedness dimension that regresses positively against inherited social capital ($Beta = .294$, $p = .057$). Technological relatedness, although showing a positive effect as well, is not significant ($p = .267$). The analysis shows that although the effects of the other hypothesized antecedents (mother company support, personnel transfer and mother company ownership) on relational social capital inheritance are positive, they are not significant (p values comprised between .155 and .818), thus lending no support to hypotheses H1, H4 and H5. The results of this multiple regression are summarized in Table 5.3.

Regression analysis provides support for hypothesis H3, showing that relatedness between the spin-off's and the mother company's activities has a positive impact on the degree of mother company support (see Table 5.4). Industrial relatedness has a significant positive effect on mother company support ($p = .049$). Technological relatedness is only significant at the .1 level.

In summary of the above, multiple regression analysis provides support for our hypotheses linking relatedness between the spin-off's activities and the inheritance

Table 5.4: Regression: antecedents of mother company support

R	**R Square**	**Adj. R Square**	**Std. Error**
.477	.227	.196	1.664
Variable	**Beta**	**t**	**Sig**
(constant)		3.001	.004
Technological relatedness	.252	1.720	.092
Industrial relatedness	.296	2.022	.049

Dependent variable: Mother company support

of social capital (hypothesis H2). In addition, we find that different dimensions of relatedness appear to have an impact on different social capital dimensions, with industrial relatedness having a positive impact on relational social capital inheritance, whereas technological relatedness has a positive effect on structural social capital inheritance. We also find evidence confirming our hypothesis that stronger degrees of support from the mother company are to be expected when the activities of the spin-off are related to those of the mother company, particularly when there is industrial relatedness (hypothesis H3). Finally, we find some evidence indicating that an equity stake by the mother company in the spin-off has a positive impact on structural social capital inheritance (hypothesis H5).

5.2.2 Founder experience and firm-level social capital

We turn now to testing hypotheses H6a and H6b, which predict that founder experience will be a stronger source of firm-level social capital for *de novo* start-ups than for corporate spin-offs. As the reader will recall, our hypotheses were worded as follows:

H6a : The higher the experience of their founders, the higher the firm-level social capital of *de novo* start-ups.

H6b : Founder experience will have less positive impact on firm-level social capital of corporate spin-offs than for *de novo* start-ups.

An initial indication that founders play a relatively modest role in corporate spin-off's firm-level social capital formation was provided by the lack of support found for hypothesis H1, which stated that the total number of years that founders worked at the mother company before transferring to the spin-off positively influenced the spin-off's social capital inheritance.

In order to test hypotheses H6a and H6b, we will proceed as follows: first, we will test whether corporate spin-offs and *de novo* start-ups differ in their respective levels of social capital. Second, we will test for differences in the experience

levels of company founders. Finally, we will test whether founder experience is a predictor of total social capital and of strong network ties in spin-offs and in *de novo* start-ups, and whether any differences exist in this regard between both types of firms.

Because these analyses require comparing corporate spin-offs to *de novo* start-ups, we will be using a different dataset than in the preceding section, using our entire database of companies created between 1999 and 2005 (usable sample size: 142 firms).

Total social capital in *de novo* start-ups and spin-offs: As discussed in Chapter 4, we measured structural social capital for both corporate spin-offs and *de novo* start-ups, using the same "resource generator" questionnaire instrument, based on Lin et al. (2001). This instrument measures the total extensity of the respondents' network, as the number of firms they knew that could provide them with strategic resources. Respondents were also asked how many of those firms they had a strong tie with, and finally corporate spin-off founders were asked how many contacts had been developed while at the mother company, or in other words "inherited". For the purpose of testing hypotheses H6a and H6b, we are interested in the total contacts, i.e. not just those that were inherited.

Firstly, we compared the total amount of social capital held by the *de novo* start-ups and corporate spin-offs in our sample, using one-way analysis of variance (ANOVA). The total amount of structural social capital does not differ significantly between spin-offs and *de novo* start-ups ($p = .372$).

Second, we compared the number of ties qualified as "strong" by respondents in corporate spin-offs and *de novo* start-ups. Our ANOVA test shows that the number of strong network ties does not differ significantly between between both groups of firms ($p = .435$).

These results suggest that corporate spin-offs and *de novo* start-ups have similar network extensity and a similar number of strong network ties. Table 5.5 summarizes the results of both one-way ANOVA tests.

Table 5.5: ANOVA: total social capital of spin-offs and *de novo* start-ups

Variable	F	Sig.
Total structural social capital	.802	.372
Total strong network ties	.612	.435

Founder experience in *de novo* start-ups and spin-offs: As a second step, we compare the amount of founder experience in corporate spin-offs and *de novo* start-ups. Using one-way ANOVA, we find little difference in the amount of experience

that spin-off and *de novo* start-up founders bring into their respective new ventures. Only the number of years of experience in the new venture's industry differed across both company groups, although the difference was only significant at the .1 level. In our sample, the founding teams of corporate spin-offs total a higher number of years of experience in their new venture's industry than the founding teams of *de novo* start-ups (on average, 19.3 years vs. 14.1, respectively). Start-up founding teams total a slightly higher number of years of experience in other industries (10.7 years vs. 9.6), as well as a slightly higher number of higher education years (5.7 years vs. 5.4), but these differences are not statistically significant (p values range between .569 and .749). Table 5.6 summarizes the results of the ANOVA tests.

Table 5.6: ANOVA: experience of spin-off and *de novo* start-up founders

Variable	F	Sig.
Years of experience (same industry)	3.603	.060
Years of experience (other industries)	.257	.613
Number of industries worked in	.325	.569
Total years of higher education	103	.749

Founder experience and social capital in *de novo* start-ups: At this point, we test whether founder experience has an effect on the level of social capital of *de novo* start-ups. We use three indicators of start-up founder experience: (1) Total years of experience in the industry the company was founded; (2) Total years of experience in other industries, and (3) Total years of higher education. We run a multiple regression using the above variables as predictors for the start-ups' total structural social capital, then for the total number of strong ties in the network.

In both cases, we find that all three variables are significantly and positively related to the start-ups' social capital, with p values comprised between .000 and .019 in the case of total structural social capital and between .000 and .132 in the case of strong network ties. The R^2 values for the regressions are .495 and .466 for total structural social capital and for strong network ties, respectively, indicating that founder experience is a good predictor of social capital in early-stage *de novo* start-ups.

This result confirms that individual-level social capital of founders is an important source of firm-level social capital of *de novo* start-ups (hypothesis H6a), and is consistent with previous studies of founder experience and firm-level social capital (Arenius, 2002). Tables 5.7 and 5.8 summarize the results of the multiple regression analyses.

Founder experience and social capital in spin-offs: As a next step, we ran a multiple regression analysis of the same measures of founder experience against

Table 5.7: Regression: *de novo* start-up founder experience ⟶ total structural social capital

R	**R Square**	**Adj. R Square**	**Std. Error**
.704	.495	.478	17.81
Variable	**Beta**	**t**	**Sig**
(constant)		-2.820	.006
Years of experience (same industry)	.456	5.668	.000
Years of experience (other industries)	.198	2.388	.019
Total years of higher education	.302	3.728	.000

Dependent variable: Total structural social capital

Table 5.8: Regression: *de novo* start-up founder experience ⟶ strong network ties

R	**R Square**	**Adj. R Square**	**Std. Error**
.683	.466	.448	10.49
Variable	**Beta**	**t**	**Sig**
(constant)		-1.840	-0.69
Years of experience (same industry)	.410	4.996	.000
Years of experience (other industries)	.129	1.522	.132
Total years of higher education	.381	4.602	.000

Dependent variable: Strong network ties

the total structural social capital level and the number of strong network ties of corporate spin-offs.

Contrary to what was found in the case of *de novo* start-ups, in our sample founder experience does not predict total social capital or number of strong network ties for spin-offs. All three founder experience indicators regress non-significantly against total structural social capital, with p values comprised between .309 and .547 in the case of total structural social capital and between .082 and .594 in the case of strong network ties. The R^2 values are respectively .054 and .094. The results of both regressions are shown in Tables 5.9 and 5.10.

Table 5.9: Regression: spin-off founder experience ⟶ total structural social capital

R	**R Square**	**Adj. R Square**	**Std. Error**
.233	.054	-.040	10.183
Variable	**Beta**	**t**	**Sig**
(constant)		1.211	.235
Years of experience (same industry)	.121	.634	.531
Years of experience (other industries)	-.110	-.609	.547
Total years of higher education	.195	1.035	.309

Dependent variable: Total structural social capital

This difference in the impact of founder experience on social capital between spin-offs and *de novo* start-ups is striking and supports hypothesis H6b. It is also

Table 5.10: Regression: spin-off founder experience ⟶ strong network ties

R	**R Square**	**Adj. R Square**	**Std. Error**
.308	.095	.032	6.50
Variable	**Beta**	**t**	**Sig**
(constant)		2.192	.034
Years of experience (same industry)	.082	.537	.594
Years of experience (other industries)	.009	.055	.956
Total years of higher education	.290	1.780	.082

Dependent variable: Strong network ties

consistent with our previous result that the number of founders transferred from the mother company did not significantly impact the spin-off's social capital inheritance. Also, founder experience does not appear to significantly impact the spin-off's relational social capital, as indicated by the lack of explanatory power for strong network ties.

Comparison between *de novo* start-ups and corporate spin-offs highlights an interesting difference between these two types of firm. Where *de novo* start-ups rely heavily on their founder's individual-level social capital and experience to derive their firm-level social capital in the early stages of their development, corporate spin-offs' social capital is not affected by this. Contrary to *de novo* start-ups, and although their founding teams are slightly more experienced, spin-offs do not seem to draw firm-level social capital predominantly from their founders' experience. Yet, as we find no significant difference in the total endowment of social capital between both firm groups, it follows that the origin of spin-off's social capital must be different.

In summary, we find support for hypotheses H6a and H6b. We suggest in this dissertation that social capital inheritance is a key source of firm-level social capital for spin-offs in their early development phase. Our findings support our proposition that a different mechanism of firm-level social capital inheritance by corporate spin-offs exists. Instead of being mainly explained by the transfer of entrepreneurs' individual-level social capital, as is the case for *de novo* start-ups, we find that spin-offs' social capital is influenced by industrial and technological relatedness to their mother companies.

5.2.3 Inherited social capital and network resource co-optation

We turn now to the last set of hypotheses in our model, which concern the impact of inherited social capital and resource co-optation by spin-offs. Our hypotheses were the following:

H7 : The higher the social capital inherited by the spin-off, the higher the resource co-optation from the network.

H8 : The higher the degree of support offered the spin-off by the mother company, the higher the resource co-optation from the mother company.

Regression analysis supports hypothesis H7, showing that inherited social capital has a significant positive effect on the quantity and cheapness of resources co-opted from the network.

The relational dimension of social capital, in particular, seems to be decisive in resource co-optation, both in terms of the quantity and cheapness of resources co-opted (p values of .002 and .004, respectively, and $beta$ values of .422 and .418). The structural dimension of social capital appears to play a lesser role, with lower $beta$ values (.239 for resource co-optation quantity and .020 for resource cheapness) and lower significance (at the .1 level in the case of resource co-optation quantity, non-significant in the case of resource cheapness).

The results of both regressions are summarized in in Tables 5.11 and 5.12.

Table 5.11: Regression: social capital $\longrightarrow$ net resource co-optation quantity

R	**R Square**	**Adj. R Square**	**Std. Error**
.539	.290	.261	12.27
Variable	**Beta**	**t**	**Sig**
(constant)		3.475	.001
Inh. structural soc. capital	.239	1.893	.064
Inh. relational soc. capital	.422	3.335	.002

Dependent variable: Net resource co-optation quantity

Table 5.12: Regression: social capital $\longrightarrow$ net resource co-optation cheapness

R	**R Square**	**Adj. R Square**	**Std. Error**
.425	.180	.145	13.97
Variable	**Beta**	**t**	**Sig**
(constant)		2.408	.020
Inh. structural soc. capital	.020	.142	.887
Inh. relational soc. capital	.418	3.015	.004

Dependent variable: Net resource co-optation cheapness

Regression analysis also supports hypothesis H8, indicating a strong positive effect of mother company support on the quantity ($beta = .639$, $p = .000$) and cheapness ($beta = .390$, $p = .006$) of resources co-opted by the spin-off from the mother company.

The results of these regressions are summarized in Tables 5.13 and 5.14.

Table 5.13: Regression: mother company support ⟶ mother company resource co-optation quantity

R	R Square	Adj. R Square	Std. Error
.639	.408	.396	13.14
Variable	**Beta**	**t**	**Sig**
(constant)		-.886	.380
Mother company support	.639	5.809	.000

Dependent variable: Mother company resource co-optation quantity

Table 5.14: Regression: mother company support ⟶ mother company resource co-optation cheapness

R	R Square	Adj. R Square	Std. Error
.390	.152	.134	17.52
Variable	**Beta**	**t**	**Sig**
(constant)		.936	.354
Mother company support	.390	2.873	.006

Dependent variable: Mother company resource co-optation cheapness

5.2.4 Control variable: Company age

As a control test, we checked whether company age had an influence on the endogenous variables in the model. We did this by running a series of regressions of the spin-offs' age at the time of survey against each endogenous variable in the model. Company age was not found to be a significant predictor of any of these variables, with p values comprised between .073 and .995. The results of the regressions are summarized in Table 5.15.

Table 5.15: Control regression: company age ⟶ endogenous model variables

Variable	R Square	Beta	Sig.
Inh. relational social capital	.003	-.056	.724
Inh. structural social capital	.016	-.807	.424
Net resource co-optation quantity	.073	-.270	.073
Net resource co-optation cheapness	.039	-.196	.202
Mother co. resource co-optation quantity	.000	-.022	.894
Mother co. resource co-optation cheapness	.007	-.086	.596
Mother company support	.000	-.001	.995

Ideally, we would have also liked to check whether company industry, another commonly-used control variable in strategic management studies, had an influence on the endogenous variables in our model. Unfortunately, this was not feasible in our case, due to the combined issues of small sample size and the distribution of industries in our sample. As discussed previously (see Table 4.2), in our sample the "Data Processing", "Software" and "Data Processing Services" industries account

for over 80% of the corporate spin-offs, with other industries only accounting for less than 5-10% each (i.e. only 1 to 4 spin-offs respondents per industry). Given the sizes of these sub-groups, results would not have been meaningful.

5.2.5 Individual hypotheses tests: Conclusions

In the previous pages we tested all the hypotheses that we formulated in the theoretical part of this dissertation using multiple regression and analysis of variance. Our results provide empirical support for several of the hypothesized relations, as well as evidence to discard others. They also shed light on the relative strength of the interactions between the different dimensions of the theoretical constructs.

The relations which are found to be significant concern the role of relatedness as an antecedent of social capital inheritance and mother company support, and the importance of inherited social capital and mother company support in co-optation of resources.

Both dimensions of inherited social capital are found to be significantly and positively influenced by the relatedness between the spin-off's and the mother company's activities. This relation is stronger between technological relatedness and structural social capital, on one hand, and between industrial relatedness and relational social capital, on the other hand. Inheritance of social capital, however, does not seem to depend on the mother company's attitude or the number of founders that originated from the mother company. To apply the biological metaphor of spin-offs (Klepper and Sleeper, 2005), this result suggests that the source of the social capital inheritance is the very "lineage" of the spin-off, i.e. "who" the spin-off's mother company is. Social capital inheritance seems to occur independently of the mother company's will and to not even rely on personnel transfer as a vehicle.

Concerning the role of new venture founders as a source social capital, our results show a stark contrast between corporate spin-offs and *de novo* start-ups. Whereas the latter derive substantial firm-level social capital from their founders' individual-level social capital, we find that in the case of corporate spin-offs, founders' social capital is not a predictor of firm-level social capital. Given that there is no difference in the amount of experience between founders of *de novo* start-ups and corporate spin-offs, and that both types of firms have similar amounts of firm-level social capital, this finding brings support to our proposition that the source of firm-level social capital is different between both types of firms and that social capital inheritance is strongly at play between mother companies and their spin-offs.

Inherited social capital is found to significantly and positively affect co-optation of resources from the network, on both dimensions of quantity and cheapness. Both the structural and the relational dimensions of social capital play a role, but the relational dimension seems to be predominant, influencing quantity and price of the

acquired resources, whereas the effect of structural social capital seems constrained to quantity. In any case, the main benefit of inherited social capital seems to lie in the acquisition of higher levels of resources, not so much in a price advantage. We suggest the interpretation that corporate spin-offs, armed with their inherited social capital, do not so much receive "gifts" from other actors in the network as they are able to quickly identify the resources available through the network, establish credibility with the relevant contacts and secure access to the necessary resources. The "cheapness" of resource co-optation comes only as an additional benefit, indicating that relational social capital serves to counter to a certain extent the spin-off's lack of track record with other network actors.

Regarding co-optation of resources from the mother company, the results show that favorably disposed mother companies provide significantly more resources and at a better price to their spin-offs. The results also show that when the opportunity is available, spin-offs will significantly leverage their mother company as a complement, but not a substitute, to network resource co-optation. As was the case for network resource co-optation, the quantity dimension seems to be more strongly influenced than the cheapness dimension. However, the difference is not as strong, suggesting that supportive mother companies engage in subsidizing behavior towards their spin-offs. This could be explained by the mother company having more information regarding the spin-off than outside network agents and being therefore better able to evaluate the economic potential and risks associated with their patronage of the spin-off.

5.3 Path analysis: testing the theoretical model as a whole

Having tested individual hypotheses in the previous section, we now test the theoretical model as a whole. In the following pages, we describe the results of the path analysis conducted on two alternative versions of the theoretical model of social capital inheritance and resource co-optation by corporate spin-offs. The first path analysis is run on the full version of the model that was presented in Chapter 3. In the second path analysis, in line with standard practice in structural equation modeling (Byrne, 2001; Maruyama, 1998), we test model fit after dropping variables that do not show significant regression paths and/or exhibit strong deviations from the normality assumption.

The path analyses will again test our hypotheses H1 through H5 and H7 through H8, which were formulated as follows:

H1 : The more personnel is transferred between the mother company and the spin-off at the time of the spin-off's founding, and the longer this personnel has

worked at the mother company, the higher the inheritance of firm-level social capital by the spin-off from its mother company.

H2 : The higher the relatedness between the mother company's activities and the spin-off's activities, the higher the inheritance of social capital by the spin-off from its mother company.

H3 : The higher the relatedness between the mother company's activities and the spin-off's activities, the higher the degree of support the mother company can offer the spin-off.

H4 : The higher the degree of support offered the spin-off by the mother company, the higher the inheritance of social capital by the spin-off from the mother company.

H5 : The higher the ownership stake held by the mother company in the spin-off, the higher the inheritance of social capital by the spin-off from its mother company.

H7 : The higher the social capital inherited by the spin-off, the higher the resource co-optation from the network.

H8 : The higher the degree of support offered the spin-off by the mother company, the higher the resource co-optation from the mother company.

It should be noted that because Hypotheses 6a and 6b involve testing a different set of companies (*de novo* start-ups and corporate spin-offs), these cannot be included in the path analysis model.

5.3.1 Path analysis: model 1

We first test the full version of the model[1]. We will present the results of this analysis in three steps. First, we will give an overview of the results regarding the fit of the overall model to the dataset and examine the individual regression relations that are found to be significant. Second, we will test whether the dataset used in the path analysis deviates significantly from the multivariate normality assumption, which could affect the precision of the path analysis results, as discussed in Section 4.7.3.

[1] Note: the sample size used in this path analysis is N=44. This number is lower than N=57 used in the previous correlation and multiple regression analyses, due to the fact that path analysis requires the same number of observations for all regressions. Additionally, the bootstrapping techniques we will use to assess the impact of sample size do not allow missing data. For these reasons, we use listwise deletion on all cases with missing data.

Third, we will evaluate the robustness of our model estimates using bootstrapping analysis.

Overall model fit and hypotheses test

We first examine the overall fit of our model to the data. As discussed in Chapter 4, model fit is measured by the following tests, based on the approach by Messner et al. (2004): (1) Chi-Square; (2) Goodness-of-Fit Index (GFI); (3) Comparative Fit Index (CFI) and (4) Root Mean Square Error of Approximation (RMSEA).

Model fit statistics are satisfactory. Chi-squared is not significant, with a p-value of .686. A significant Chi-squared value would have indicated a significant difference between the observed and predicted variance/covariance matrix, and would be an indication of poor fit of the tested model to the data.

The following fit indicator, GFI, yielded a value of .903, indicating a satisfactory percentage of observed covariances that are explained by the covariances implied by the model. Conventionally, GFI values above .9 indicate good model fit (Bentler, 1990).

The CFI indicator also shows good model fit, with a value of 1.0 whereas the conventional threshold is at .9 (Byrne, 2001). CFI is of particular importance in our case, because it is the least sensitive to sample size (Fan et al., 1999).

The same applies to the RMSEA, which gives a value of .000 in our sample, with a PCLOSE value of .810, indicating adequate to good model fit (Browne and Cudeck, 1993).

In light of the above results, we find that the data fits the well. Let us now take a closer look at the results of the regression paths included in the model. These results provide empirical evidence to support or reject our hypotheses, as well as indications on possible improvements of the model.

The regression path results confirm the results of the individual regression analyses conducted earlier. They provide support for and reject the same sets of hypotheses.

We find a significant relationship between industrial relatedness and relational social capital inheritance ($p = .01$), as well as between technological relatedness and structural social capital inheritance ($p = .00$), providing support for hypothesis H2.

We also find a positive relationship between industrial and technological relatedness, on one hand, and mother company support, on the other hand (p values of .08 and .21, respectively). This brings some support for hypothesis H3, but the significance of these regressions is poorer than in the individual regression analysis conducted earlier.

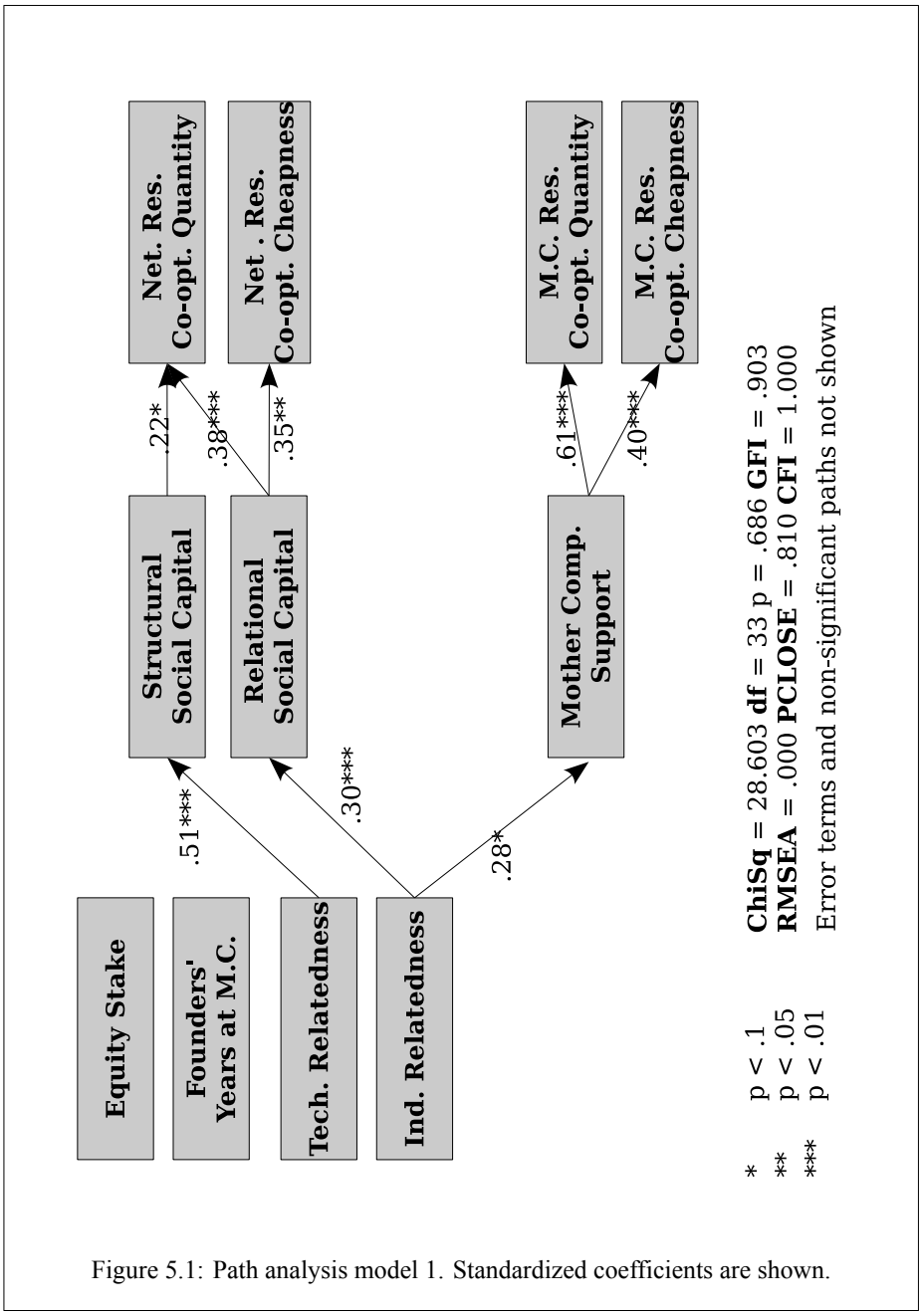

Figure 5.1: Path analysis model 1. Standardized coefficients are shown.

Table 5.16: Model 1: regression estimates

Regression Path	Std. Estimate	Estimate	S.E.	C.R.	P
Mother company support ⟵ Industrial relatedness	.28	.33	.19	1.72	.08
Mother company support ⟵ Tech. relatedness	.20	.19	.16	1.25	.21
Inh. structural social capital ⟵ Industrial relatedness	-.13	-.59	.70	-.84	.40
Inh. structural social capital ⟵ Tech. relatedness	.51	1.88	.57	3.30	.00
Inh. structural social capital ⟵ Equity stake	.21	.04	.03	1.62	.11
Inh. structural social capital ⟵ Founder years at Mother co.	-.09	-.03	.04	-.69	.49
Inh. structural social capital ⟵ Mother co. support	-.09	-.33	.55	-.60	.55
Inh. relational social capital ⟵ Mother co. support	.14	.10	.11	.91	.37
Inh. relational social capital ⟵ Founder years at Mother co.	-.07	.00	.01	-.51	.61
Inh. relational social capital ⟵ Tech. relatedness	.11	.08	.11	.70	.49
Inh. relational social capital ⟵ Industrial relatedness	.30	.36	.14	2.62	.01
Inh. relational social capital ⟵ Equity stake	.10	.00	.01	.76	.45
Mother co. resource co-optation quantity ⟵ Mother co. support	.61	5.45	1.09	4.99	.00
Mother co. resource co-optation cheapness ⟵ Mother co. support	.40	4.19	1.46	2.86	.00
Net resource co-optation cheapness ⟵ Inh. relational soc. cap.	.35	3.55	1.54	2.31	.02
Net resource co-optation quantity ⟵ Inh. relational soc. cap.	.38	3.75	1.39	2.70	.01
Net resource co-optation quantity ⟵ Inh. structural soc. cap.	.22	.42	.24	1.71	.09
Net resource co-optation cheapness ⟵ Inh. structural soc. cap.	.10	.20	.30	.68	.50

Inherited social capital is found to predict network resource co-optation, bringing support for hypothesis H7, with the relational dimension being predominant and the effect being stronger on quantity of co-opted resources. Inherited relational social capital predicts network resource co-optation quantity ($Beta = .38$, $p = .01$) and cheapness ($Beta = .35$, $p = .02$). Inherited structural social capital is positively related to net resource co-optation quantity, but only significant at the .1 level.

Mother company support regresses positively and significantly on resource co-optation from the mother company, with strong effects on both quantity and cheapness ($p = .00$ in both cases), which is in line with our hypothesis H8.

As in the case of individual regression testing using OLS, we find no support for hypotheses H1 and H4, as social capital inheritance appears to occur independently of personnel transfer and mother company support. Hypothesis H5, which stated that mother company support would lead to higher inheritance of social capital, and which had only received moderate support in individual regression testing, is rejected by the path analysis. Figure 5.1 summarizes the results of the path analysis conducted on the full model and Table 5.16 shows the results of the path regressions.

Multivariate normality check

As discussed earlier, a critical assumption in path analysis, and structural equation models in general, is multivariate normality. We address this firstly by assessing the normality of our variables individually, and at the multivariate level. As a second step, we will check the data for outliers, using the Mahalanobis multivariate distance indicator. Finally, we will evaluate the robustness of our model estimates using bootstrapping analysis.

The first step in addressing this concern is diagnosing how much the data deviates from normal distributions. Table 5.17 shows the descriptive statistics (minimum, maximum, skewness, kurtosis and critical ratios) for the variables in the model, as well as the Mardia multivariate kurtosis indicator. At the univariate level, critical ratios (C.R.) below 1.96 are conventionally considered acceptable. In our results, two variables are of particular concern: Equity Stake and Founders' years at Mother company have critical ratios of kurtosis of 3.09 and 5.03, respectively, and critical ratios for skewness of 5.37 and 5.69, respectively. Three other variables (Inh. structural social capital, Net resource co-optation cheapness and Mother co. resource co-optation quantity) also have positive skewness values that are significantly different from zero, although to a lesser degree (C.R.: 3.42, 2.08 and 3.21, respectively). On the other hand, all other kurtosis values do not depart significantly from the normal distribution, a positive element, as kurtosis is the type of deviation from normality that most strongly affects Maximum Likelihood estimators (Byrne, 2001). Probably as a result of the strong deviation by the first two

variables, Mardia's multivariate kurtosis indicator is significantly different from zero (C.R. 2.36). Normality assumptions are therefore not perfectly respected, but this analysis gives us an indication that this issue is largely constrained to two variables (Equity stake, Founders' years at the Mother company). In a subsequent run of the path analysis, we will remove these two variables and check whether this improves model fit statistics.

Table 5.17: Model 1: assessment of normality

Variable	min	max	skew	c.r.	kurtosis	c.r.
Equity stake	.00	100.00	1.98	5.37	2.28	3.09
Founder years at Mother co.	.00	90.00	2.10	5.69	3.71	5.03
Tech. relatedness	1.00	7.00	-.66	-1.77	-.54	-.73
Industrial relatedness	1.00	7.00	.11	.30	-.81	-1.10
Mother company support	1.00	7.00	-.20	-.55	-1.05	-1.42
Inh. relational social capital	1.00	5.83	.36	.97	-.81	-1.10
Inh. structural social capital	.00	27.00	1.26	3.42	1.17	1.59
Net resource co-optation quantity	9.00	54.00	.24	.66	-1.05	-1.42
Net resource co-optation cheapness	9.00	60.00	.77	2.08	-.34	-.47
Mother co. resource co-optation cheapness	9.00	63.00	.72	1.94	-1.04	-1.41
Mother co. resource co-optation quantity	9.00	61.00	1.19	3.21	.03	.05
Multivariate					12.04	2.36

As a second step, we scanned the data for outliers and computed Mahalanobis's d-squared distance indicator and calculated the probability of observing these deviations from the centroid. Specifically, Table 5.18 focuses on the occurrence of outliers, individual observations that differ markedly from the general run of observations. The table lists the observations that are furthest from the centroid of all observations, using as the distance measure for the i-th observation the squared Mahalanobis distance. The p1 column indicates the probability of any arbitrary d-squared exceeding the observed value. The p2 column indicates the probability of the largest (or second largest, etc.) d-squared exceeding the observed value. Small numbers in the p1 column are to be expected. Small numbers in the p2 column, on the other hand, would indicate observations that are improbably far from the centroid under the hypothesis of normality (Arbuckle, 2006). In our data, none of the probabilities in the p2 column is significant (p2 values are comprised between .11 and .70), so there is no evidence that any of the five most unusual observations should be treated as outliers under the assumption of normality.

Table 5.18: Model 1: observations farthest from the centroid (Mahalanobis distance)

Observation number	Mahalanobis d-squared	p1	p2
2	21.70	.03	.70
9	20.83	.04	.46
13	20.21	.04	.29
25	19.77	.05	.16
36	19.16	.06	.11

Bootstrapping analysis

As a final step, having found evidence of non-normality in our dataset probably due to small sample size, we tried to assess the stability of our results using bootstrapping analysis.

We conducted a bootstrap of 2,000 iterations on our sample data in order to assess overall model fit using the Bollen-Stine corrected p-value (Arbuckle, 2006; Bollen and Stine, 1992). We obtained a Bollen-Stine p-value of .79, which does not allow us to reject the model as fitting the data correctly. In other words, the data does not depart significantly from the model at any conventional significance level.

Using bootstrapping analysis, we also computed confidence intervals for the parameter estimates, standard errors of parameter estimates, and significance tests for individual parameters. Table 5.19 shows the 90% confidence intervals and p values for the standardized regression weights in the model. Bootstrapping analysis confirms all regression paths that had previously been found to be significant, with the exception of the path between Industrial relatedness and Mother company support. This regression path was only significant at the .1 level in the original regression and has an estimated p value of .11 in the bootstrap, only a slight deterioration.

These results give us some degree of confidence in the stability of the parameter estimates despite the small sample size and some deviations from normality.

Table 5.19: Model 1: bootstrap confidence intervals, standardized regression estimates

Regression Path	Std. Estimate	Lower	Upper	P
Mother company support ⟵ Industrial relatedness	.28	-.01	.57	.11
Mother company support ⟵ Tech. relatedness	.20	-.11	.54	.30
Inh. structural social capital ⟵ Industrial relatedness	-.13	-.35	.07	.28
Inh. structural social capital ⟵ Tech. relatedness	.51	.29	.72	.00
Inh. structural social capital ⟵ Equity stake	.21	-.09	.52	.23
Inh. structural social capital ⟵ Founder years at Mother co.	-.09	-.35	.14	.59
Inh. structural social capital ⟵ Mother co. support	-.09	-.32	.14	.50
Inh. relational social capital ⟵ Mother co. support	.14	-.19	.41	.51
Inh. relational social capital ⟵ Founder years at Mother co.	-.07	-.26	.14	.50
Inh. relational social capital ⟵ Tech. relatedness	.11	-.16	.41	.55
Inh. relational social capital ⟵ Industrial relatedness	.30	.13	.54	.02
Inh. relational social capital ⟵ Equity stake	.10	-.13	.37	.47
Mother co. resource co-optation quantity ⟵ Mother co. support	.61	.44	.73	.00
Mother co. resource co-optation cheapness ⟵ Mother co. support	.40	.13	.62	.02
Net resource co-optation cheapness ⟵ Inh. relational soc. cap.	.35	.10	.57	.03
Net resource co-optation quantity ⟵ Inh. relational soc. cap.	.38	.15	.59	.00
Net resource co-optation quantity ⟵ Inh. structural soc. cap.	.22	.02	.43	.05
Net resource co-optation cheapness ⟵ Inh. structural soc. cap.	.10	-.12	.34	.44

5.3.2 Path analysis: model 2

In this section we examine the fit of an alternative path model, from which we discard those variables that were found to have no or very limited explanatory power, as well as having the highest deviations from normality. These variables are Founders' years at mother company and Equity stake owned by mother company[2].

As we did in the previous path analysis run, we will first give an overview of the overall model fit and the individual path regressions. We will then check the new dataset for multivariate normality and finally test the stability of the results using bootstrapping analysis.

Overall model fit and hypotheses test

The following are the results of the path analysis on the second version of the model, illustrated in Figure 5.2.

All goodness-of-fit statistics for this version of the model show good model fit, with some improvement over the previous version:

- Chi-squared is not significant, with a p-value of .624
- Goodness-of-Fit Index (GFI) stands at .935, above the recommended threshold of .9
- Comparative Fit Index (CFI) has a maximum value of 1.00
- Root Mean Square Error of Approximation (RMSEA) is calculated at .000, well below the recommended threshold of .05, and PCLOSE stands at .728

These goodness-of-fit results lead us to accept the current model as globally consistent with the data.

Turning to the regression paths between constructs, the sets of hypotheses that are supported or rejected by the path analysis are the same as in the previous path analysis run, as well as in the individual regression tests. Table 5.20 shows the regression weights for the paths included in the model, along with their standard error, critical ratio and P-value. The combination of good model fit and significant regression coefficients lend empirical support to hypotheses H2, H3, H7 and H8.

Technological relatedness has a significant positive effect on inherited structural social capital ($Beta = .48, p = .00$). Industrial relatedness has a significant positive

[2]Note: by removing these variables, available sample size after listwise deletion increases to 49 and the number of parameters to estimate decreases by 6.

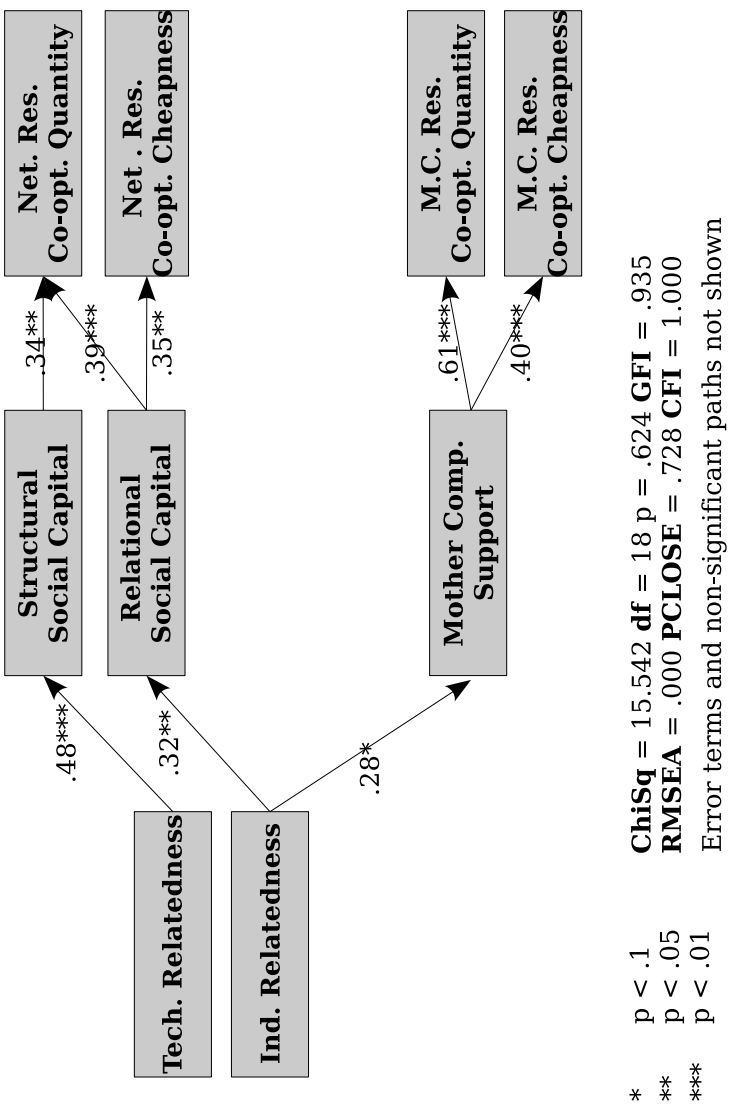

Figure 5.2: Path analysis model 2. Standardized coefficients are shown.

effect on inherited relational social capital ($Beta = .32$, $p = .05$). This is in line with our hypothesis H2.

Although the corresponding regression path is only significant at the .1 level, the positive regression coefficient of industrial relatedness on mother company support ($Beta = .28$, $p = .08$) lends some support to hypothesis H3.

Inherited relational social capital has a significant positive effect on both dimensions of network resource co-optation. The effect appears equally strong on quantity of resource co-optation and on "cheapness" ($Beta$: .39 and .35, respectively). Inherited structural social capital has a significant positive effect on the quantity dimension, but shows no significant effect on the "cheapness" of resource co-optation. This brings empirical support for hypothesis H7.

This result is consistent with the notion that the structural dimension of social capital refers to the ability to access resources through network ties rather than to the content or strength of those ties. It is the relational dimension of social capital which allows the spin-off to obtain more favorable conditions.

In line with hypothesis H8, mother company support has significant positive effects on both dimensions of resource co-optation from the mother company, the effect being stronger on the quantity dimension ($Beta = .61$, compared to .40).

The hypothesis H4 is not supported by the analysis of this model, as none of the corresponding regression paths yielded significant estimates. Our empirical evidence suggests that social capital inheritance is independent of the degree of support offered by the mother company. Hypothesis H5 was dropped from this path analysis along with the variable on the Equity stake held by the mother company in the spin-off.

Table 5.20: Model 2: regression estimates

Regression Path	Std. Estimate	Estimate	S.E.	C.R.	P
Mother company support ⟵ Industrial relatedness	.28	.33	.19	1.73	.09
Mother company support ⟵ Tech. relatedness	.20	.19	.16	1.25	.21
Inh. structural social capital ⟵ Industrial relatedness	-.08	-.37	.73	-.51	.61
Inh. structural social capital ⟵ Tech. relatedness	.48	1.76	.59	2.98	.00
Inh. structural social capital ⟵ Mother co. support	-.05	-.19	.57	-.35	.73
Inh. relational social capital ⟵ Mother co. support	.15	.11	.11	.99	.32
Inh. relational social capital ⟵ Tech. relatedness	.09	.07	.12	.57	.57
Inh. relational social capital ⟵ Industrial relatedness	.32	.28	.14	1.95	.05
Mother co. resource co-optation quantity ⟵ Mother co. support	.61	5.45	1.09	4.99	.00
Mother co. resource co-optation cheapness ⟵ Mother co. support	.40	4.19	1.47	2.86	.00
Net resource co-optation cheapness ⟵ Inh. relational soc. cap.	.35	3.56	1.54	2.32	.021
Net resource co-optation quantity ⟵ Inh. relational soc. cap.	.39	3.75	1.39	2.71	.01
Net resource co-optation quantity ⟵ Inh. structural soc. cap.	.34	.63	.26	2.48	.01
Net resource co-optation cheapness ⟵ Inh. structural soc. cap.	.10	.20	.30	.67	.50

Multivariate normality check

As we did for the previous model, we now test our data for normality, having excluded the two variables that deviated the most from normality. The results are reported in Table 5.21. Although skew is still a concern for three variables (Inh. structural social capital, Net resource co-optation cheapness and Mother co. resource co-optation quantity), with skew Critical Ratios (C.R.) of 3.42, 2.08 and 3.21, respectively, all variables have kurtosis values that do not depart significantly from the normal distribution. Also, and most importantly in the context of path analysis and structural equation modeling, Mardia's multivariate kurtosis indicator is now no longer significantly different from zero (C.R.: 1.32). Given this caveat that three variables show some degree of skewness, normality assumptions on a multivariate level are more closely respected in this second run of the path analysis.

Table 5.21: Model 2: assessment of normality

Variable	min	max	skew	c.r.	kurtosis	c.r.
Tech. relatedness	1.00	7.00	-.66	-1.77	-.54	-.73
Industrial relatedness	1.00	7.00	.11	.30	-.81	-1.10
Mother company support	1.00	7.00	-.20	-.55	-1.05	-1.42
Inh. relational social capital	1.00	5.83	.36	.97	-.81	-1.10
Inh. structural social capital	.00	27.00	1.26	3.42	1.17	1.59
Net resource co-optation quantity	9.00	54.00	.24	.66	-1.05	-1.42
Net resource co-optation cheapness	9.00	60.00	.77	2.08	-.34	-.47
Mother co. resource co-optation cheapness	9.00	63.00	.72	1.94	-1.04	-1.41
Mother co. resource co-optation quantity	9.00	61.00	1.19	3.21	.03	.05
Multivariate					5.60	1.32

Mahalanobis distance has also improved as a result of dropping the two most non-normal variables, as can be seen in Table 5.22. None of the p2 values are significant (range: .15 to .55), indicating that none of the observations can be considered outliers under the assumption of normality. Also, the lowest values in the p2 column are higher than in the previous run of the path analysis, indicating an improvement.

Table 5.22: Model 2: observations farthest from the centroid (Mahalanobis distance)

Observation number	Mahalanobis d-squared	p1	p2
2	19.972	.02	.55
25	17.677	.04	.52
15	17.310	.04	.31
6	17.096	.05	.15
42	15.693	.07	.22

Table 5.23: Model 2: bootstrap confidence intervals, standardized regression estimates

Regression Path	Std. Estimate	Lower	Upper	P
Mother company support ⟵ Industrial relatedness	.28	-.05	.59	.16
Mother company support ⟵ Tech. relatedness	.20	-.11	.54	.29
Inh. structural social capital ⟵ Industrial relatedness	-.08	-.29	.13	.59
Inh. structural social capital ⟵ Tech. relatedness	.48	.26	.66	.00
Inh. structural social capital ⟵ Mother co. support	-.05	-.31	.19	.71
Inh. relational social capital ⟵ Mother co. support	.15	-.15	.43	.39
Inh. relational social capital ⟵ Tech. relatedness	.09	-.13	.39	.49
Inh. relational social capital ⟵ Industrial relatedness	.32	.04	.54	.05
Mother co. resource co-optation quantity ⟵ Mother co. support	.61	.47	.74	.00
Mother co. resource co-optation cheapness ⟵ Mother co. support	.40	.11	.61	.02
Net resource co-optation cheapness ⟵ Inh. relational soc. cap.	.35	.08	.57	.04
Net resource co-optation quantity ⟵ Inh. relational soc. cap.	.39	.14	.56	.01
Net resource co-optation quantity ⟵ Inh. structural soc. cap.	.34	.06	.56	.05
Net resource co-optation cheapness ⟵ Inh. structural soc. cap.	.10	-.13	.31	.57

Bootstrapping analysis

Running again a bootstrap analysis (2,000 iterations), we obtain a Bollen-Stine corrected p-value of .77, which indicates good model fit to the data.

Finally, we use the bootstrap analysis to generate confidence intervals for parameter estimates, standard errors of parameter estimates, and significance tests for individual parameters. The results are shown in Table 5.23. The bootstrap analysis confirms all regression paths that were flagged as significant by the path analysis, giving us some level of confidence in the stability of the results in this second model, despite the small sample size.

5.3.3 Path analyses: Conclusions

The results of the two path analyses largely confirm those of multiple regression analysis, but give us additional information as to which combination of variables as a whole fit the data best. A significant regression path in a well-fitting model provides stronger support for the underlying hypothesis than does isolated regression analysis (Byrne, 2001).

The central portion of the initial theoretical model, consisting of the inheritance of social capital and its positive effect on resource co-optation, finds empirical support. Despite the small sample size, bootstrap analysis indicates that the path analysis results are quite stable.

Path analysis provides empirical support for hypothesis H2, which predicts that higher degrees of relatedness between the spin-off's activities and the mother company's will lead to higher inheritance of social capital for the spin-off. Looking at the dimensions of relatedness and social capital in more detail, we find that industrial relatedness has a positive effect on the inheritance of relational social capital, whereas technological relatedness positively impacts structural social capital inheritance.

We also find partial empirical support for hypothesis H3, although generally only at the .1 significance level. Industrial relatedness appears to have a positive effect on the degree of mother company support. One theoretical possibility that we would like to explore, and will discuss further in the next chapter, is that this low degree of significance could be caused by a relationship that is actually non-linear.

On the resource co-optation side of our model, we find empirical evidence supporting hypothesis H7, which predicts a positive impact of inherited social capital on the spin-off's resource co-optation from the network. Looking more closely at the dimensions of social capital and resource co-optation, we find that inherited structural social capital has a positive effect on the quantity of resource co-optation,

whereas relational social capital seems to positively affect both quantity and cheapness of resources co-opted by the company.

Lastly, our analyses support hypothesis H8, which predicted higher resource co-optation from the mother company when the mother company's attitude to the spin-off is favorable. We find that both quantity and cheapness of resource co-optation are positively affected by a supportive attitude from the mother company.

Our analyses also provided us with evidence to reject hypothesis H1, which stated that the number of founders transferred from the mother company to the spin-off would have a positive impact on inheritance of social capital. We believe this rejection is an interesting information regarding the mechanism of social capital inheritance for spin-offs as it indicates that the founders do not act so much as a vehicle, but that the social capital inheritance happens at the organizational level.

Hypothesis H4 is also rejected, which predicted higher levels of social capital inheritance in the presence of a supportive mother company. This also provides us information regarding the social capital inheritance mechanism, as it appears to occur independently of the mother company's attitude. We speculate that the "lineage" of the spin-off is what is at play in determining social capital inheritance, to use a biological metaphor from the spin-off literature (Klepper and Sleeper, 2005). We will investigate this point further in the next chapter.

6 CONCLUSIONS

The final chapter of this dissertation presents the main findings of our research. Our conclusions regarding the inheritance of social capital, its antecedents and impact for spin-offs and *de novo* start-ups are discussed. We discuss the implications of our findings from a theoretical and managerial standpoint and draw the reader's attention to the limitations of the study. Finally, we conclude by suggesting avenues for further research.

6.1 Conclusions

The Figure 6.1 crystallizes the model developed from our empirical observations, showing only those hypothesized relations that were supported[1]. In the following sections, we present our findings on the relations between the constructs identified in the model.

6.1.1 Inheritance of social capital

The first research question of this dissertation was whether social capital could be inherited between a mother company and its spin-offs, and if so which factors affected the level of inheritance and which dimensions of social capital were involved. We find that inheritance of structural and relational social capital does occur between mother company and spin-off and that the level of inheritance is positively affected by industrial and technological relatedness between the two firms. We also find that relatedness positively affects the level of support that the mother company is willing to give its spin-off, although social capital inheritance happens largely independently of the mother company's stance. Lastly, we find that corporate spin-offs differ significantly from *de novo* start-ups in that they do not rely on their founders' individual-level social capital to form their firm-level social capital, but rather on firm-level social capital inheritance.

We hypothesized that inheritance of social capital would be positively influenced by relatedness between the mother company's and the spin-off's activities. One reason for this hypothesis is "relational inertia", or the notion that when social ties have proved productive in the past, actors are less prone to break away from them,

[1] In order to avoid unnecessary clutter, only the significant regressions in the second path analysis model are shown, and founder experience is limited to experience in the same industry.

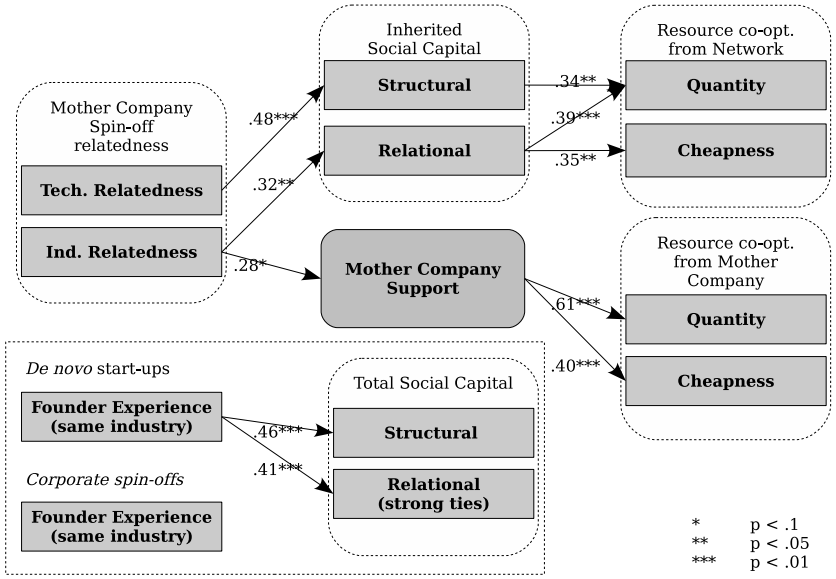

Figure 6.1: Conclusions: Significant paths and standardized coefficients are shown.

or even consider forming alternative ties (Coleman, 1988; Grabher, 1993). Spin-offs that are industrially related to their mother company would be all the more inclined to rely on ties inherited from the mother company, because these ties would likely retain their usefulness. A second justification for this hypothesis is that linkages where common knowledge exists can be used more efficiently to exchange knowledge and resources, as well as increase the likelihood of common interests for cooperation between organizations (Cohen and Levinthal, 1990; Inkpen, 1998; Sapienza et al., 2004). For this reason, spin-offs in related lines of business will be all the more prone to rely on their inherited contacts. A third justification for our hypothesis was based on institutional theories, which argue that firms with related activities will tend to adopt similar organizational forms, due to environmental pressure, which will in turn result in higher legitimacy towards the actors in their environment (Dimaggio and Powell, 1983).

This hypothesis is supported by our empirical findings. Industrial and technological relatedness are positively associated with structural and relational social capital. Regression analysis shows that relatedness between the mother company's and the spin-off's activities has a significant positive impact on inheritance of structural and relational social capital.

We also hypothesized that relatedness between the mother company's and the

spin-off's activities would have a positive impact on the degree of support that the mother company provided to the spin-off. This hypothesis was based on the same arguments as the previous one: greater legitimacy resulting from similar organizational forms (Dimaggio and Powell, 1983) and a greater degree of overlap in the knowledge bases, leading to higher likelihood and interest of knowledge and resource exchange and cooperation (Cohen and Levinthal, 1990; Inkpen, 1998; Sapienza et al., 2004).

This hypothesis also found empirical support in our sample. Industrial and technological relatedness were positively correlated with mother company support and regression results showed a positive relation between the hypothesized constructs.

Several authors have proposed that newly-created ventures may benefit from the credibility and prestige of an incumbent organization of they are perceived by the network as associated to the incumbent (Arenius, 2002; Stuart et al., 1999). The literature suggests that this perception of association can be increased through several factors. Our findings show that technological and industrial relatedness are the most prominent of these factors and indeed constitute a predictor of social capital inheritance. When the spin-off develops in the same direction that the mother company is known for, it can more readily leverage the mother company's social capital and reputation. For example, spin-offs can then resort to marketing slogans such as "*From the same development team that brought you product X*". Indeed, 65% of the spin-offs in our sample found that the link to the mother company was very useful in establishing credibility towards potential customers.

Other factors suggested in the literature that could potentially increase the association and transfer of social capital between mother company and spin-off, such as transfer of personnel or resources, were tested but found not to contribute as significantly as industrial and technological relatedness. In our sample, social capital inheritance is explained by the relatedness link between spin-off and mother company, and occurs largely independently of the mother company's willingness to cooperate in the process or even the number or experience at the mother company of the spin-off's founders.

This latter point takes on additional importance when considered together with the comparison of spin-offs' and *de novo* start-ups' social capital sources. In her analysis of four in-depth case studies in the context of international social capital, Arenius (2002) finds evidence to indicate that the previous industry experience of new venture founders, particularly in related industries, serves as a vehicle for new ventures to develop part of their firm-level social capital. Our findings in this regard uncover a significant difference between *de novo* start-ups and corporate spin-offs. In our sample, we find strong empirical support for a positive relationship between founder experience (in the same industry, in other industries and in higher education) and the firm-level social capital of *de novo* start-ups. On the other

hand, founder experience does not predict firm-level social capital or social capital inheritance for corporate spin-offs, even though spin-off founding teams appear on average more experienced than start-up teams.

These findings lead us to conclude that inheritance of social capital occurs between corporate spin-offs and mother companies, and that the main explanatory factor behind this process lies in the association between both companies resulting from industrial and technological relatedness of their respective activities. We explain the difference in the importance of founders' experience between corporate spin-offs and *de novo* start-ups by the fact that *de novo* start-ups, not having the benefit of a founding organization to transfer initial social capital from, are left to rely more heavily on their founders' individual-level social capital, which is derived from their individual experiences. On the other hand, spin-offs, especially in related fields of activity, find it more relevant to rely on the existing social capital inherited from the mother company, rather than to form their social capital from the backgrounds of their individual founders.

6.1.2 Social capital inheritance and resource acquisition

The second research question of this dissertation covered how the inheritance of social capital would affect resource acquisition by new organizations. We find that inheritance of structural and relational social capital has a significant positive effect on resource acquisition through the process of resource co-optation. Spin-offs with higher levels of inherited social capital were able to co-opt resources from their network in both higher quantities and at lower prices than spin-offs with less inherited social capital. Further, we find that support by the mother company also translates into resource co-optation and that spin-offs that are able at co-opting resources from their mother company are generally also more able to co-opt resources from the rest of the network. The effect of social capital inheritance on resource acquisition is stronger on the quantity dimension than on the price dimension. Also, relational social capital shows a stronger effect on resource acquisition than structural social capital.

We hypothesized that the higher the level of social capital inherited by a spin-off, the higher its level of resource co-optation. Several authors consider that access to resources is implicit in the notion of social capital (Bourdieu, 1985; Burt, 1995; Nahapiet and Ghoshal, 1998). The literature also provides a number of examples of new ventures leveraging their social capital in order to increase resource accumulation and exchange (Tsai and Ghoshal, 1998; Yli-Renko, Autio, and Sapienza, 2001; Yli-Renko, Autio, and Tontti, 2000) or to obtain better conditions on the acquisition of resources (Uzzi, 1999).

This hypothesis found empirical support in our analysis. We find that social capital inheritance has a strong effect on resource co-optation by corporate spin-offs. Furthermore, having distinguished operationally quantity and price of resource co-optation, we found that the structural and the relational dimension of social capital play different roles in this process. The relational dimension has a positive effect on both the quantity and the price of resource co-optation and seems to play the more important role. The structural dimension has a positive effect on quantity of co-opted resources, but shows no significant impact on the price.

We also hypothesized higher levels of dyadic social capital between the spin-off and its mother company would lead to higher levels of resource co-optation from the mother company. Indeed, depending on the degree of support it is willing to offer, the mother company is ideally placed, as the spin-off's most evident point of contact, to provide it with initial resources. Several examples have been recorded where new venture founders leveraged their relation with a previous employer in order to gain access to resources such as meeting rooms, laboratory time or part-time access to company expertise (Arenius, 2002; Ndonzuau et al., 2002; Pirnay, 2001).

This hypothesis was also supported empirically in our sample. We found that mother company support had a strong positive impact on both the quantity and the price dimensions of resource co-optation, the stronger impact being on quantity.

Our analysis also shows strong positive correlation between resource co-optation from the mother company and from the network. Because social capital inheritance and mother company support do not appear to be correlated in our sample, this finding suggests the existence of a resource co-optation capability. In other words, firms that are able to co-opt resources from one source are also more readily able to co-opt resources from other sources even when faced with more limited social capital. This result also suggests that although mother company support does not directly explain social capital inheritance, it can still play a role in resource acquisition from the network by providing legitimacy and credibility to the spin-offs towards other network players.

6.2 Theoretical implications

This research seeks primarily to contribute to the body of knowledge in social capital theory. Most existing studies of the social capital of firms have focused on the creation of dyadic social capital within organizations (Tsai, 2000; Tsai and Ghoshal, 1998) or between network partners (Uzzi, 1997).

By contrast, in this study, we develop and study the notion of social capital inheritance and more broadly speaking of social capital transfer. Our research ties into the literature streams on knowledge transfer and legitimacy and contributes to

the body of knowledge on the sources of firm-level social capital.

Fukuyama (1995) notes how little is still known about the accumulation of social capital. The existing literature considers social capital as a by-product of other network activities (Coleman, 1988) or as the consequence of certain network configurations (Burt, 2000a). Other authors consider firm-level social capital primarily as an aggregate of individual-level social capital (Burt, 1995; Pennings et al., 1998) or as an appropriation by the firm of its members' social capital (Leenders and Gabbay, 1999). In this research, we distinguish between social capital that is inherited from the mother company and that which is created by the firm through other means. We suggest that new firms with special ties to an incumbent have the option to leverage the incumbent's social capital, and indeed are prone to do so rather than to rely on other sources such as the individual-level social capital of their founders. In so doing, we suggest a novel source of firm-level social capital and provide evidence to indicate that an organization's social capital is more than an aggregate of its members' individual-level social capital.

Our findings further suggest that there is substantial variation in the sources of an organization's social capital. Indeed, whereas our findings regarding *de novo* startups confirmed that the founders were a major source of social capital for the firm, results for spin-offs were strikingly different and suggested that founders did not constitute an important source of social capital, but that firm-level social capital had a different origin. We suggest firm-level social capital inheritance as the alternative source of social capital and we find technological and industrial relatedness to be predictors of social capital inheritance for corporate spin-offs.

Our research brings additional elements to the discussion of the competitive advantages afforded by social capital. Tsai and Ghoshal (1998) described how social capital between business units of a company increased resource exchange and cooperation. We adopt an external perspective of social capital and study the process through which social capital can help a new venture acquire resources and thus overcome its liability of newness. In so doing, we contribute to the literature stream of the "relational view", which as an extension of the resource-based view maintains that competitive advantage is not only derived from valuable, rare, difficult to imitate and non substitutable resources, but also in capabilities embedded in network relationships (Dyer and Singh, 1998; Lane and Lubatkin, 1998). This stream of literature sheds some light on how some entrepreneurial firms are able to leverage network knowledge and resources in order to overcome the liability of newness. Our research extends the literature by exploring in detail a hitherto little studied way in which entrepreneurial firms may procure the necessary network relationships in the early stages of their development.

This dissertation contributes both theoretical elements and empirical evidence to the discussion on the properties of social capital and on its importance for new

ventures. Tsai and Ghoshal (1998) examined the relations among the different dimensions of social capital defined by Nahapiet and Ghoshal (1998). Our empirical findings are consistent with, and bring further empirical evidence to, these authors' claim that dimensions of social capital interact, and in particular that structural social capital reinforces relational social capital. Furthermore, our study suggests that the different dimensions of social capital do not have the same impact on the development of new ventures, and in particular on their resource acquisition. Relational social capital seems to play a more important role than structural social capital in this area.

As the concept of social capital gains currency in an increasing number of applications in social sciences, it also runs the risk of diverging interpretations and measurement. Serious questions have been raised as to the concept's rigor and scientific usefulness, prompting several authors to press for the development of clear conceptualization (Anderson and Jack, 2002) and measurement (Lin et al., 2001). Our research contributes to this development not least because it is one of still relatively few studies carried out on external firm-level social capital with a primary measurement instrument (other examples include Lee et al. (2001) and Yli-Renko et al. (2001); see Burt (1995) and Tsai and Ghoshal (1998) for quantitative research from an internal perspective, and Chorev and Anderson (2006) for an external perspective example, but not focusing exclusively on social capital). By developing a quantitative instead of a qualitative approach (e.g. Arenius, 2002), we hope to contribute towards greater generalizability of the research findings. By opting for direct measurement instead of relying on archival sources (e.g. Florin et al., 2003), we can adapt more closely the measurement instrument and the theoretical conceptualization and are not as constrained by archival proxies. Inevitably, primary quantitative research also has its shortcomings, and by discussing these limitations at the end of this chapter we also hope to contribute to further development of measurement instruments and survey design in this field.

The literature on spin-offs presents evidence that spin-off firms put into practice knowledge and routines inherited from mother companies (Agarwal et al., 2004; Cantner et al., 2006; Dahl et al., 2003; Klepper, 2002; Wenting, 2008). So far, the literature has focussed strongly on knowledge, often of a tacit nature and difficult to imitate, acquired by spin-off founders during the course of their employment at the mother company (Klepper and Sleeper, 2005; Roberts and Hauptman, 1986; Teece et al., 1997). However, the links of the spin-off literature with the research on social capital have received less attention up to this point. In one rare example, Sedaitis (1998) compares the formation of alliances by newly-formed spin-offs and *de novo* start-ups in the context of the creation of commodity exchanges in the early years of post-Soviet market reform. Sedaitis finds that spin-off founding teams have greater homogeneity in past professional experience and strong network ties, which allows

them to quickly develop a shared vision and codes of behavior and to draw on founders' social capital to obtain necessary resources to begin the operation. On the other hand, although spin-offs enjoyed an easier founding process and resource acquisition, Sedaitis finds that *de novo* start-ups achieved greater performance a few years into operation, partly as a result of greater network heterogeneity leading to a higher probability of structural holes to exploit (Burt, 2000a). This dissertation contributes to the spin-off literature and expands on Sedaitis's findings in three ways. Firstly, Sedaitis compares spin-offs and *de novo* start-ups in a very particular historical, geographical and industrial context. Our findings in a completely different setting can contribute towards generalization of our understanding of the process of social capital inheritance by spin-offs in the early stages of their organizational life. Secondly, Sedaitis's article focuses on spin-off founders as the only source of social capital for spin-offs. We take a wider view by exploring inheritance of social capital at the organizational level, not just by the movement of founders. In this regard, this dissertation extends the "biological metaphor" of spin-offs, by considering that spin-offs can inherit social capital from their mother company in the same way that living organisms can inherit genes from their parents (Klepper, 2002; Klepper and Sleeper, 2005). Thirdly, Sedaitis's approach is qualitative (based on 9 case studies), whereas we use a wider-ranging quantitative approach through a survey, which although providing less in-depth information can also contribute to greater generalizability.

6.3 Managerial implications

We now turn to discussing the implications of our research for management practice. Our findings show that social capital, both structural and relational, plays an important role in the acquisition of resources by new entrepreneurial firms. Social capital allows such firms to acquire resources through co-optation, both in higher quantities and at lower prices, thus allowing these firms to overcome their liability of newness. It is suggested that social capital management should become an explicit part of managers' strategic thinking. The importance of social capital, and in particular relational social capital is already beginning to be recognized in respected practitioner publications (Buhner and Mitchell, 2005; Chantrain et al., 2008; Cross et al., 2007; De Smet et al., 2007; Uzzi and Dunlop, 2005). Our study contributes further academic evidence to this trend.

In this dissertation, we have focused largely on one particular type of new entrepreneurial firm, namely high technology spin-offs. Spin-offs are able to inherit structural and relational social capital from their mother companies. Because at early stages of their development, new entrepreneurial firms typically have a very limited stock of social capital (Arenius, 2002), inheritance of social capital can have

significant impact on the spin-offs' ability to acquire resources from the network. This is a sizable potential advantage that spin-offs enjoy over *de novo* start-ups and it is suggested that spin-off founders should be aware of this factor and of managing its antecedents. We find that social capital inheritance occurs more strongly when spin-offs are created in business areas that are closely related industrially or technologically to those of their mother companies. This finding informs the prospective founders' strategic choice of business model. Choosing to create a spin-off in a related area implies a higher potential for social capital inheritance, of which managers should be aware and which they should proactively manage. On the other hand, choosing to create the spin-off in an unrelated business area implies that the founders forego the potential benefits of social capital inheritance. This firm would find itself in a position very similar to that of a *de novo* start-up and it is suggested that its founders should manage its social capital as such, not trying to leverage a faint association with their mother company.

Spin-offs can not only inherit social capital from their mother company, but they can also enjoy varying degrees of support from it. Our findings show that the relation to the mother company can have important implications on the spin-off's resource acquisition process, as the mother company itself can often become a major provider of co-opted resources. Mother companies are found to be generally more interested and able to support spin-offs in related fields. Spin-off managers should be aware of this, and work to secure a supportive relationship, or at least a non-competitive one, during the period leading to the separation. On the other hand, if the spin-off is created in an unrelated area, investing the new venture's limited resources in the relation with the mother company is less likely to be fruitful.

Contrary to spin-offs, *de novo* start-ups do not inherit social capital from any founding organization. For this reason, they turn to other sources to develop their social capital during the early stages of their development. We find that *de novo* start-ups rely heavily on their founders' individual experiences prior to the creation of the new venture to develop firm-level social capital. This finding is consistent with the suggestions of Arenius (2002). *De novo* start-up founders should be aware of the importance of transferring the individual-level social capital of their founding teams to the firm level. On the contrary, our findings show that corporate spin-offs do not rely as much on their founders' social capital as *de novo* start-ups, but instead on the association to their mother companies. Given that on average spin-offs in our sample show similar total levels of social capital than *de novo* start-ups, this suggests that relying on social capital inheritance is a sound strategy. However, we also find that spin-offs in with low relatedness to their mother company, and thus with low levels of inheritance, also fail to tap into their founders' individual social capital. We suggest here that founders of unrelated spin-offs should think of their companies as *de novo* start-ups and manage their early-stage social capital in the

same way as them.

6.4 Limitations

Every study has limitations, on account of the scoping of the research or operational considerations. Although efforts were made to minimize limitations, those that do remain must be acknowledged here.

6.4.1 Sample size

The empirical findings in our sample are significant and generally consistent with what was expected. However, we must acknowledge the relatively small size of our sample, due to the relative scarcity of corporate spin-offs matching our sampling criteria and to the inevitable material constraints of research. We have kept this limitation in mind throughout the analysis, checking to ensure that statistical power was sufficient on all tests and discarding from the analysis those hypotheses that were not central to the model and did not offer sufficient statistical power to be robust. We also cross-checked our findings with different analysis methods. However, sample size raises the need for further empirical verification of the generalizability of our findings.

6.4.2 Industrial, organizational and geographic scope

The scope of our research was defined to include corporate spin-offs in high technology industries in Switzerland. We believe this is a good setting to study social capital inheritance because newly-created corporate spin-offs have a clearly identified tie to a founding organization, they retain a similar organizational purpose to that of the founding organization (which would not be the case between a university and a commercial academic spin-off) and could potentially inherit social capital through several channels. Switzerland is a knowledge-intensive and open market economy with a significant high technology sector, and there is some initial evidence to suggest that high technology industries are relatively spin-off prone. Also, the literature suggests that new ventures in high technology sectors are more severely affected by liability of newness, making social capital inheritance and resource co-optation a potentially more relevant issue for these firms. A second limitation of our study is that it is possible that our findings do not apply equally well in other industries, for other organizational forms or in different markets.

6.4.3 Retrospective bias

Because the information analyzed in this study was collected *ex-post*, it is susceptible to retrospective bias. Recollections could differ from reality, and this becomes more likely with the amount of time separating the creation of the company and the survey date. Also, responses may be shaped by *ex-post* rationalizations that would lead the respondent to reconstruct past events to match current or expected performance or conventional beliefs. To minimize this impact, we limited the age range of the surveyed companies, relied as much as possible on factual information, tested the reliability of our constructs, and checked for outliers across respondents and for inconsistent responses within questionnaires.

6.4.4 Single respondents and common method bias

Another limitation due to the constraints of the survey methodology lies in the fact that data for each firm was collected from a single respondent. While all firms in the sample were relatively small and recent at the time of responding, and although respondents were always part of the top management team, a single respondent increases the risk of measurement error, as the respondent may not be aware of the total social capital of the firm.

Furthermore, the fact that all data was collected from a single response is a potential source of common method bias (Podsakoff et al., 2003). The utilization of a single respondent per firm is therefore explicitly acknowledged as a limitation of the study.

In the context of a general firm population study, where the phenomenon of interest is relatively rare (cf. the final 3% usable response rate), requiring several respondents per spin-off would have been a practical impossibility. While one cannot estimate with precision the exact probability level of receiving two individual responses from the same firm, a back-of-the-envelope calculation, assuming that the observed probability of response remains constant for each respondent, allows us to discard this avenue, with an expected response rate of roughly 0.09%. With these prospects, over 62,000 firms would have to be surveyed to yield 56 observations. As there are not enough firms created in Switzerland over a 5-year period for this, a survey in these conditions would need to be pan-European and would be impossible to sustain financially in the context of a doctoral dissertation. Similar considerations made a two-step survey of the responding firms (temporal separation) impracticable.

An alternative approach suggested by Podsakoff et al. (2003) to avoid common method bias is to measure predictor and criterion variables from different sources, such as for example archival sources. Several secondary data sources that were un-

successfully investigated before opting for a general population survey have already been cited. Furthermore, social capital and resource co-optation data is unlikely to be available from any secondary source.

Since source and temporal separation were not implementable in this study, the following measures were taken to ensure sufficient psychological and methodological separation of measurement. As suggested by Podsakoff et al. (2003), the predictor and criterion variables were clouded (psychological separation) by including items in the questionnaire that suggested we may have been trying to establish a link between founder background and firm internationalization, not only firm performance, resource co-optation and social capital inheritance. Furthermore, these constructs were measured with different response formats (methodological separation). Respondent anonymity was assured and protected, also following Podsakoff et al. (2003). Finally, every effort was made to avoid problems with the comprehension stage of the response process and item ambiguity, as per de Vaus (2002) and Dillman (2006). Item wording was extensively reviewed and tested on external reviewers. Vague concepts were avoided and wording was always concrete, with examples provided where confusion was possible. No double-barreled questions were included. Additionally, preventive measures were taken to avoid translation difficulties, as has already been discussed. Further, post-hoc verifications were done to ensure as much as possible that item comprehension was good and indeed two items were dropped on little more than a hint that they may have been unclear. Finally, the variables in the study were tested for method bias using Harman's one-factor test. Exploratory factor analysis resulted in a 5-factor solution, with no factor accounting for more than 27% of variance, indicating that there were no serious problems with common method bias.

6.4.5 External perspective

As we discussed in the literature review, definitions of social capital may broadly be classified as adopting an internal or an external perspective. In this dissertation, we chose to focus on external social capital as the most directly relevant to the process of social capital transfer. However, an internal perspective concentrating on social relations within the firm is also pertinent to study the role of social capital in the development of new ventures.

6.5 Avenues for further research

The objective of this research is to expand the knowledge on the properties of social capital and its implications for organizational development. The theoretical model developed and the empirical evidence gathered in this dissertation are submitted in

hopes of stimulating further work in the area. We conclude this work by suggesting a few directions for future investigation.

Further empirical verification and generalization: In the previous section, we indicated a number of operational limitations to our work. While we provide empirical evidence to support our findings, further empirical validation is needed to confirm, expand and generalize these findings beyond the current setting of Swiss high technology corporate spin-offs.

Shape of central relations: The shape of the relations between relatedness, social capital inheritance and mother company support are in need of further investigation. We suspect that these relations could be concave, a hypothesis that our sample does not allow us to test. We have evidence that too little relatedness diminishes the inheritance of social capital as well as the support provided by the mother company. However, what happens when the relatedness is too high between the spin-off's activities and those of the mother company? We suggest that the spin-off would likely be perceived as a direct and "disloyal" competitor and withdrawn support from the mother company, as well as experiencing more difficulties to establish connections with the rest of the network, as other players would not want to risk retaliation from the mother company for providing their patronage to a competitor.

Resource co-optation and firm performance: We find significant evidence that social capital inheritance has a positive impact on resource acquisition by new ventures. New ventures, especially in high technology sectors, are affected by the "liability of newness" and are in a particularly high need of acquiring resources quickly and at affordable costs (Aldrich and Fiol, 1993; Hambrick and MacMillan, 1984). For this reason, resource co-optation through social capital can be a particularly valuable strategy for high technology spin-offs, as it allows them to acquire more resources than their financial constraints would normally allow. But does increased resource acquisition lead to improved economic performance for companies? Based on the resource-based view of the firm, we believe that higher levels of resource co-optation from the network and from the mother company would lead to higher performance of spin-offs. There is ample evidence in the resource-based view literature to the effect that differences in resource endowments of firms, when deployed by their managers, may result in organizational rent and improved performance (Amit and Schoemaker, 1993; Baum et al., 2000; Carmeli and Tishler, 2004; Hitt et al., 2001). Our data set does not contain performance data, and such data is not available for most Swiss spin-offs from third-party databases. As a re-

sult, we are unable to test the relationship between resource co-optation and firm performance, and an empirical test of this relation is needed.

Duration dependence of social capital inheritance: How long does the advantage offered by social capital inheritance last? Fichman and Levinthal (1991) suggested the existence of a "liability of adolescence", i.e. that there is a concave relationship between company age and failure. New organizations have an initial set of resources (goodwill, commitment, positive beliefs…) which shelters them from initial negative outcomes during a "honeymoon" period. After this period is over, if organizations are unable to replace depleted stocks of resources, their chances of failure increase. Sedaitis (1998) found that although spin-offs performed better than *de novo* start-ups in the initial founding phase, their performance lagged that of *de novo* start-ups a few years into their operation. Our findings suggest that social capital inheritance plays an important part in providing the newly-created spin-off with an initial stock of resources, as well as with the immediate means to replace used resources. In this sense, social capital inheritance would not only be affording the spin-off a longer honeymoon period, but it may also contribute to reducing the liability of adolescence altogether. On the other hand, if the activities of the spin-off evolve away from an area closely related to that of the mother company, the spin-off could be harmed by relational inertia, which would impede the adaptation of its network of contacts and eventually aggravate the liability of adolescence. Further research is needed to determine the mid- and long-term effects of social capital inheritance on organizations.

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