The connected firm

FINANCIAL SUPPORT
The author gratefully acknowledges financial support (grant number 400-05-197) provided by Netherlands Organization for Scientific Research (NWO).

De auteur is dankbaar voor de financiële steun (subsidienummer 400-05-197) van de Nederlandse Organisatie voor Wetenschappelijk Onderzoek (NWO).

ISBN 9789039357125

GRAPHIC DESIGN
Pot & van der Velden, Grafisch Ontwerpers

The connected firm
The spatial dimension of interorganizational dependence along the industry life cycle

Het verbonden bedrijf
De ruimtelijke dimensie van bedrijfsrelaties en de invloed van de industrie-levenscyclus (met een samenvatting in het Nederlands)

Proefschrift
ter verkrijging van de graad van doctor aan de Universiteit Utrecht
op gezag van de rector magnificus, Prof.dr. G.J. van der Zwaan,
ingevolge het besluit van het college voor promoties in het openbaar
te verdedigen op vrijdag 13 januari 2012 des middags te 12.45 uur door
Mathijs de Vaan, geboren op 9 februari 1983 te Nijmegen

Promotoren
Prof.dr. R.A. Boschma
Prof.dr. K. Frenken

We shall not cease from exploration
And the end of all our exploring
Will be to arrive where we started
And know the place for the first time.

T.S. Elliot
Four Quartets

Acknowledgements

The past four years have been proven to be an exciting journey. Throughout these years I have started to become more and more intrigued by all the different facets of doing research in an academic setting. I love the fact that academic research allows me to study phenomena that I am interested in, I love the fact that academic research allows me to meticulously unravel these phenomena, and – above all – I love the fact that my research has mainly been a social process fuelled by social interactions and discussions with an interesting group of people, some of which became true friends. Therefore I would like to express my profound gratitude to everyone who has supported me in this journey.

First and foremost, I would like to thank my two promoters, Ron Boschma and Koen Frenken. Ron, I would like to thank you for giving me time to explore my research interests. During the first two years I have been swimming around, directionless, but with a goal. It allowed me to fully develop and understand my research interests and it got me to where I am now. I would also like to thank you for your untamed enthusiasm which has been an important stimulus and for sharing your skills in structuring scientific texts and addressing academic communities. These insights have been very valuable. Koen, you were one of the reasons I chose to commit myself to start a PhD project. Having you as an advisor for my Master's thesis was a real delight and I am very happy that, despite your move to Eindhoven, you've remained very engaged in my PhD project. I greatly appreciate our discussions and I really enjoyed working together on our co-authored papers. I would like to thank you for sharing your broad range of knowledge of all kinds of academic fields. This broad orientation has really helped me developing myself as a researcher. Hopefully we can continue working together in the future. Koen and Ron, I would also like to thank you both for giving me the chance to visit the Center on Organizational Innovation at Columbia University as a visiting scholar. As you know, I greatly enjoyed my time there and it provided an opportunity that I will seize with both hands.

I would also like to thank all my colleagues at the Economic Geography cluster at Utrecht University for their helpful discussions, suggestions and the small talk during lunch or at the coffee machine. In particular I would like to thank Jarno, Sjoerd, Tom, Pierre-Alex, and Barbara. It has been great to share so many interesting experiences, both social and professional, with you. I would also like to thank my former office mates Frank and Rik for providing me guidance at the start of my project. Being able to learn from your skills and expertise really gave a head start in my research project.

I am also greatly indebted to David Stark and Monique Girard. David and Monique, I would like to thank you for giving me such a warm welcome when visiting the Center on Organizational Innovation. Coming to Columbia University as a visitor, I couldn't have wished for a better introduction into the community. I would also like to thank you for hosting the CODES seminar and the interesting discussions we had. They greatly improved my work. I am very much looking forward to the coming years.

Last but certainly not least, I would like to thank my parents, Math and Nelly, my sister, Eva, and my girlfriend, Stéphanie, for supporting me throughout the past four years. The long hours of work I have put into this dissertation and the sometimes stressful periods around deadlines have certainly not been easy, but thanks to you I have been able to cope with these periods and learn from them. Mom and dad, thank you for being such great listeners, for always supporting me and for all the great talks we had over the terrific dinners in Oude Leede. Eva, thanks for our carpool trips to Utrecht, for all the talks we had about life in general and for always being there for me. And Stéphanie, thank you for always being there for me, for coping with my sometimes impossible habits and for supporting me when I needed it most. From the bottom of my heart: Thank you very much. I love you.

Mathijs de Vaan
New York, September 2011

Table of contents

List of figures

List of tables

chapter 1
The process of spatial industrial concentration

Introduction

New York City is one of the most important financial centers in the world. The Big Apple is characterized by its high density of banks and other financial institutions and more than 450,000 New Yorkers are employed by these organizations which account for a large share of the national employment in that particular industry. The vast majority of all financial businesses in New York City have an office in or around Wall Street. Within a range of 500 meters, some of the largest and most important banks in the world account for several billions of dollars worth of financial trade every day.

The origins of Wall Street as a financial center can be traced back to the second half of the 17th century. When Peter Stuyvesant, the Dutch Director-General of the colony New Amsterdam – now known as Lower Manhattan –commissioned to build a wall to protect the colony from foreign intruders and local indians, he coincidently created a place where merchants and traders could gather to trade bonds, shares and other securities. Having served as a vibrant and profitable market for financial products for over a century, the need for a more formal and structured organization of trade prompted the traders in Lower Manhattan to sign the Buttonwood Agreement in 1792. One of the most important provisions in this agreement was that the traders of Wall Street – the wall was replaced by a street – could only trade with other Wall Street traders. This provision continued to influence the trade of financial products until the 1980s when the requirement, that stock exchange brokerage firms needed to have offices clustered around Wall Street, was abolished. Despite the abolition of the co-location provision and the introduction of computers and digital communication in the market for financial products, Wall Street remains to attract traders of financial products and continues to be one of the largest financial centers in the world.

High levels of clustering of economic activity in space can be observed in other industries too. For example, during the first couple of decades of the 20th century Detroit grew out to become the booming heart of America's industrial economy. Companies such as the Ford Motor Company, Olds Motor Works and General Motors were founded either in or around Detroit turning the city into the 'Car Capital of the world'. These companies were responsible for some of the most innovative car designs in the history of automobile production and the introduction of the moving assembly line by Henry Ford completely changed industrial production. Similar to the financial industry in New York City, automobile production in Detroit was responsible for a tremendous increase in employment and a sharp rise in economic prosperity in the city and the United States as a whole.

Cases of geographic clustering of economic activity are neither limited to the United States nor are they limited to older industries that emerged more than a century ago. Outside the United States similar patterns of geographic concentration can be found for the aerospace industry which is located mainly in the Toulouse region or for the automobile industry in the United Kingdom where Coventry became the breeding ground of successful British car manufacturers such as Daimler and Jaguar. Also, fairly recent industries such as the Information Technology industry are subject to high levels of spatial concentration. One of the frequently mentioned examples is Silicon Valley. Located in the San Francisco Bay Area, Silicon Valley is often credited for being one of the most fertile regions in creating and retaining successful high-tech ventures. Companies such as Google, Oracle Corporation and Apple were founded in Silicon Valley, and the region has also attracted many, yet established firms, from all over the world.

The non-exhaustive list of examples of spatially concentrated industries around the world and the fact that these areas seem to accommodate some of the most successful and profitable firms worldwide have caused geographers and economists alike to develop research projects aimed at explaining these remarkable patterns. While the aim of these research projects is more or less similar, the approaches used by geographers and economists proved to be quite different. Typically, geographers approach the question of spatial concentration of economic activity by conducting in-depth case studies and by theorizing about possible explanations based on rich and fine-grained anecdotal evidence. Alternatively, economists have been active in developing formal models, free from any contextual influence, that are aimed at explaining why homogenous and rationally behaving firms are likely to cluster in space. Paul Krugman, the Nobel Prize winner and the initiating force behind economic research on clustering of economic activity, phrased the difference between geographers and economists as follows: *"instead of asking why a particular industry is concentrated in a particular area – for example, carpets in Dalton, Georgia – I shall ask why manufacturing in general might end up concentrated in one or a few regions of a country, with the remaining regions playing the "peripheral" role of agricultural suppliers to the manufacturing core"* (Krugman 1991, p. 485).

In addition to – or because of – the differences in methodological approaches, the dominant findings in each of these two disciplines are different by and large. Geographers tend to stress the heterogeneity in regional conditions by highlighting the role of untraded interdependencies (Storper 1997). Untraded interdependencies refer to regional assets that *"take the form of conventions, informal rules, and habits that coordinate economic actors under conditions of uncertainty. These relations constitute region-specific assets in production", "a central form of scarcity in contemporary capitalism"* and *"of geographical differentiation in what is done, how it is done, and in the resulting wealth levels and growth rates of regions"* (Storper, 1997, p. 5). Alternatively, economists attributed spatial concentration to role played by increasing returns to scale. In order to be competitive, firms are forced to lower transportation costs and these transportation costs tend to be low in places *"where demand is large or supply of inputs is particularly convenient – which in general are the locations chosen by other producers"* (Krugman 1991, p. 98). While the main arguments made in the two streams of research are not necessary contradictory, the incompatibility of both the methodological tools and the theoretical frameworks used by geographers versus economists has prevented the two disciplines from entering into in a fruitful debate.

Recently, a third – distinctive but to some extent hybrid – approach emerged that seeks to explain the remarkable patterns of spatial concentration and the performance of firms in clusters. Evolutionary Economic Geography (Boschma and Frenken 2003, 2006; Frenken and Boschma 2007) systematically integrates historical accounts of the emergence and growth of geographically concentrated economic activity and quantitative examinations of the case at hand. By doing so, the framework is able to deductively identify patterns of spatial concentration processes, despite its focus on contextual embeddedness. The central tenet in Evolutionary Economic Geography is that the concentration of economic activity in space is the result of a continuous process of diffusion of resources and routines. These resources and routines constitute a firm's competitive advantage and the uneven distribution of resources and routines among firms fuels competition and fosters a spatially bounded diffusion process. The rigorous study of these diffusion processes allows Evolutionary Economic Geography to provide empirical accounts of why and how industries emerge at specific places, how they grow and why they eventually decline or even disappear. Thus, Evolutionary Economic Geography provides a framework for studying the spatial dimension of economic, technological and institutional change and how this relates to the rise and fall of industries.

In order to fully account for the historical and contextual factors related to the spatial evolution of industries, scholars in Evolutionary Economic Geography have relied on insights provided by research on industry life cycles. Industry Life Cycles (ILCs) describe industrial development as a sequential pattern of stylized stages and provides a framework for analyzing the nature of competition and selection of firms in an industry. A commonly observed pattern of industrial dynamics describes an initial stage with only few entrants into the industry, followed by a period of high levels of entry. Then, the industry goes through a shakeout characterized by the net outflow of firms, and ultimately the industry matures into an oligopoly. The selection of firms that remain active in the industry is based on the successful adaptation of firms to the nature of competition. The nature of competition has been argued to shift from product innovation to process innovation and the ability of firms to become leaders in these innovation processes determines whether they will make it through the shakeout period.

In addition to the ILC concept, which approaches industry evolution as a result of competition and the subsequent selection processes, scholars in the field of Evolutionary Economic Geography have also adopted a social network perspective that deals with the collaboration and interaction among firms and other organizations within an industry (Boschma and Frenken 2006; Grabher 2006; Glückler 2007). The importance of networks stems from the fact that firms are by no means isolated and that external sources are often involved in the co-production of routines, ideas, knowledge, resources, legitimation, etc., needed to compete in a dynamic market space. The heterogeneity in these resource and routine endowments of firms is one of the building blocks of Evolutionary Economic Geography, because it generates a continuous diffusion pattern that is interwoven with the spatial concentration process. For example, an important finding in the field of network analysis shows that the relationships upon which firms rely have a clear spatial dimension. Thus, rather than studying firms as isolated units that only compete, the network perspective draws attention to the webs of relations that firms maintain and turn to in order to survive. In particular, whereas the ILC approach provides insights on the competition among and selection of firms, the network perspective analyzes how firms are embedded in structures of relationships and how this allows them to outperform other firms.

Although both the ILC approach (Wenting 2008; Neffke 2009) and the network perspective (Ter Wal 2009; Balland 2011) have enriched the literature on Evolutionary Economic Geography, the question of how the ILC and the network perspective can be integrated is left unanswered. Since ILCs and networks both constitute meso-level analytic frameworks that are related to the spatial dimension of entry into and exit from an industry, the integration of the two allows one to analyze the effect of the coevolution of competition and collaboration on spatial concentration processes. Therefore, this dissertation attempts to integrate network analytic insights into the ILC perspective with a special emphasis on geography.

The empirical context of this dissertation is the video game industry. This internationally organized industry emerged in the early 1970s and is often credited for its high growth rates and its ability to integrate technology and art. Contrary to a vast range of manufacturing industries such as automobile production or steel production, the video game industry remains largely unexamined in terms of its spatial organization. Similar to some manufacturing industries, the video game industry is concentrated in just a few locations worldwide. Cities such as Tokyo, Los Angeles, California and London accommodate the majority of all video game producers. However, the video game industry also exhibits various features – not found in manufacturing industries – that are likely to have an effect on the industry's spatial organization. For example, rather than relying on bulky, tangible inputs, the production system of the video game industry runs on the human capital. Another difference that sets apart the video game industry from manufacturing is its strong cultural component which makes it highly dependent on fads and fashions. Such features, combined with the availability of global, longitudinal, and high quality data promote the video game industry as an interesting empirical setting to study the process underlying the spatial concentration of an industry. Based on the research aim and the empirical setting introduced in the previous sections, the main research question of this dissertation can now be stated as follows:

MAIN RESEARCH QUESTION

HOW DO SOCIAL NETWORKS AFFECT THE INDUSTRIAL DYNAMICS AND SPATIAL CONCENTRATION OF THE VIDEO GAME INDUSTRY ALONG ITS INDUSTRY LIFE CYCLE?

In the remainder of this chapter, the main concepts and sources of scientific inspiration of this dissertation are introduced and discussed. They serve as an introduction to the following chapters. The first section reviews the literature on ILCs and addresses the subtleties that are of particular interest for the spatial concentration of economic activity. Then, we will explore the role played by resources and routines – which are the sources of competition and collaboration – in more detail. The third section reviews the literature on networks as diffusion mechanisms of resources and routines and finally we introduce the empirical cases and provide an outline for the rest of the dissertation and a detailed description of each of its chapters.

COMPETITION AND SELECTION ALONG AN INDUSTRY'S LIFE CYCLE

The ILC concept offers a starting point to analyze industrial change as a historical process. It is a commonly used framework in various streams of research. The ILC concept is embraced by scholars in marketing science (Cox 1967), industrial organization (Jovanovic and MacDonald 1994; Klepper 1996), innovation and technological change (Abernathy and Utterback 1978; Klepper 1997) and international trade (Vernon 1966; Hirsch 1967). The aim of the ILC concept is to analyze the industrial dynamics in a wide range of industries and to identify sequential patterns of stylized stages through which these industries go. Throughout the ILC literature a number of important stages of industrial change have been identified. That is, industries are likely to change in terms of the barriers to entry, its related levels of entry and exit, and the nature of the competition among firms, each related to a specific stage in the ILC. Hence, the ILC describes the development of an industry as a pattern of entry and exit of firms and the changing nature of competition. A common finding in a wide range of industries is that the birth of an industry is characterized by low numbers of entrants, and is followed by a stage with strong entry into the industry. Then, a large share of all firms is exiting the industry, also known as the shake-out, and this pattern ultimately leads to an oligopoly. This pattern in the levels of the firm population can then be visualized as an S-curve[1]. Gort and Klepper (1982) showed that this pattern largely holds across the 46 different industries that they researched.

[1] The typical ILC is based on one product life cycle (PLC). In such a PLC, a radically new product forms the basis of a new industry and subsequent improvements to the product are only incremental. However, some industries are characterized by patterns of radical technological change (Tushman and Anderson 1986; Christensen and Bower 1996) in which one PLC is replaced by another PLC. These radical changes are examples of 'creative destruction' in which a new generation of products renders and old generation obsolete (Schumpeter 1942). Moreover, the factors that made firms successful prior to the change do not per se make them successful after the change.

The forces that underlie the typical shape of the ILC are subject to debate. One strand of literature attributes the S-shaped population dynamics to the emergence of a dominant design. A dominant design is the outcome of a process of convergence of functionally similar products with different characteristics towards one commonly accepted and appreciated standard. The process that guides the emergence of a dominant design is the transition from product innovation to process innovation (Utterback and Abernathy 1975). Product innovation refers to changes in the architecture of the product itself, while process innovation refers to efficiency and productivity improvements in the manufacturing process. This distinction is related to the exploration – exploitation dichotomy introduced by March (1991). March (1991, p. 71) stated that *"exploration includes things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, innovation"* and *"exploitation includes such things as refinement, choice, production, efficiency, selection, implementation, execution"*. Thus, the pre-dominant design period is associated with exploration, followed by the post-dominant design era which is characterized by exploitation.

Although the dominant design thesis has provided a widely used stylized descriptive of a commonly observed phenomenon, it falls short in explaining whether the emergence of a dominant design is cause or effect. Moreover, a vast amount of dominant design studies rely on the assumption that the dominant design comes from an exogenous source (Jovanovic and MacDonald 1994). Recent literature has criticized this assumption. For example, Murmann and Frenken (2006) showed that the emergence of a dominant design can be fuelled both by sources outside the industry and by incumbent firms. A second problem associated with the practice of using the dominant design thesis to explain the dynamics in firm population stems from the fact that in some industries dominant designs do not arise. This is typically observed in non-manufacturing industries.

An alternative thesis for the commonly observed S-curve in industry population dynamics is provided by Klepper (1996; 1997; 2002a; 2002b; 2007). Klepper provides a formal model to explain how the S-shaped ILC may come into place in absence of a dominant design. In an early version of the model Klepper (1996) attributed the observed pattern to the variance in sequence of entry of new firms. The main argument is that the entry time of firms into the industry generates heterogeneity in terms of size and being bigger allows firms to appropriate more returns from R&D expenditures due to increasing returns. In other words, *"firms reduce their average cost through process R&D, and the value of reducing average cost is proportional to the level of output produced. Consequently, larger firms profit more from process R&D, which confers a competitive advantage"* (Klepper 1997, p. 151). Then, as more firms – pursuing profits – enter the industry, profit margins decrease and *"the increasing returns from process R&D*

impart an advantage to the earliest entrants which eventually renders entry unprofitable and forces the smallest and least capable innovators out of the industry, contributing to a shakeout" (Klepper 1997, p. 151). In a further extension of the model, Klepper (2002a) adds another explanation for the frequently observed S-shaped pattern in industrial dynamics. In addition to scale-appropriability which allows early entrants to become most successful, the pre-entry experiences of firms entering an industry are also argued to affect its survival chances. Pre-entry experience such as the experiences of diversifying firms in other industries and the experiences that the founders of spinoff firms had at their parent firm are likely to increase the productivity in R&D activities. The organizational capabilities that were formed prior to entry into the focal industry can help firms to be more successful in conducting R&D activities.

In contrast to the dominant design thesis, Klepper's model also features important and explicit spatial implications. In line with the argument that firms with experience are better able to survive along the ILC, Klepper (2007) shows that these better performing firms in the US automobile industry are also more fertile in terms of producing spinoffs. Indeed, since the routines of successful firms are very 'fit' in comparison to the average fitness of routines in an industry, successful firms are likely to spun off a high number of new organizational units. As success breeds success, new organizational units that are born from successful parents firms grow out to become industry leaders while other firms lacking this advantage have to exit. Regions that are rich in organizational units that have parent firms from which they can replicate routines are likely to grow out to become large spatial clusters. The resulting industrial and spatial organization is therefore accumulative and path dependent, leading to spatial concentration of economic activity (Klepper 2007). Thus, the model accounts for the regional concentration of industries as a result of a spinoff process.

Both the original dominant design thesis (Abernathy and Utterback 1978) and the alternative model proposed by Klepper (1996) have provided a series of stylized facts about the changing nature of competition and the subsequent process of selection in industries. However, both theses heavily rely on a pre-disposed and stable distribution of competitive advantages among firms, thereby providing little room for post-entry learning. In the dominant design thesis the sole decision that firms can make is to adopt the dominant design or exit the industry and in Klepper's model firms are endowed with advantages based on their entry time and pre-entry experience, both of which are determined at the time of entry. Following a different line of reasoning, scholars of strategic management have shown that entrepreneurs, managers, and employees can take decisions – independent from the pre-entry qualities of a firm – that can affect the survival of firms. This stream of literature stresses that firms learn throughout their lifespan and that a firm's initial endowment of resources and routines is subject to change and diffusion. Similarly, Klepper (2002; 2010) recently showed that *"the difference between the hazards of diversifiers and other entrants declines with age"* (Klepper 2010, p. 728), indicating that variation in the performance of firms at older ages should stem from post-entry sources.

In sum, the ILC concept provides an explanation for the stylized stages that many industries go through. It does so by highlighting the shift from product to process innovation. The ability of firms to successfully adapt to this shift depends on firm specific characteristics. While the dominant design thesis does not provide a fully elaborated explanation of the nature of these characteristics, Klepper's model

(1996; 2002a) does. He stresses the role of entry time and pre-entry experiences and argues that these firm specific characteristics can account for the variance in performance of firms within an industry. Although a vast range of empirical studies have shown that these factors indeed are responsible for large differences in the performance of firms, other research claims that another share of this variance is attributed to post-entry experiences of firms. Such post-entry experiences are responsible for the change of resources and routines of firm. To increase our understanding of these post-entry processes the next section provides a further elaboration on the notions of routines and resources and is followed by a review of the mechanisms that allow firms to change and diffuse these routines and resources.

RESOURCES AND ROUTINES

A wide range of literature in various fields of the social sciences such as evolutionary economics, management science and economic sociology aims to understand what it is that creates heterogeneity among firms and how this heterogeneity translates into competition and collaboration (Hannan and Freeman 1977). Schumpeter (1942) was one of the first to conjecture that the primary driver of competition should be sought in the process of accumulating resources and developing routinized practices to explore and exploit new ideas. Firms that are able to gain exposure to and internalize high-quality resources and know how about how to turn these resources into commercially viable and successful practices and products are likely to survive and stay in the industry while other firms die and leave the market. In line with the resource based view of the firm (Wernerfelt 1984), a broad range of business scholars argues that routines and resources[2] should be distinguished between. While resources are referred to as tradable and non-specific to the firm, routines are referred to as tacit and largely immobile, routinized practices that allow for the coordination of allocation of resources (Amit and Schoemaker 1993).

[2] While making a distinction between routines and resources is theoretically helpful, it must be noted however that empirically, it is difficult to disentangle a firm's routines and resources. Also, firms that have superior firm level routines and competences are also likely to be able to attract and retain valuable and unique resources.

ROUTINES

There is a large variety of concepts and labels that are used to describe what causes firms to be so heterogeneously endowed with the competences to coordinate and control production processes. Early introductions of such concepts include Selznick's (1957) distinctive competence and Nelson and Winter's notion of organizational routines (1982), while more recently absorptive capacity (Cohen and Levinthal 1990), architectural knowledge (Henderson and Clark 1990), combinative capabilities (Kogut and Zander 1992) and dynamic capabilities (Teece, Pisano and Shuen 1997) gained popularity in research seeking to analyze firm heterogeneity (Zollo and Winter 2002). Although all of these notions are different to some extent, an important commonality between them is that their power lies in describing firm heterogeneity as a firm level characteristic, rather than as an aggregate of the skills of individual employees or as the sum of all financial resources. For example, the notion of organizational routines can be defined as recurrent patterns of coordination and control with the aim of providing regularity, consistency and predictability (Becker 2004). In particular, these patterns of coordination and control are not characteristics and skills of individual employees or other firm resources, but they refer to organizational structures that guide the action and behavior of these individuals and resources in relation to one another. Organizations can then be seen as systems in which multiple routinized patterns reside and where these patterns provide guidance to parts of the system in creating structures of coordinated accountability. Since others have already written extensively about the differences and commonalities among the labels used to describe firm level distinctiveness (see for example Zollo and Winter 2002), in the remainder of this dissertation the notion of routines is used to describe heterogeneity in firm level characteristics.

Various scholars (Nelson and Winter 1982; Klepper 2002a; Boschma and Frenken 2006) argue that routines are replicated when new organizations are created from existing organizations. Following Klepper (2002a) and Klepper and Sleeper (2005) and building on the evolutionary notion of heredity they distinguish between organizations that are born out of incumbent organizations and organizations that are started from scratch. The main argument is that organizations that are born out of incumbents have the ability to replicate the routines of the parent firm which gives them a head's start in the industry. Such organizational units can, but need not per se, be fully independent. Two prominent examples include spinoffs and subsidiaries and the main difference between spinoffs and subsidiaries is that spinoffs are legally independent from its parent firm, while subsidiaries are legally owned by a parent firm.

Routines are the result of a historical and path-dependent process and are therefore argued to be relatively stable. Heiner (1983; 1988) argues that the origins of this stability can be found in the uncertainty associated with choice and varieties of alternatives. Uncertainty is a direct effect of the gap between the competence of an organization and the difficulty and complexity of the choice at hand. In order to be successful a firm needs to limit the flexibility of *"actions which are adapted to only relatively likely or recurrent situations"* (Heiner 1983, p. 567). In other words, in a complex and uncertain environment, firms will benefit from behavior decisions that are aimed at adapting to typical and recurrently observed messages (Heiner 1988). These behavior decisions will thus be structured and coordinated by stable, routinized processes and will therefore create some level of stability in an unstable and uncertain environment.

Despite the inherent stability in routines, various scholars have also argued that firms benefit from having dynamic capabilities (Teece et al. 1997). Dynamic capabilities are defined as *"the firm's ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments"* and do therefore *"reflect an organization's ability to achieve new and innovative forms of competitive advantage"* (Teece et al. 1997, p. 516). The ability of firms to dynamically update their routinized practices protects them from constraints imposed by inertia. As shown by Heiner (1983), in stable environments the rigidity of routines is likely to benefit firms because it makes these firms more efficient. However, such rigidity in routinized patterns and behavior may undermine the identification and successful interpretation of new, valuable practices, competences or knowledge (Gilbert 2005). If employees are guided to conform to the existing routines and departments and teams are structured in a way to avoid unexpected behavior, opportunities created by economic, institutional or technological change are likely to remain unexplored. Other firms that do exhibit dynamic capabilities are therefore expected outperform firms exhibiting inert behavior in period of change.

RESOURCES

In addition to firm level routines, heterogeneity among firms results from differences in stocks of resources (Wernerfelt 1984; Barney 1991). Resources refer to tradable inputs that can be used in the production process such as codified knowledge, financial inputs, human capital, etc. Typically, resources are divisible and can be priced. An early account of heterogeneity as stemming from resources was already provided by David Ricardo. In the early 19th century this British economist published a book, “On the Principles of Political Economy and Taxation”, in which he provided an argument for the existence of trade. His reasoning holds that countries specialize in the production of goods in which they have an advantage relative to all other countries. In order to fulfill all of a country’s demand for goods, it internationally trades the surpluses of the goods it produces for the goods that it does not produce. While Ricardo’s example is originally based on countries, the underlying logic holds true for firms too (Porter 1990; Hunt and Morgan 1995). The broad applicability of the idea stems from the fact that similar to countries, firms too are heterogeneously endowed with resources. Hence, Ricardian rents can then be thought of as accruing to owners of unique resources and a firm can earn rents if it owns exceptional machinery, skilled employees, or creative managers (Montgomery and Wernerfelt 1988).

If resources are indeed fully tradable, each firm would in principle have access to the complete spectrum of resources and resources which can therefore not be responsible for the distinctiveness of firms. Lippman and Rumelt (1982) however, argue that firms can also earn rents if it owns resources that are subject to uncertain imitability. In other words, if the payoffs of getting access to resources – that are similar to the resources of a successful competitor – are highly uncertain, resources can still provide firms with enduring competitive advantages (Montgomery and Wernerfelt 1988). If this is the case, the firm that owns valuable resources can continue to exploit these resources, even though the resources are in principle imitable and tradable. Another reason why tradable resources are still able to generate heterogeneity among firms is that *“the resources with which a particular firm is accustomed to working will shape the productive services its management is capable of rendering”* (Penrose 1959, p. 5). Here, Penrose refers to the intrinsic relation between resources and the routines that exploit these resources. Moreover, *“the services that resources will yield depend on the capacities of the men using them, but the development of the capacities of men is partly shaped by the resources men deal with. The two together create the special productive opportunity of a particular firm”* (Penrose 1959, pp. 78 – 79). Thus, similar to changes in routines, changes in a firm’s resource stock are likely to be bounded by a path dependent process, at least in the short run. This protects firms with a successful stock of resources against imitation and catching up by competitors (Kor and Mahoney 2004).

Having distinguished between routines and resources the question becomes how firms can get access to them. In a prior discussion of Klepper’s model (1996; 2002) we showed that entrepreneurs can inherit routines and resources from their parent firm once they decide to start their own venture. In other words, these competitive advantages are diffused from parent to offspring. This is not to say though, that the initial set of resources and routines remains stable. On the contrary, after the firm enters an industry its resources and routines become subject to change. This is necessary to deal with the changing environmental conditions as described in the ILC concept. The next section reviews the sources embarked upon in this dissertation that are responsible for the updating and upgrading processes that a firm’s resources and routines are subject to.

NETWORKS AS EVOLVING MECHANISMS OF DIFFUSION

One of the central tenets in Evolutionary Economic Geography is that the spatial patterns of evolution of an industry are driven by the diffusion of resources and routines. Therefore, one of the main aims is to identify and analyze the mechanisms that are responsible for this diffusion and how geography shapes these mechanisms. Scholars from sociology, management science and economic geography have started to investigate how firms rely on their environment in terms of getting access to resources and routines. Economic sociologists highlighted the explicit embeddedness of firms in networks of relations and economic geographers – inspired by the work of economic sociologists (Grabher 2006) – introduced a 'relational turn' in economic geography. This literature is concerned with *"the ways in which social interactions between economic agents have shaped the geography of economic performance"* (Boggs and Rantisi 2003, p. 109). By reconciling the literature in economic geography and economic sociology on the embeddedness of firms in webs of relations and the ILC, one can study the spatial concentration of firms as a process that is fuelled by the mutualism of changes in competition and collaboration.

One of the most important mechanisms responsible for the diffusion of resources and routines in space is collaboration. Over the recent decades, scholars in a wide variety of sciences have increasingly exhibited an interest in collaboration networks which are argued to act as the "plumbing" of the market (Podolny 2001). This perspective highlights the role of collaboration networks as systems through which information, ideas, and resources flow and which can subsequently be interpreted and recombined. Research emphasizing the role of networks in firm performance (Powell, Koput and Smith-Doerr 1996), the effect of network structure on stability of business groups (Vedres and Stark 2010), and the effect of durable network relations on relation specific investments (Sorenson and Waguespack 2006) are only few of many examples of this perspective. The most explicit example of collaboration networks is the ever increasing alliance activity undertaken by a large variety of firms. Alliances are motivated by the need for complementary resources and routines in research and development (R&D) projects, increased scale in consultancy assignments and risk sharing in the creation of new ventures. The common denominator in all alliances is that information is diffused among the companies involved in the alliance and that during this continuous stream of information, new ideas are generated.

In this dissertation, the main focus is on networks that describe the interaction of firms, organizations or other formal and informal collectives of individuals (Uzzi 1997; Gulati 1999). The embeddedness of firms in networks of learning and collaboration is argued to determine how successful firms are. Embeddedness can be described as the position of a firm in a structure of – qualitatively different – relations. Various studies have found that being connected to many other firms, being connected to two firms that are not connected themselves (Burt 2005) and being connected to qualitatively diverse firms (Phelps 2010) increases the performance of firms that need to develop a new product because such connections can provide firms with a wide variety of resources – mainly knowledge and ideas – that will benefit firms in the development process. In particular, access to a wide variety of resources allows firms to benchmark and make "new combinations" with yet existing resources accessed through external contacts (Schumpeter 1942).

The question becomes whether network ties can also act as modes of routine diffusion. Although the notion of interfirm networks is often portrayed as fairly straightforward, the divergent handling of interaction intensity in the literature on interfirm networks causes some ambiguity. While Granovetter (1973) already showed that interaction intensity is responsible for explaining variation in network richness, the vast majority of research on interfirm collaboration networks reasons not so much from the intensity of collaborations ties but from the structure of collaboration ties surrounding a focal firm. In other words, these studies perceive collaboration ties to be dichotomous: either there is a tie or there is not, discarding information on the intensity and duration of a relation. However while extensive interactions can provide settings in which firms exchange resources, it is unlikely that such settings allow for the diffusion of routines. In order for firms to become “infected” by the routines of other firms, intensive project-based collaborations are necessary in which the two separate organizations “melt” together. In other words, the tacit nature of routines raises the importance of prolonged, intensive collaborations.

Although the field of economic geography has started to devote some attention to the spatial dimension of interfirm collaboration – or the broader notion of localized knowledge spillovers (LKS) – the results are heavily debated (Breschi and Lissoni 2001). The vast majority of this research uses patent data to investigate whether resources such as knowledge, expressed by the industry classifications of a patent, was obtained from geographically proximate sources. Here, citations of patents owned by geographically proximate firms are used to test this idea and findings indicate that firms indeed tend to cite geographically proximate firms more frequently than expected at random (Jaffe et al. 1993; Almeida and Kogut 1997). Breschi and Lissoni (2001) showed that this type of analysis is very indirect and that it relies on a large amount of assumptions. However, if indeed firms are more likely to collaborate with geographically proximate firms, regions that accommodate many well performing firms will grow out to become even better, keeping the “fittest” routines and the best resources within the regional boundaries.

A second and somewhat related diffusion mechanism is less explicit and is best referred to as “community learning”. Following Grabher (2004) and Brown and Duguid (1991) this notion refers to the fact that changes in the routines and resources of a firm are the result of a firm’s embeddedness in a fluid set of relations. These relations are very diverse in the sense that they are not per se limited by legal or organizational boundaries and the aggregate of such relations comprises an informal community. In order to become a member of such a community proximity is highly salient (Storper and Venables 2004). Firms and its employees can only become insiders in the community by constantly observing what is going on, something that is solely achieved when geographically proximate. In addition to the increasing ability to observe, co-location in space may also increase the likelihood that the observing firm fully understands the behavior of the observed firms and other actors. Indeed, institutional and cognitive proximity are highly correlated with geographical proximity and through these shared bases of evaluation (Nooteboom 1992; Stark 2009), observations made by firms become more meaningful and valuable.

Storper and Venables (2004) also stress the importance of face-to-face contact. In order to become and remain member of a community, firms, employees and other actors need to be engaged in a continuous process of judging, being judged and sharing judgments. Storper and Venables (2004, p. 356) argue that *“(i)n such fields as fashion, public relations, and many of the arts (including cinema, television, and radio) there are international networks ‘at the top,’ but in the middle of these professions networks are highly localised, change rapidly, and information used by members to stay in the loop is highly context-dependent”*.

Staying in the loop is a complex process because it requires tacit knowledge that can only be absorbed by members that are *"deeply embedded in specific contexts"*. Such embeddedness increases the social, cognitive and institutional similarity of the community members and allows them to be more efficient in communicating ideas, absorbing knowledge and providing other resources (Boschma 2005). Through this similarity norms and values are being calibrated and codes are used a signaling devices.

Economists have studied how firms base their decision making on the aggregate actions of other firms facing a similar decision problem (Banerjee 1992; Bikhchandani et al. 1998). Such herding behavior can then neutralize the heterogeneity of preferences among firms so that a conformist situation emerges. A similar argument was put forward by DiMaggio and Powell (1983) who observe firms are likely to mimic each other's behavior. They argue that *"(n)ew organizations are modeled upon old ones through-out the economy, and managers actively seek models upon which to build"* (DiMaggio and Powell 1983, pp. 151 – 152). More recently, sociologists have shown how consumers of cultural products base their purchasing patterns on the patterns of other consumers (Salganik et al. 2006). Observational learning is likely to only provide a means to acquire resources rather than routines. Moreover, the resources acquired through observational learning remain limited to information on what competitors do. Even more so, by observing one's competitors, firms are unlikely to be able to fully grasp *how* other firms do what they do and why they exhibit this behavior.

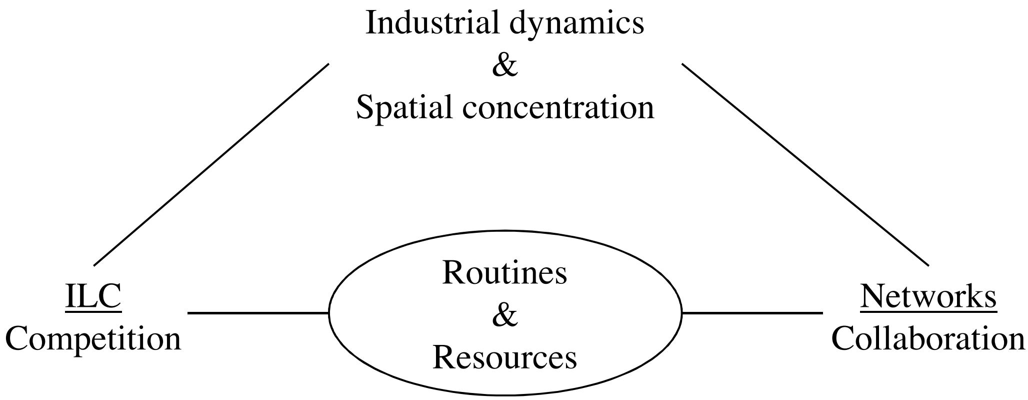
SYNTHESIS

This dissertation aims to bring together the literature on ILCs and the literature on networks in order to provide a basis for analyzing the spatial concentration of economic activity (see figure 1.1). Both the industrial dynamics and the spatial concentration of firms are dependent on the changing nature of competition and the distribution and diffusion of resources and routines among firms. While the literature on ILCs stresses the changing nature of competition, the literature on networks describes the mechanisms that fuel this competition. By integrating these frameworks and by applying it to study the spatial concentration of industries, we aim to do full justice to the fact that clustering processes are: i) inherently dynamic, and ii) largely affected by the spatial dimension of collaboration and competition. As a result this dissertation extends the emerging field of Evolutionary Economic Geography.

The nature of both competition and collaboration changes as industries evolve. Evolution refers to changes in technology that subsequently alter the resource and routine requirements of firms. Following a typical ILC, firms initially need inputs to explore new product designs and compete on the basis of different product architectures. Later stages of the industry are characterized by the need for inputs that help firms to exploit existing ideas and the role of price in guiding competition between firms in the industry. In the analyses of cluster processes we bring together insights on these changing industrial conditions and the connectedness of firms. Connectedness refers to the interdependence of firms both in terms of competition and in terms of collaboration.

Although a vast amount of research points towards the widening boundaries of competition as a result of globalization processes (Friedman 2005), other accounts stress that competition is still mainly a local process (Hannan and Freeman 1977; 1989; Baum and Mezias 1992) due to the imperfect mobility of

FIGURE 1.1
Spatial Dimension of industrial dynamics



resources. Consumer behavior is still guided by cultural background, workers are unlikely to move over great distances and venture capitalists are prone to support local, rather than distant initiatives. Similarly, collaboration is also affected by distance. Firms working together with other firms, employees meeting informally and potential entrepreneurs depending on their social networks and family: all these examples refer to interactions that are likely to take place over relatively short distances.

A prime example of the spatial and temporal dimension of industrial dynamics and spatial clustering is the automobile industry. Detroit once was the "Car Capital of the World", but after Japanese automakers entered the US territory in the 1970s and the 1980s this status changed. This temporal state of the spatial organization of industries is a key issue in Evolutionary Economic Geography as it aims to explain current industrial states from its history.

The theoretical framing of this dissertation is used to understand the evolution of the spatial industrial organization of the video game industry. The following section describes its main characteristics and its subtleties.

THE VIDEO GAME INDUSTRY

Hirsch (1972) stressed the fact that cultural products are different from other products sold in a capitalist marketplace. Its unpredictability in terms of popularity, the continuously changing nature of fads and fashions and the fact that the value added is generated through content rather than architecture of the product have motivated researchers from various fields to study the principles of 'creative industries' (DiMaggio 1997; Pratt 1997; Scott 2000; Caves 2000). Throughout this literature the boundaries of creative industries have been set by the extent to which products are associated with cultural, aesthetic, or entertainment value. Prime examples of such industries include feature film, television, fashion, music, and advertising (Scott 2000; Caves 2000; Wenting 2008).

Despite the increasing interest for creative industries (Scott, 2000) little is known about the spatial organization of these industries. Its peculiarities, such as its project-based organization and its strong reliance on human capital rather than tangible materials, are likely to set creative industries apart from more traditional manufacturing industries. The question becomes how the difference in input requirements and other discrepancies in production processes affect the spatial organization of an industry. Recent studies show that, similar to some manufacturing industries, creative industries are highly concentrated in space (Schoales 2006; Lazzeretti et al. 2008; Lorenzen and Frederiksen 2007). Research on fashion design in Paris, New York, London and Milan (Rantisi 2004; Wenting 2008), film production in Hollywood and Bollywood (Mezias and Mezias 2000; Scott 2004), and popular music production in New York and Los Angeles (Scott 1999) are only few examples of such studies. This dissertation contributes to the understanding of why these industries are highly concentrated in space and how the concentration process and outcome differs from tradition manufacturing industries.

The video game industry can also be classified as a creative industry. The production of video games is associated with great uncertainty. Nobody knows a priori whether a video game will be accepted or rejected by the larger audience (Caves 2002) and hits can easily be followed by flops. To become a success, a video game needs to capture the attention of a large audience and fulfill the needs of this audience. While marketing budgets and social influence among peers have a strong effect on the ability of a video game to capture the attention of consumers (DeVany and Walls 1999; Salganik et al. 2006), fulfilling the needs of consumers is more dependent on the intrinsic quality of the video game relative to other video games. Each video game differentiates itself from any other video game by introducing new game plays, new perspectives, new genre combinations, new characters or enhanced graphics. The combination of these stylistic elements is used by video game developers to set apart their game from yet existing games or to position their game within a tradition of yet existing games. Some stylistic elements are very popular and are subsequently covered by a large share of all video games, while other elements are only marginally covered. Thus, all video games are essentially novel and its success depends on whether consumers are prepared to pay for the quality of the product innovation (Delmestri et al. 2005).

The production of a video game is carried out as a project typically involving a development company and a publishing company, even though many development companies publish their own games and many publishing companies set up in-house development studios in order to capture a larger percentage of the value added. Developers are responsible for developing the creative content of a video game and they do so by providing programming skills, artistic design and insights on the gameplay[3]. Publishers on the other hand are responsible for managing, funding and marketing the video game project by providing the project management, market insights, marketing skills and financial capital (Tschang 2007).

[3] Gameplay is "the formalized interaction that occurs when players follow the rules of a game and experience its system through play" (Salen and Zimmerman 2003, p. 303).

The video games industry is affiliated with the computer hardware industry. Computer platforms set the technological boundaries within which video game developers can explore and exploit their creative interests. Some of these computer platforms are specifically designed to play video games, while others are multi-purpose machines. The computer platforms that are taken into account in this research can be divided into 3 different categories. First, game consoles are non-portable computer platforms that are specifically and solely designed to play video games. Early examples range from the Atari 2600 to the Coleco ColecoVision and later examples include platforms such as the Microsoft Xbox 360 and the Sony Playstation. Second, handhelds are portable game consoles which are specifically designed to function as a games platform. Examples include the Atari Lynx and the Nintendo Gameboy. Third, Personal Computers (PC's) are multi-purpose machines that often have processors that allow for an interactive gaming experience. Prior to the hegemony of Microsoft Windows and Apple Operating System (OS), many PC platforms ran on operating systems that were provided by the manufacturer of the hardware. Amiga OS on Commodore machines is a prime example.

The start of the video game industry is marked by the introduction of the first commercially available home console, the Magnavox Odyssey which was released in May 1972. Prior to the introduction of the Magnavox Odyssey some digital games had been created both for experimental purposes and as arcade games. The most popular and most well-known digital game available on arcade machines was PONG. This game was developed by Atari, a Sunnyvale, California based firm that was also responsible for the second home console available on the market, the Atari PONG. While the Magnavox Odyssey was commercially not very successful, the Atari PONG became Sears' best selling product over the 1975 holiday season with total sales exceeding 150,000 units. After the success of the Atari PONG, more firms entered the market, some with success others being less successful. In the early 1980s Activision, which had just spun off of Atari, created a revolution in the industry. Until then, manufacturers of video game consoles were also the producers of the video games. Activision disrupted this business model and started to produce video games for a variety of consoles, without producing a console themselves. Other firms followed swiftly and the business model with third party game production remains to be dominant.

In sum, its project-based organization, its reliance on art and technology, its unpredictability and its strong dependence on novelty and creativity makes the video game industry and industry that stands out from traditionally investigated industries such as automobile production or shoe production. However, it also shows many similarities why emerging and highly successful industries such as biotech, advertising and animation. In addition to its interesting position in the industry space, the video game industry is also a good case to answer the main research question because of its uneven spatial distribution and the strong presence of technological change.

RESEARCH QUESTIONS AND DISSERTATION OUTLINE

In order to answer the main research question this dissertation contains four empirical studies. These four empirical studies are based on four distinct but related questions and the answer to each question comprises a chapter. Essentially, each of the four chapters is based on four separate research articles[4], both co-authored and single-authored. Chapter 2 and chapter 3 are based on co-authored research papers with Koen Frenken and Ron Boschma, chapter 4 is based on a paper co-authored with Pierre-Alexandre Balland and Ron Boschma and chapter 5 is based on a single-authored paper. In the final chapter, we summarize the findings from the four preceding chapters and we present the overall conclusions on the logic of spatial industrial dynamics in the video game industry. We point out the contributions to the literature, and we identify remaining challenges for future research. Below we briefly introduce the four empirical chapters.

[4] Since each of the four chapters was written as an independent study, there might be some overlap, especially in the description of the data. However, each chapter employs a slightly different dataset than the other. Therefore, we opted to implement the studies in this dissertation in it's original form.

RESEARCH QUESTION 1

HOW DOES SOCIAL CAPITAL AFFECT THE REGIONAL ENTRY RATES OF FIRMS IN THE US VIDEO GAME INDUSTRY?

As firms in manufacturing industries face increasing competition from countries with low labor costs, national and regional governments tend to put a large amount of effort in the creation and attraction of new industries to stimulate economic growth. This tendency has been observed by a wide range of academic research and has motivated scholars to study the formation of new industries with a focus on ICT, biotechnology, nanotechnology and green technology as well as cultural industries such as film, music, media and design (Bresnahan and Gambardella 2004; Braunerhjelm and Feldman 2006; Cooke and Lazzeretti 2008). Although the vast majority of these studies indicates that the conditions under which new industries can successfully grow out to become important providers of employment and economic wealth are context specific, a commonly held belief is that the success of a new industry depends on the networks between all those involved in the creation of a new industry.

Organizational ecologists have found that, in a wide range of industries, the regional entry of firms into a new industry is a function of the firms already present in the region. They argue that firms initially benefit from the presence of other firms because it generates legitimation for their production activity. As more firms start to enter the industry, this effect is reversed through the increase of crowding and competition. In response to these findings, Aldrich and Fiol (1994) have argued that the legitimation effect as a result of increasing populations should be seen as a form of cognitive legitimation because industry stakeholders become more familiar with the activities undertaken by firms in the industry and develop a level of "taken-for-grantedness". They argue that cognitive legitimation alone cannot explain the full process of institutionalization of an industry. In particular, socio-political legitimacy, which can be described as the process *"by which the general public, key opinion leaders, or government officials accept a venture as appropriate and right, given existing norms and laws"* (Aldrich and Fiol 1994, p. 648) should also be taken into account. Although this idea is highly celebrated, very few studies have been able to translate the ideas put forward by their paper into an empirical context. Chapter 2 provides an explicit attempt to do so.

The main argument we develop in this chapter is that the level of regional social capital in relation to the regional firm population is responsible for variation in the number of regional entrants. Potential entrepreneurs require inputs such as knowledge, venture capital and employees to start a business and make it successful. In the early stages of firm formation, these inputs are often provided by geographically proximate sources such as local banks, family, social networks and local governments (Sorenson 2003; Hite and Hesterly 2001). The likelihood that entrepreneurs can actually get access to the resources needed to start a venture depends on the social capital available in the region. Indeed, social capital is defined as *"features of social organization such as networks, norms and social trust that facilitate coordination and cooperation for mutual benefit"* (Putnam 1995, p. 67). By defining social capital as a property of a local community characterized by density and intensity of relations, social capital is thus expected to support regional development by facilitating cooperation for innovation and providing a support structure for entrepreneurs. However, social capital may also hamper the creation of new industries.

Since new industries tend to be surrounded with controversy as established norms and values are being challenged and vested interests in substitute industries are being threatened, social capital can also generate conformity bias within tight groups which acts as a barrier for venture creation in new industries. As a result, the dense community network related to high levels of social capital is likely to withhold entrepreneurs in new and contested industries from support. The lack of support for new ventures in new industries is likely to fade over time, as more entrepreneurs in a region become active in the new industry allowing them to organize themselves, thereby lowering the contestedness of the industry. Hence, social capital is expected to discourage entry in new contested industries, while it is expected to promote entry in established legitimate industries. We hypothesize that the net effect of social capital on entrepreneurship can even become positive as the benefits of social capital for established ventures start to outweigh its detrimental effects for new and controversial ventures as a new industry continues to grow over time. In sum, in this chapter we investigate the relation between social capital the regional distribution of firms entering the US video game industry.

RESEARCH QUESTION 2
TO WHAT EXTENT DID FIRMS IN THE GLOBAL VIDEO GAME INDUSTRY BENEFIT FROM BEING CO-LOCATED IN SPACE?

Traditionally, economic geographers explain spatial clustering of firms as a result of agglomeration externalities that stem from the co-location of firms within the same or related industries (Marshall 1920), and that allow firms to survive longer than firms unable to benefit from such agglomeration externalities. However, a recent stream of research challenged this view by showing that the higher survival probability of firms in clusters is not the result of agglomeration externalities per se (Boschma and Wenting 2007; Klepper 2007; Buenstorf and Klepper 2009; Klepper 2010; Heebels and Boschma 2011). Klepper (2007) finds that the Detroit cluster in automobile production emerges as the result of the pre-entry experience of the founders of firms in the cluster. Successful firms in clusters tend to be spinoff firms that co-locate with their parent firm and profit from the pre-entry experience inherited from this parent firm. Cluster formation can then be explained as a cumulative spinoff process where a few successful parent firms create successful spinoff firms, which in turn give birth to new spinoff firms, et cetera.

Since manufacturing industries mainly rely upon other types of resources, the spatial concentration process of the video game industry is argued to differ from manufacturing industries (Scott 1997). The question then becomes whether the argument that regional characteristics do not benefit firms in terms of their likelihood to survive also holds for the video game industry. Due to its project-based nature, the video game industry is argued to benefit from pools of creative and specialized individuals that tend to reside in a limited number of places. These pools of creative and specialized individuals can be seen as repositories of knowledge and, following a network logic, may allow firms to benefit exponentially from the increasing number of firms in a region. Then, if negative externalities that arise from the co-location of firms only increase linearly, positive agglomeration externalities are likely to arise.

In this chapter we also address use of firm survival as the single measure of firm performance. An increasing body of literature argues that one should distinguish between modes of exit, some of which may reflect failure while other modes may reflect success (Cefis and Marsili 2007), and that these modes of exit are dependent on spatial characteristics. In particular, in current high-tech industries, many firms are founded in the hope that a large incumbent player will acquire the firm as to gain access to critical resources and organizational capabilities (Rogers 2004). Moreover, such acquisition activity is not uniformly distributed across space.

RESEARCH QUESTION 3

WHAT ARE THE DRIVING FORCES OF NETWORK FORMATION BETWEEN FIRMS IN THE GLOBAL VIDEO GAME INDUSTRY?

The analysis of interfirm networks has gained momentum in the field of economic geography and other social sciences. Investigations of how regions are affected by network relations between firms (Ter Wal and Boschma 2009; Morrison 2008), how firms are embedded in webs of relations (Uzzi 1997; Boggs and Rantisi 2003), how firms can benefit from their position in the network (Gulati 1999; Zaheer and Bell 2005), how innovation results from interfirm network relations (Powell et al. 1996; Vedres and Stark 2010) and how knowledge is transferred between firms across space (Giuliani 2007) have increased our understanding of the role of business networks in industrial change.

The interest in interfirm networks is motivated by the fact that interfirm networks are argued to generate crossbreeding of ideas, allow for risk sharing, increase market power and create heterogeneity in wealth across various spatial dimensions. But while the research on the outcomes of interfirm networks is abundant, relatively little work has been done on explaining how these interfirm networks come into being, how this process changes over time and whether there is spatial influence in this process. Theoretical accounts of network formation have identified three main sources that generate patterns in process. Heterogeneity in firm characteristics (Boschma and Frenken 2010), relational structures that tend to reproduce themselves over time (Rivera et al. 2010), and the level of similarity between attributes of actors are argued to act as drivers in tie formation processes (McPherson et al. 2001; Boschma 2005).

This chapter employs longitudinal data on the collaboration between publishers and developers of video games which allows me to study network formation across changing competitive, cultural and institutional settings. The main objective is to provide a detailed account of the underlying mechanisms of network dynamics along the ILC. Empirically, the contribution is twofold. First, this approach allows for the evaluation of influence of endogenous structural effects, individual characteristics of firms and similarity in terms of attributes on observed relational changes (Rivera et al 2010). Second, the longitudinal framing of our study allows us to answer the question of whether the influence of these different mechanisms changes or remains stable along the video games industry life cycle. From a theoretical perspective, we bring together network theory developed in sociology and statistical physics and concepts related to the spatial dimension of collaborative efforts developed in the field of evolutionary economic geography (Boschma 2005; Malmberg and Maskell 2006; Frenken and Boschma 2007).

RESEARCH QUESTION 4

HOW DO INTERFIRM COLLABORATIONS HELP FIRMS TO SURVIVE DURING CHANGING TECHNOLOGICAL SETTINGS IN THE GLOBAL VIDEO GAME INDUSTRY?

In this fourth study we develop and test arguments about how network relations can benefit firms when changes in technology affect the industry evolution. While the research on configurations of interfirm networks and firm performance has gained popularity over the last decades, little is known about the changing effects of network configurations on firm performance along the ILC. This chapter extends network research in that direction by explicitly integrating insights from network analytic research with theoretical arguments found in research on the technological evolution of industries. By combining these two strands of literature – interfirm networks and evolution of industrial settings – we explicitly explore how the relation between network ties and firm performance depends on and is moderated by the varying technological settings in an industry. We do so by employing the co-production network of publishers and developers to examine the developers' network linkages and its changing set of publishing partners.

Since the beginning of the video game industry there have been six waves in which a generation of game platforms was replaced by a new generation of game platforms. Each new generation brings big improvements in technology which allows video game developers to explore the creative boundaries of the new technology (Kent 2001). Once the boundaries are explored, video game production shifts towards exploiting the knowledge and ideas that were generated during the exploration phase (March 1991; Klepper 1996). In sum, this chapter shows how changes in technology created turbulence in the video game industry and how this turbulence moderated the effect of network relations on firm survival.

The main arguments made and tested in this chapter are that the failure of a developer's network partners affects the life chances of these developers and that the benefits that may arise from diversity in network partners is moderated by the changes in technological settings in an industry. Stressing the importance of technological change along an industry's lifespan allows us to provide a more dynamic and detailed analysis of the benefits and hazards that may arise from reliance on network relations. Hence, the main contribution of this chapter is to show how the quality and quantity of network relations affect firm performance while accounting for changing technological conditions. By doing so, this chapter provides a first attempt to link the dynamics associated with ILCs and the benefits accruing to firms as a result of being connected to other firm.

Table 1.1 provides an overview of the four empirical chapters. The dependent variable in these chapters varies. Chapter 2 explains the regional entry rates of firms, chapter 3 and chapter 5 estimates the hazard of failure and chapter 4 provides a model that explains the formation of ties in the collaboration network between developers and publishers of video games. In line with the differences in the dependent variables, the chapters also differ in terms of the model specification. A third clear distinction between the chapters is the operationalization of the connectedness of firms. We argued earlier in this chapter that relations between firms and other stakeholders in an industry may have a strong effect on the spatial organization of an industry. In chapters 2 and 3 we operationalized the relations between firms by studying the density of firms located in a region and the nature of relations between stakeholders in a region. Rather than explicitly observing every interaction, we measure the likelihood of firms and other stakeholders interacting at the regional level. In the second pair of chapters we explicitly observe and measure the interactions between firms in the video game industry.

TABLE 1.1
Schematic overview of chapters

	UNIT OF ANALYSIS	METHODOLOGY	OPERATIONALIZATION OF CONNECTEDNESS	KEYWORDS
CHAPTER 2 The downside of social capital in new industry creation	Regional entry in the US	Negative binomial count model	Implicit: regional	Venture founding, social capital
CHAPTER 3 Agglomeration externalities and modes of exit in project-based industries	Firm survival	Hazard analysis	Implicit: regional	Clusters, modes of exit
CHAPTER 4 The dynamics of interfirm networks along the industry life cycle	Network tie formation	Stochastic actor-oriented model	Explicit: networks	Network evolution, technological complexity
CHAPTER 5 Interfirm networks in periods of technological turbulence and stability	Firm survival	Hazard analysis	Explicit: networks	Network externalities, technological change

The empirical investigations in this dissertation are based on a dataset that includes both longitudinal information on the global population of firms that produce video games and longitudinal information on the regions where these firms are located. This appendix aims to describe the data collection process and it aims to show why this dataset is well suited to test the questions raised in the previous section.

The starting point of the construction of the dataset was the Game Documentation and Review Project Mobygames. This online, crowd-sourced data project is the most comprehensive data source available on video games. Before my decision to use the Mobygames data as a starting point of my research project I tested the comprehensiveness of this data source by comparing it to three other high-quality and popular data sources: *www.vgchartz.com, www.gamespot.com*, and *www.ign.com*. I randomly selected 50 video games from each data source and tested whether these video games were covered in the other data sources. I also tested how rich the additional information on these randomly selected video games was. Mobygames received the highest score, both on coverage and on richness of the additional information. The lowest level of coverage by Mobygames of any of the three randomly selected samples was 98% implying that only one game in one of these samples was not covered. The other three sources achieved much lower scores ranging between 65% and 87%. With respect to the quality of additional data: In many instances, Mobygames provides data on the firms involved in the production of a game, their location, their year of entry into and exit from the industry, and a large range of detailed game specific characteristics.

The second step involved the collection of additional and missing data and the review of the existing data. To obtain missing data on entry, exit, and location of firms and to obtain additional data on the background of firm founders I consulted the German Online Games Datenbank. This online database is complementary to the Mobygames database in that it provides more detailed information on the location of companies and backgrounds of entrepreneurs and also reports entry into and exit from the industry. In the rare case that neither of the two databases provided this information or in the rare case that the information in the two databases was contradicting, other online or hardcopy resources were consulted. Comparing the two datasets and reading and consulting other sources of data also allowed me to meticulously review the data in the Mobygames dataset. I purged out all data-entry errors, both by hand and by using algorithms specifically designed for this task. Exemplary of the thoroughness of the review process is the reduction of the number of unique firms in the Mobygames dataset from 8,861 to 4,607 firms and its 1,229 subsidiaries. The Mobygames dataset includes the names of the parties credited on the video game. However, two different parties do not always imply that there are two separate firms involved. In many of the cases, a label or subsidiary of a parent firm is not correctly indicated to be part of a larger legal entity. Therefore, I started reviewed the history of every single firm in the dataset and created a new dataset on all ownership structures in the video game industry and also on how these structures changed over time as a result of mergers or acquisitions.

In addition to the data on the firm level, I collected a large amount of data on the regions in which the firms in the dataset were located. Each chapter is based on a different subset of the entire database and each chapter individually describes the spatial reach of the data. The majority of this data was publicly available on the websites of the OECD and the US Census Bureau. The resulting dataset has a high quality and is very rich in detail. I can trace the entire histories of a total of 4,607 firms and its 1,229 subsidiaries since the inception of the video game industry in 1972 until the end of the data collection in 2007. Moreover, the dataset includes all variables that are needed to investigate the spatial dimension of resource and routine diffusion mechanisms and its effect on the industrial dynamics of the video game industry.

chapter 2

The downside of social capital in new industry creation

CO-AUTHORED WITH KOEN FRENKEN AND RON BOSCHMA

Introduction

One of the biggest concerns of regional governments today is to create new industries and stimulate its development. With global competition pressuring firms in mature industries to relocate their business to locations with lower factor costs, it is commonly held that future growth depends on the creation of innovative clusters. This explains the surge of studies into the location of new industries with a focus on ICT, biotechnology, nanotechnology and green technology as well as cultural industries such as film, music, media and design (Bresnahan and Gambardella 2004; Braunerhjelm and Feldman 2006; Cooke and Lazzeretti 2008). Though the individual histories of high-tech clusters are complex and context-dependent, a common denominator identified in a series of case studies concerns the role of networks between all those involved in the creation of a new industry. Entrepreneurs require knowledge, venture capital and other resources to start a business and make it successful and these resources are often provided by geographically proximate sources (Sorenson 2003). It has been argued that the level to which entrepreneurs are able to access resources needed to start their venture, depends on the social capital available in the region. Following 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"* our task becomes to examine how social capital relates to entrepreneurship and more specifically to the creation of a new industry. Defined a as a property of a local community characterized by density and intensity of relations, social capital is thus expected to support regional development by facilitating cooperation for innovation and providing a support structure for entrepreneurs.

Despite the support that social capital can provide for entrepreneurs in general, we argue that it is more likely that social capital hampers the creation of *new* industries. Most new industries are surrounded with controversy as established norms and values are being challenged and vested interests in substitute industries are being threatened. With social capital comes conformity bias within tight groups, both regarding values and ideas, and hence, a barrier for venture creation in new industries. Our argument does not imply that social networks do not play any role when entrepreneurs create new industries. Rather, while micro structures in the larger community network may indeed provide support for entrepreneurs in a new industry (Hite and Hesterly 2001), a dense community network characterized by high levels of social capital is likely to withhold entrepreneurs in new and contested industries from support. Once an industry becomes more legitimate in that more entrepreneurs in a region are becoming active in this industry, the less contested will new ventures in this industry be, and the less restrictive social capital will be on new foundings. That is, social capital is expected to discourage entry in new contested industries, while it is expected to promote entry in established legitimate industries. In principle, the net effect of social capital on entrepreneurship can even become positive as the benefits of social capital for established ventures start to outweigh its detrimental effects for new and controversial ventures as a new industry continues to grow over time.

Since we relate new venture creation to the existing stock of firms in a region, an organizational ecology approach is appropriate. Organizational ecologists look at the formation of new industries by explaining entry rates at one moment in time by the density of firms already present in a region. Our theory contributes to the ecological perspective in that we hypothesize that while firm density provides legitimation for newcomers, social capital discourages entry in a new industry, but the less so, the more firms are already present.

The context of our study is the US video game industry. The US video game industry is an interesting case as it is highly concentrated in a few major cities such as San Francisco, Seattle, Dallas, New York and Los Angeles and, historically, the industry has been characterized by controversies and lack of legitimation. Combining information on historical events within the industry with the spatial founding rates of new firms allows us to provide a fine-grained analysis of the legitimation processes at work back to its founding in the year 1972.

The paper is organized as follows. In section 2 we develop our theory regarding the role of social capital in the creation of new industries. In section 3 we describe the video game industry. Section 4 describes research design and data used in this study. Section 5 explains our methodology and section 6 presents the results from our empirical study. In the final section we summarize and conclude.

SOCIAL CAPITAL, ENTREPRENEURSHIP AND THE CREATION OF NEW INDUSTRIES

Since Putnam (1993) popularized the concept of social capital, its blessings for regional and national economic development have been widely embraced by policy makers and academics alike, leaving these blessings largely uncontested. The main line of reasoning put forward by Putman and echoed in most papers elaborating on his thesis holds that *"features of social organization such as networks, norms and social trust (…) facilitate coordination and cooperation for mutual benefit"* (Putman 1995, p. 67). In this view, social capital is a property of a community (typically geographically bounded) and is expected to support regional development by reducing transaction costs, pacifying social conflicts, facilitating cooperation for innovation and, our particular focus in this study, by providing a support structure for entrepreneurs.

Portes and Landolt (1996) were quick to argue that there might be downsides to social capital. These have been largely overlooked as scholars tend to equate social capital as the ability to draw on resources through social networks with the quality of such resources. Even if social capital within a community is high, this does not imply that the resources that are percolating through social networks are necessarily valuable. In fact, given that social capital creates demands for conformity in ideas and values following from group participation and social control, the resources that group members can access may well be redundant and of little relevance for starting a new venture, let alone, ventures in new industries (for a recent argument along the same lines, see Florida et al. 2008). Related, social capital within a regional community may prevent the success of business initiatives by its members. That is, excess social capital may well discourage entrepreneurship as *"less diligent members enforce on the more successful all kinds of demands backed by a normative structure. For claimants, their social capital consists precisely of privileged access to the resources of fellow members"* (Portes 1998, p. 16).

The possible positive and negative effects of social capital on regional development may well underlie the disappointing return on the massive investment in empirical research. In a typical research design, indicators of regional development such as growth in domestic product, innovation rate, or new venture creation are regressed on indicators of social capital growth while controlling for other determinants like human capital, investment and accessibility. As a recent review by Westlund and Adam (2010) has shown, this strategy has lead to results that are far from conclusive. After Putman's (1993) own study, only four out of 19 studies found unambiguous positive effects of social capital on regional development.

These concern a study on growth in per capita gross regional product for Italian regions (Helliwell and Putman 1995), two studies on EU regions using various regional development indicators (Beugelsdijk and Van Schaik 2005; Alcomak and Ter Weel 2007) and a study on U.S. states again using different regional development indictors (Dincer and Uslaner 2007). By contrast, two other studies did not find any positive effect of social capital whatsoever on regional development, one on U.S. states (Casey and Christ 2003) and one on Indonesian districts (Miguel et al. 2005). The remaining 13 studies reviewed by Westlund and Adam (2010) all found mixed results within a single study, with some regressions showing positive effects and other negative or insignificant effects of social capital on regional development.

Thus, there are both theoretical and empirical arguments that suggest that the effect of social capital on regional development is not as straightforward as originally put forward by Putman (1993). If, indeed, social capital can have both beneficial and detrimental effects on regional development we are left with the question under what conditions social capital is beneficial and under what conditions it is detrimental. Since the dangers of social capital lie in the conformity bias within tight groups, both regarding values and ideas, a natural extension of social capital theory is to argue that social capital is expected to hamper radical innovation and the creation of *new* industries, while it is expected to be supportive of incremental innovation and the promotion of *established* industries. With social capital comes social control and homogeneity in ideas and values, which renders entrepreneurship in new industries less likely. This is not to say that social networks do not play any role when entrepreneurs create new industries (Hite and Hesterly 2001). On the contrary, social networks, as defined by direct linkages between entrepreneurs and supportive resources such as investors, potential employees, and real estate suppliers have been found to be capable of increasing the likelihood of firm founding and the likelihood of firm success (Ruef et al. 2003). Rather, our argument is based on a higher level of social structures largely exceeding an entrepreneurs' ego network. Hence, this study fits into the tradition that defines social capital at the level of macro structures rather than at the level of micro structures or even ego networks (Portes 1998).

The thesis that we advance in this study holds that the more social capital is present in a region, the less likely entrepreneurship will venture into new industries. The underlying idea of our thesis is that deviant entrepreneurial behavior is less accepted in communities with strong social capital producing conformity in values and ideas. This line of argumentation also implies that once an industry becomes more organized and involved in local communities, as a result of more entrepreneurs becoming active in this industry, the less contested new ventures in this industry will be, and the less restrictive social capital will be. That is, regarding entrepreneurship as defined as new venture creation, social capital is expected to discourage entry in new contested industries, while it is expected to promote entry in established legitimate industries. As a new industry continues to grow over time, the net effect of social capital on entrepreneurship can even change from negative into a positive effect as the benefits of social capital for legitimized ventures start to outweigh its detrimental effects, provided that the existing stock of firms passes a critical threshold. Our thesis is in line with DiMaggio and Powell (1983) who state that the more firms entering a new field, the more likely it is that representatives of these firms will become involved in local associations. This in turn will allow them to better organize their new field and influence the public opinion about the new firms' activities for the benefit of these firms.

Since we relate new venture creation to the existing stock of firms in a region (otherwise known as firm density), an organizational ecology approach is appropriate. Organizational ecologists study the formation of new industries by explaining entry rates at one moment in time by the regional density of firms already present in a region (Sorenson and Audia 2000; Cattani, Pennings and Wezel 2003). The basic idea is that the initial increase in a regional population of firms generates a taken-for-grantedness among stakeholders, subsequently resulting in legitimacy for the new ventures. After some threshold is reached the marginal effect of firm population growth on legitimacy creation is outweighed by the marginal effect of firm population growth on competition. This process can be visualized as a U-shaped relation between firm population and firm entry. Recent research (Aldrich and Fiol 1994; Zimmerman and Zeitz 2002) has stressed that regional density provides legitimation in a cognitive sense in that other entrepreneurs can learn from existing ones (e.g. through the creation of a spinoff) and become familiarized with their activities. More in particular, *"actors learn both who they are (…) and what is expected of them (…) from contact with ongoing systems"* (Zimmerman and Zeitz 2002, p. 420). This same line of research argues that in addition to cognitive legitimacy, entrepreneurs can benefit from socio-political legitimacy which refers to the match between their entrepreneurial activities and the dominant, normative codes, rules, laws and traditions under which the stakeholders operate (Meyer and Rowan 1977; Aldrich and Fiol 1994; Elsbach and Sutton 1992; Baum and Shipilov 2006). Such a match is necessary in order to motivate stakeholders to legitimize the population of new ventures and provide these ventures with valuable resources such as funding and human capital.

At the time a new industry emerges, it is most likely that the act of founding a new firm is considered illegitimate. As Zimmerman and Zeitz (2002, p. 426) formulated it: *"when the scripts, rules, norms, values, and models created by the institutional entrepreneur differ from and perhaps contradict the existing socio-political regulatory, normative, and/or cognitive aspects of the social structure, acquiring legitimacy may be difficult"*. In particular, in regions with strong social capital, legitimacy is lacking as the new ventures challenge the common norms and ideas held in tight social networks. Fischer (1975) argued that the acceptance of deviant behavior is more likely to occur in places that accommodate multiple subcultures. Diversity in and relations between subcultures plays an important role in the legitimation process, because each subculture represents a different order of worth (Boltanski and Thévenot 1987; Stark 2009). Orders of worth refer to the criteria of valuation and evaluation used by a population or sub-population of individuals to assess what counts. Valuation and evaluation processes are relational by nature in that they involve a continuous stream of negations and renegotiations. Thus, our theory contributes to the organizational ecology perspective in that we hypothesize that while firm density provides legitimation for newcomers, social capital discourages entry in a new industry, but the less so, the more firms are already present. That is, as legitimation is built up over time by a growing stock of firms operating in a new industry, the detrimental effect of social capital is dampened or even reversed into a positive net effect.

Our empirical case study concerns regional entry in the U.S. video game industry. We feel this industry is particularly suited to test our hypotheses as entry in this industry was indeed regarded as deviant and non-conformist and games in general were contested. Yet, even if our thesis applies especially well to the specific case of the game industry due to its contested cultural and social value, in general, new industries seem to be socially contested in their early stages as documented for industries as varied as life insurance (Zelizer 1978), bikes (Bijker et al. 1987), adult entertainment industry (Hanna 2005), wind energy (Sine and Lee 2009), cochlear implants (Blume 2010) and ready-to-wear fashion (Wenting and Frenken 2011). This suggests that our thesis may be applicable to a wide range of industries and across different times and nations.

On a methodological note, looking at social capital in the context of the emergence of new industries allows us to circumvent a recurrent problem of endogeneity in social capital research: social capital may not only support regional development, but it may also be an outcome of regional development (Portes 1998; Westlund and Adam 2010). When one analyzes new venture creation in a single industry, once can safely assume that the failure or success of a region in this industry in terms of new venture creation will not alter the stock of social capital in any important way.

THE VIDEO GAME INDUSTRY

The video game industry emerged in 1972 with the introduction of the Magnavox Odyssey. While this revolutionary new computer for home entertainment became a commercial success, extremely high levels of growth in the industry were only achieved until the end of the 1970s with the introduction of the Atari 2600. Games such as Pac-Man and Space Invaders became instant hits. During the first half of the 1980s de US dominance in computer production diminished as a result of the introduction of the Nintendo Entertainment System and the releases of hit video games Donkey Kong and Mario Bros. Nintendo was able to continue its dominance as a console manufacturer through the success of the Super Nintendo Entertainment System. In the early 1990s Sony entered the market and secured a leading position due to its successful game machines, the Playstation and the Playstation 2. The current generation of video game consoles is characterized by heavy competition between Sony, Nintendo and Microsoft.

Though commercially a huge success, video games have always been contested as a commodity. Various politicians and interest groups condemned video games and the producers of video games. This strong disapproval of video games and the production of video games have been caused by two interrelated factors. One of the initial reasons for the disapproval of video games was the strong association of the video game industry with the arcade industry. Nearly all of the early video game companies, including Atari, Gottlieb and Williams, were founded by entrepreneurs that were previously active as producers of arcade equipment such as pinball machines (Kent 2001). Arcades and pinball machines were extremely profitable, but they were strongly associated with gambling, mafia and criminal activities. *"There was a certain amount of skill involved, but basically the law looked at it like a gambling device. Pay-outs started out legally in many states and eventually ended up being operated mostly illegally in places where the police would look the other way, such as New Orleans. They were nickel games, by the way. They paid off in nickels. So, it was a little gamble, but nevertheless it was gambling"* (Kent 2001, p. 5). The smear campaign against arcades and pinball machines reached its climax in the 1940s when Mayor LaGuardia of New York City passed a law that banned pinball machines in New York City from the 1940s to the late 1970s. The ban did not go by unnoticed: Mayor LaGuardia publicly demolished existing pinball machines with a sledgehammer and the debris was thrown in the river. New York City was not the only place in the US where video gaming was associated with gambling and criminal activity: all around the US local legislators and activist organizations were starting to protest against arcade gambling. As a result of the association of video games and arcade games, video game startups had trouble getting access to financial capital.[5]

[5] For example, Nolan Bushnell, the founder of Atari, experienced this negative connotation of video game production when he sought investment in his business. After being turned down by many banks, Wells Fargo agreed to provide him with $ 50,000, only a fraction of the amount asked for by Bushnell (Kent 2001).

A second factor causing a skeptical stance towards video gaming comes from the proclaimed negative effect of playing video games on children. The concerns with the new industry came from parents and teachers. Throughout the 1980s video games became very popular among children, and both parents and teachers accused the industry from keeping their children inside the house and away from school work (New York Times, 01/24/1982), causing them to underachieve at school (USA Today, 08/28/1990), become physically unfit (Washington Post, 01/12/1988) and develop aggression as a result of playing violent games (New York Times, 01/28/1982). These negative externalities of playing video games have spawned a broad stream of research from various academic disciplines. Early studies include Harris and Williams (1985) who investigate the effect of playing video games on school performance and Segal and Dietz (1991) who examine the physiologic responses to playing video games. Griffiths (1999) conducted a meta-analysis on the relation between playing video games and aggressive behavior. Among other findings, he reports a study by Lin and Lepper (1987) who studied the relationship between the amount of (arcade) video gaming and aggressiveness among 9 – 11 year olds and found a positive and significant relationship. This line of research emerged in the 1980s but continues to keep academics motivated to further explore the topic. A recent study shows that the relation between playing video games and negative externalities on children is still subject to a vivid debate (Anderson et al. 2010).

In sum, the continuous stream of critical issues related to video games raised in various media has been questioning the legitimacy of such ventures, even up to recent times. Founding a new venture in this business was indeed contradicting *"the existing socio-political regulatory, normative, and/or cognitive aspects of the social structure"* (Zimmerman and Zeitz 2002, p. 426), especially the normative and cognitive aspects. This industry is thus suited as a context for our hypothesis that regions with more social capital will initially be less likely to see entry in a contested business like the video game industry.

DATA

The analyses in this paper are based on a unique, newly constructed database that contains information on firms that developed or published one or more computer games from the inception of the industry in 1972 to the end of our dataset in 2007. We collected firm level data such as the entry year, exit year and location of video game developers and publishers[6] from the inception of the industry in 1972 until the end of 2007. The data is a compilation of various data sources. The starting point was the Game Documentation and Review Project Mobygames[7]. The Mobygames website is a comprehensive database of software titles and covers the date and country of release of each title, the platform on which the game can be played, and the name of the publisher and developer of the game. The database goes back until the inception of the industry in 1972, and the project aims to include all games that have ever been developed and published in the video game industry.

[6] The production of a video game involves a publisher and a developer.Developers "are charged with the creative development of a game code" (Johns 2005, p. 169), while publishers manage and fund the project. Essentially, developers provide programming skills, artistic inputs and insights on the gameplay, while publishers provide project management, market insights, marketing skills and financial capital (Tschang 2007).
The production of a video game is similar to production processes in other project-based industries, such as the pharmaceutical industry and the advertising industry, in which each project member temporarily takes up a specific task.

To obtain data on entry, exit, and location of firms and to control and monitor the quality of the Mobygames data we also consulted the German Online Games Datenbank.[8] This online database is complementary to the Mobygames database in that it provides more detailed information on the location of companies. In the rare case that neither of the two databases provided this information or in the rare case that the information in the two databases was contradicting, other online or hardcopy resources were consulted. By combining the Game Documentation and Review Project Mobygames and the Online Games Datenbank, we were able to track down 1,684 firms and 373 subsidiaries.

We also collected data on computer platforms produced in the US. This set of data includes 29 platforms on which computer games can be played. These 29 platforms (see table 2.1) can be categorized into 3 types: game consoles, personal computers (PCs) and handhelds. Game consoles are computers specifically designed to play video games, PCs are computers that have multiple applications (which include gaming), and handhelds are small, mobile game consoles specifically designed for playing games. We traced back the location of the manufacturer of the platform and we gathered information on the lifespan of each computer system.

In addition to firm level data and data on computer platforms, we collected data at the regional level from publicly available resources. This data was provided by The Bureau of Economic Analysis, The US Census bureau, The National Center for Charitable Statistics, Dave Leip's Atlas of US Presidential elections and the Organisation for Economic Co-operation and Development. We will further elaborate on these data in the description of the variables used in this study.

Figure 2.1 shows the entry and exit of the video game firms in the US video game industry throughout the history of the industry. The figure clearly shows that the video game industry has been growing rapidly until 1994 after which the population of firms stabilized. After 1994 two smaller peaks in the population can be observed. Both the peak around 2000 and the peak around 2007 coincide with the introduction of two US produced computer platforms: the Microsoft Xbox and the Microsoft Xbox 360.

In figure 2.2 we plotted the historical growth of the five largest regions, while figure 2.3 shows the density map for all regions in 2007. San Francisco and Los Angeles rank 1st and 2nd, with a maximum of 87 establishments in the Los Angeles region and a maximum of 75 establishments in the San Francisco region. Other regions in the top 5 of the US video game industry are New York, Seattle and Dallas. The top-5 regions (Los Angeles, San Francisco, Dallas, Seattle and New York) have dominated the industry in absolute numbers. In many years these regions accounted for more than 55 percent of all firms, while in some years these regions accommodated over 60 percent of all firms in the video game industry. This pattern is highly stable with small yearly fluctuations bounded by a 50 percent and 70 percent range.

METHODOLOGY

In order to investigate the founding processes of new firms in the US video game industry, we analyze the arrival rates of new video game producers at the regional level. Since we do not have information about the risk set of potential entrepreneurs willing to enter the video game industry, we estimate a model that predicts the yearly number of founding events within a region. Such a specification allows us to model entry rates as a continuous flow of counts with explanatory variables

[7] The Game Documentation and Review Project Mobygames can freely be consulted at http://www.mobygames.com. The Mobygames database is a catalog of 'all relevant information about electronic games (computer, console, and arcade) on a game-by-game basis' (http://www.mobygames.com/info/faq1#a). The information contained in MobyGames database is the result of contribution by the website's creators as well as voluntarily contribution by Mobygames community members. All information submitted to MobyGames is checked by the website's creators and errors can be corrected by visitors of the website.

[8] The Online Games Datenbank can freely be consulted at http://www.ogdb.de.

TABLE 2.1
Computer platforms

Computer Name	Manufacturer Name	Type	Released	Discontinued	Manufacturer Location
Odyssey	Magnavox	Console	1972	1975	Napa, California
Channel F	Fairchild Semiconductor	Console	1976	1979	Mountain View, California
Atari 2600	Atari	Console	1977	1984	Sunnyvale, California
Apple II	Apple	PC	1977	1993	Cupertino, California
TRS-80	Tandy Corporation	PC	1977	1991	Fort Worth, Texas
Commodore PET/CBM	Commodore	PC	1977	1982	West Chester, Pennsylvania
Odyssey 2	Magnavox	Console	1978	1984	Napa, California
Atari 8-bit	Atari	PC	1979	1992	Sunnyvale, California
Intellivision	Mattel Electronics	Console	1979	1985	Fresno, California
TRS-80 CoCo	Tandy Corporation	PC	1980	1991	Fort Worth, Texas
TI-99/4A	Texas Instruments	PC	1981	1983	Dallas, Texas
VIC-20	Commodore	PC	1981	1985	West Chester, Pennsylvania
Atari 5200	Atari	Console	1982	1986	Sunnyvale, California
Vectrex	Western Technologies	Console	1982	1984	Santa Monica, California
Commodore 64	Commodore	PC	1982	1993	West Chester, Pennsylvania
ColecoVision	Coleco	Console	1982	1984	Hartford, Connecticut
Macintosh	Apple	PC	1984	2007	Sunnyvale, California
Amiga	Commodore	PC	1985	1992	Santa Clara, California
Atari ST	Atari	PC	1985	1992	Sunnyvale, California
Commodore 128	Commodore	PC	1985	1989	West Chester, Pennsylvania
Atari 7800	Atari	Console	1986	1991	Sunnyvale, California
Apple IIGS	Apple	PC	1986	1992	Cupertino, California
Lynx	Atari	Handheld	1989	1994	San Francisco, California
3DO	3DO	Console	1993	1995	Redwood City, California
Amiga CD32	Commodore	Console	1993	1994	Santa Clara, California
Jaguar	Atari	Console	1993	1996	Sunnyvale, California
Game.Com	Tiger Electronics	Handheld	1997	2000	Vernon Hills, Illinois
Xbox	Microsoft	Console	2001	2006	Redmond, Washington
Xbox 360	Microsoft	Console	2005	2007	Redmond, Washington

predicting both the pool of potential entrepreneurs in the video game industry and the likelihood that a potential entrepreneur actually starts a video game venture (Sorenson and Audia 2000; Stuart and Sorenson 2003).

Our units of analysis are economic areas as defined by the Bureau of Economic Analysis (BEA). *"BEA economic areas (BEA EA) define the relevant regional markets surrounding metropolitan or micropolitan statistical areas. They consist of one or more economic nodes - metropolitan or micropolitan statistical areas that serve as regional centers of economic activity - and the surrounding counties that are economically related to the nodes. These economic areas represent the relevant regional markets for labor, products, and information. They are mainly determined by labor commuting patterns that delineate local labor markets and that also serve as proxies for local markets where businesses in the areas sell their products"* (Johnson and Kort 2004, p. 68). This regionalization, as initiated by the BEA, has also been adopted by the Organisation for Economic Co-operation and Development (OECD) and divides the US into 179 comparable regions. In our founding model we estimate yearly founding rates at the BEA EA level.

FIGURE 2.1
Entry and exit in the US video game industry

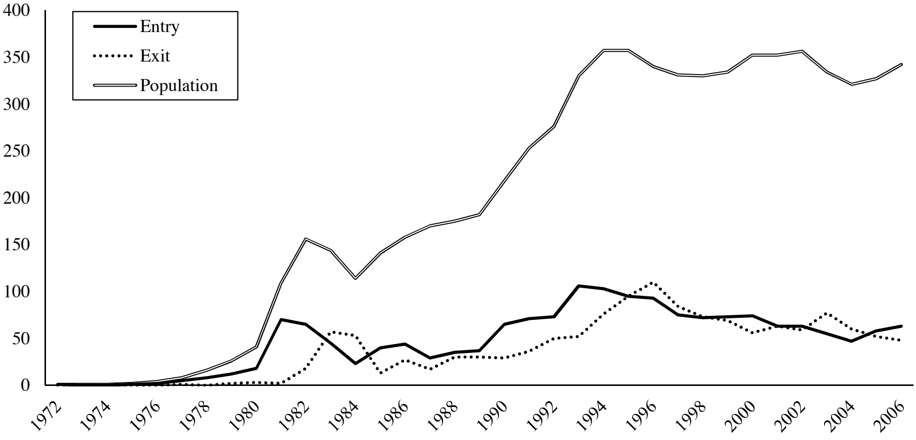
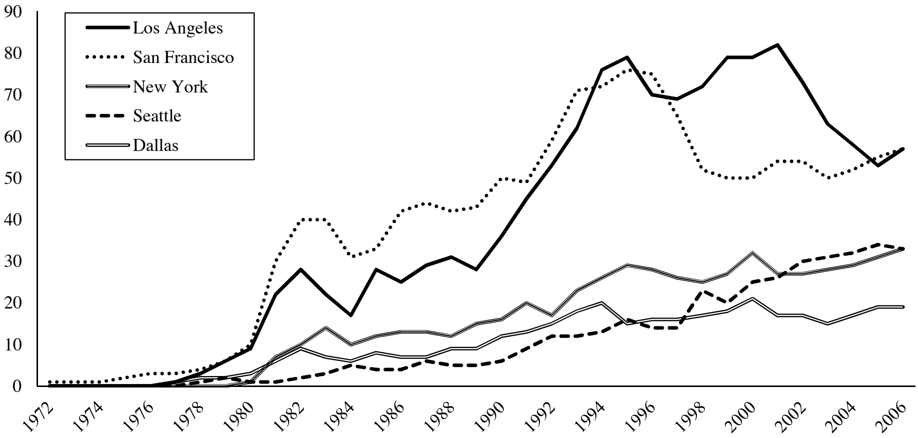
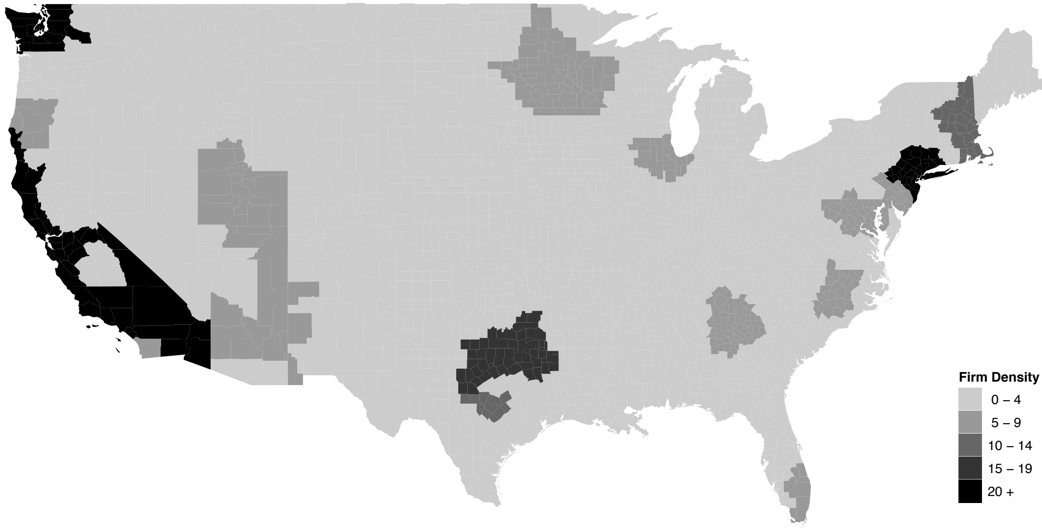


FIGURE 2.2
Firm density in the top 5 regions



Consistent with other studies (Stuart and Sorenson 2003; Barnett and Sorenson 2002), each region enters the model in the year of the first firm founding event in that specific region. More in particular, we estimate a model that predicts the yearly number of founding events within a region given that a firm is already present in that specific region. We therefore do not model why the first firm is founded in region i, but we model the arrival rates of new firms given that a firm has already been established in region i. Regions in which no single entry has occurred are thus excluded from the analysis. Our dataset contains time-series data of annual event counts (Sorenson and Audia 2000) which might result in a highly skewed error distribution because negative event counts cannot occur. Such data is most commonly analyzed using a Poisson regression, which is based on the assumption that the data follows a Poisson distribution. However, various factors such as the presence of unobserved heterogeneity and time-dependence

FIGURE 2.3
The regional distribution of firms in the US video game industry in 2007



of the entry rate violate the assumptions of the Poisson process. Since negative binomial regression models do not carry these assumptions we employ negative binomial regression models to study the effect of the covariates on the yearly regional founding rates. We specified the negative binomial model using a random effects[9] specification. The main reason to employ a random effects specification, rather than a fixed effects specification is that the level of social capital is largely stable within cases (region), but varies between cases. In particular, our theoretical argument does not stress the change of social capital within regions; it stresses that the available social capital in a region can only become an asset for local entrepreneurs when their presence in the region is strong enough to influence the public opinion about the nature of the new industry. Finally, the independent variables are lagged one year.

9 To ensure the robustness of our results, we also estimated fixed effects models. In these models both the direction and the significance of the coefficients remained unaltered.

DEPENDENT VARIABLE

Our dependent variable, *yearly regional foundings* is a count variable describing the yearly number of regional (at the BEA EA level) foundings of both headquarters and subsidiaries. All yearly regional foundings add up to 2,057, which is the sum of all headquarters and subsidiaries in the database[10].

10 Most prior studies that estimate regional founding rates focus solely on headquarters. By doing so, these analyses do not account for economic activity that is generated as a result of establishing subsidiaries. In order to verify the robustness of our outcomes, we also ran our models on the set of regions excluding subsidiaries. The results are similar in direction and significance.

INDEPENDENT VARIABLES

Social capital. The variable *Regional Social Capital* is an index[11] measuring the yearly levels of social capital at the BEA EA level. This index is created using principal component analysis. We follow Rupasingha et al. (2006) and collected data[12] on the total number of associations, the number of not-for-profit organizations per 10,000 inhabitants, the census mail response rates for the decennial household census, and the vote cast for president divided by the total population of 18 years and over for every BEA EA in our dataset. The census mail response rate is updated every 10 years and we therefore calculated the yearly rate by taking into account the observation closest in time. For example, to calculate the social capital index of 1994 we used the value of the census mail response rate of 1990, while we used the value of the census mail response rate of 2000 to calculate the social capital index in 1996. We applied the same method for the vote cast for US Presidential elections, which are held every 4 years. By applying principal component analysis to each year of observations, we were able to calculate a first principal component for each region in each year. For each year the eigenvalue of the first principal component exceeded 1.5 while other components had an eigenvalue of below 1. As an example, the index for 2007 reports the highest level of social capital in the Salina, Kansas area and the lowest level of social capital in the Fresno-Madera area in California. The process of constructing the dataset and extracting the index is similar to the procedure initiated by Rupasingha et al. (2006) and is recently used by other studies (e.g. Putnam 2007). Note also that using the number of associations to measure social capital is in line with an argument made by DiMaggio and Powell (1983). They state that *"the greater the participation of organizational managers in trade and professional associations, the more likely the organization will be, or will become, like other organizations in its field"* (DiMaggio and Powell 1983, p. 155). Initially, managers of ventures with controversial activities will find it difficult to be fully accepted. However, as soon as the number of organizations in an industry starts to increase, social capital can bring organizational managers together – through associations – allowing them to collectively organize their field.

Density. The variable *Regional Firm Population* measures the number of video game firms in year t that were located in region i. A firm enters the population in the year of entry and exits the population in the year of bankruptcy. This variable measure regional density and, as such, serves as a proxy for legitimation effects due to familiarity. Possibly, legitimation effects operate on a higher level of spatial aggregation (Hannan et al. 1995; Bigelow et al. 1997). We therefore also include the variable *National Firm Population* measuring the number of video game firms in year t within the US but excluding *Regional Firm Population* of the region i in question. By doing so, we clearly distinguish between density effects at regional levels and density effects at the national level (Bigelow et al. 1997). As common in ecological models, the squared terms of *Regional Firm Population* and *National Firm Population* indicate the competition effects. The sign of these variables is expected to be negative since competition sets bounds to unlimited growth of the population.

CONTROL VARIABLES

GDP. The variable *Regional GDP per Capita/100,000* measures the absolute GDP per capita in a region in constant (baseyear = 2007) US dollars divided by 100,000. This variable is included to control for the differences in purchasing power of the inhabitants of a region.

Population. *National Population/100,000* is a count variable that describes the size of the US population in year t minus the population of the focal region in year t divided by 100,000. We included the population variables to control for the potential base of consumers and entrepreneurs. The vast majority of video games is sold to individual consumers. Besides consuming the video game, these consumers also act as a critical mass that gives feedback. *Regional Youth Population/100,000* accounts for the number of inhabitants of a region below the age of 25. We included this control variable in the model because video gaming is an activity most popular among younger people. *Regional Rest Population/100,000* accounts for the rest of the population of region *i* in year *t*. *Regional Youth Population/100,000* and *Regional Rest Population/100,000* add up to the total population of a region in year *t* divided by 100,000.

[11] There is considerable debate on the measurement of social capital, both at national and at regional levels. Studies that examine national stocks of social capital tend to rely on surveys that attempt to capture the share of people within a country that 'have trust in other people'. The World Value Survey is one of the most widely used surveys. Two major disadvantages of using these measures is that they are either not updated annually or started to be updated annually only recently and that they are usually not available at detailed regional levels. A second popular data source, following Putnam's definition of social capital, includes datasets on the number of associations within spatially bounded areas. One of the major advantages of this type of data is that it is updated annually and that it is available at various spatial levels (Westlund and Adam 2010). By using data closer to the second family of data sources we do not intend to argue that this measure better fits the original definition of social capital. Rather this measure is preferred because it better fits the spatial and temporal dimension of our case.

Technology. *National Platform Production* is a count variable that measures the number of platforms manufactured by US manufacturers in year *t*. A platform enters the market in the year in which it is released and exits the market in the year after it is abandoned by its manufacturer. For example, in 1985 US manufacturers produced 7 platforms: The Commodore VIC-20, the Atari 5200, the Commodore 64, the Macintosh, the Commodore Amiga, the Atari ST and the Commodore 128. *Regional Platform Production* is a count variable that measures the number of platforms manufactured by manufacturers in region *i* in year *t*. This variable follows the same logic as the *National Platform Production* variable: a platform enters the region in the year in which it is released and exits the region in the year after it is abandoned by its manufacturer. These two variables are added to the model to account for changes in technology. The introduction of a new platform requires producers of video games and other stakeholders such as investors to learn about the new technology. By adding a spatial dimension to the variable we are able to examine at which level the introduction of a new technology affects the entry rates in regions.

RESULTS

Table 2.2 shows the descriptive statistics and the correlation coefficients[13] of all variables in the dataset. In the models presented in table 2.3 we test our hypothesis concerning a negative of effect of social capital on entry *per se*, and a positive effect of social capital on entry for increasing regional density.

In the first model we run the standard population ecology model with density and density squared variables plus our list of control variables. Both regional firm population and national firm populations are positive and statistically significant at a 1 percent confidence interval. This implies that regions experience higher entry rates when the population of firms in the region and the population of firms at the country level increases. Bigelow et al. (1997) found the same positive effect of both national and regional density on entry at the regional level, but various other studies (Sorenson and Audia 2000; Cattani et al. 2003; Stuart and Sorenson 2003) found no such effect from national density. The squared terms of *Regional Firm Population* and *National Firm Population* are both negative, but only the squared term of *Regional Firm Population* is significant at the 1 percent confidence interval level indicating that the relevant level of competition is regional which is in line with previous studies (Bigelow et al. 1997; Cattani et al. 2003; Greve 2002; Sorenson and Audia 2000). The results from model 1 indicate that an increase in regional entry rates is positively affected by an increase in both national and regional firm population levels – an effect that can be attributed to cognitive legitimation processes. However, at the regional level, after reaching a threshold, increases in the firm population lowers the number of firms entering a region – which is possibly the result of an increase in competitive forces.

Of all control variables, *Regional Platform Production, Regional Youth Population, Regional Rest population* and *National Population* display a significant effect on regional entry rates. The platform variable indicates that the positive effect of the presence of a platform manufacturer in a region remains confined to the region in which the manufacturer is located and does not spill over nationally. As games are developed for specific platforms, and platforms change regularly, platform producers seem to attract entries specifically oriented towards producing games suitable for this platform. This idea is confirmed by the fact that US video game firms are 1.28 more likely than expected at random to produce video games for a

[12] Associations include bowling alleys, public golf courses, civic and social associations, religious organizations, fitness facilities, political organizations, labor organizations, business organizations, professional organizations and sports clubs as defined by the US Census bureau. Not-for-profit organizations include all tax exempt legal entities registered at the National Center for Charitable Statistics. Vote cast was measured using Dave Leip's Atlas of US Presidential elections and mail response rates were obtained from the US Census bureau. The complete dataset is available from the authors upon request and the method we employed is exactly similar to and fully described in Rupasingha et al. (2006).

[13] Correlation values of some variables exceed 0.50. Although high levels of correlation are unlikely to bias the coefficient estimates, it may cause the standard errors to be inflated. As a result, tests of the hypotheses become more conservative (Allison 1999). We assessed whether our results are affected by multicollinearity by calculation the Variation Inflation Factors (VIF's). None of the VIFs were greater than 5 indicating that our results are unlikely to be affected by multicollinearity.

TABLE 2.2
Desciptive statistics and correlations

	Variables	Observations	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10
1	Regional Entry	1739	1.27	3.28	0	33	1.00									
2	Regional Social Capital	1739	-0.27	0.65	-2	2	-0.21	1.00								
3	Regional Firm Population	1739	5.03	13.45	0	117	0.87	-0.21	1.00							
4	National Firm Population	1739	363.44	143.52	0	505	-0.11	0.07	-0.02	1.00						
5	Regional Platform Production	1739	0.08	0.54	0	7	0.40	-0.03	0.30	-0.19	1.00					
6	National Platform Production	1739	3.97	3.86	0	13	-0.03	-0.04	-0.10	-0.88	0.00	1.00				
7	Regional Youth Population/100,000	1739	8.81	11.08	0	79	0.67	-0.29	0.68	-0.22	0.16	0.08	1.00			
8	Regional Rest Population/100,000	1739	21.31	25.89	1	169	0.60	-0.29	0.62	-0.18	0.17	0.06	0.96	1.00		
9	National Population/100,000	1739	2647.70	226.85	2031	2993	-0.16	0.11	-0.05	0.94	-0.17	-0.81	-0.30	-0.26	1.00	
10	Regional GDP per Capita/100,000	1739	0.32	0.05	0	1	0.32	0.07	0.40	0.43	0.10	-0.43	0.40	0.48	0.43	1.00

[14] We calculated the expected number of games that would have been produced for a local platform under the assumption that distance between game producer and platform producer played no role. Then we employed data from the Mobygames database on all video games produced in the US and calculated the actual number of games that were produced for a local platform. Finally, we divided the observed (1642) by the expected (1281) number of games.

console manufactured in region in which the firm is located[14]. Both *Regional Youth Population* and *Regional Rest population* are positive and significant. However, the effect of *Regional Youth Population* is more than twice as large as the effect of *Regional Rest population* which indicates that regions that accommodate more young people are likely to attract higher levels of entrants in the video game industry. *National Population* is also positive and significant which indicates that an increase in the population in the United States increases the likelihood that entrepreneurs will found a video game company.

In models 2 and 3 we further probe the effect of legitimation on the entry of new firms in the region. In model 2 we include the *Regional Social Capital* variable. The coefficient is negative and significant at the 5 percent level, indicating that, as expected, regions with more social capital witness less entry in the video game industry. In model 3 we add an interaction between our *Regional Social Capital* and *Regional Firm Population* variables. By including this interaction in our model, the main effect of Regional Social Capital remains negative and significant. Additionally, the interaction effect alone is statistically significant at the 1 percent level and the interaction effect and its main effects are jointly significant too. This result implies that high levels of social capital have a negative effect on regional firm foundings if the population of firms is low. However, an increase in the regional population of firms positively moderates the effect of *Regional Social Capital*. In other words, initial regional growth of the number of firms is negatively affected by high levels of social capital, and this effect is reversed as soon as a certain threshold of firms is reached.

CONCLUDING REMARKS

We have argued that social capital will discourage entrepreneurship into new industries. As social capital leads to conformity in values and ideas, deviant entrepreneurial behavior is less accepted in regions with strong social capital than in regions with little social capital. Once an industry becomes more legitimate over time as firms grow in numbers, social capital will be become less restrictive on entrepreneurship, and can even become positive. Using data on all entrants in the U.S. video game industry, we found indeed that regions with more social capital witness fewer entrants in the video game industry. We also found that, as a new industry continues to grow over time in a region, the net effect of social capital on entrepreneurship changes from negative into a positive effect as the benefits of social capital for starting new ventures start to outweigh its detrimental effects. Thus the initial negative effect of social capital is transposed into a positive effect by video game firms already present, because the more video game firms are already present in a region, the more likely they will be able to organize themselves to alter the socio-political context. We understand this pattern as reflecting the mainstream status that video games have achieved in regions with high density of video game firms.

We feel that our study provides a useful extension to the theory underlying organizational ecology by bringing in the concept of social capital as a determinant of regional entry. Yet, our study is not without limitations. One of the limitations of this study is that we treated new entries as being homogenous, i.e. each new entrant in the industry faces the same opportunities and challenges. Buenstorf and Klepper (2010) showed that different types of entrants were unevenly distributed across space and were facing different opportunity sets. Similarly, Aldrich and Fiol (1994) argue that without legitimacy entrepreneurs need to rely on personal and interpersonal resources and the quality of these resources differ

TABLE 2.3
Negative binomial regional entry rates (RE), Robust standard errors; ** ≤ 0.01, * ≤ 0.05

VARIABLES	1	2	3
REGIONAL SOCIAL CAPITAL		-0.328 *	-0.362 **
		0.130	0.129
REGIONAL SOCIAL CAPITAL * REGIONAL FIRM POPULATION			0.015 **
			0.005
REGIONAL FIRM POPULATION^2/100	-0.025 **	-0.025 **	-0.016 *
	0.005	0.005	0.006
NATIONAL FIRM POPULATION^2/100	0.000	0.000	0.000
	0.000	0.000	0.000
REGIONAL FIRM POPULATION	0.045 **	0.044 **	0.046 **
	0.007	0.007	0.007
NATIONAL FIRM POPULATION	0.004 **	0.003 **	0.004 **
	0.001	0.001	0.001
REGIONAL PLATFORM PRODUCTION	0.057 *	0.067 *	0.078 *
	0.028	0.028	0.028
NATIONAL PLATFORM PRODUCTION	0.024	0.026	0.025
	0.019	0.019	0.019
REGIONAL YOUTH POPULATION/100,000	0.015 **	0.013 *	0.025 **
	0.005	0.005	0.007
REGIONAL REST POPULATION/100,000	0.007 *	0.005	0.007 *
	0.003	0.003	0.003
NATIONAL POPULATION/100,000	-0.003 **	-0.003 **	-0.003 **
	0.000	0.000	0.001
REGIONAL GDP PER CAPITA/100,000	1.540	2.014	1.035
	1.413	1.424	1.464
CONSTANT	6.882 **	6.901 **	6.210 **
	1.091	1.089	1.111
NUMBER OF OBSERVATIONS	1,739	1,739	1,739
NUMBER OF REGIONS	91	91	91
LOG-LIKELIHOOD	-1747.057	-1743.865	-1739.104

between people and between places. A second limitation stems from the fact that we are unable to test if the BEA EA's used as the units of analysis in this paper reflect indeed the most interesting and appropriate spatial dimension. Other studies have used widely varying spatial scales such as Dutch provinces (Cattani et al. 2003), US states (Sorenson and Audia 2000), and ZIP-code areas (Stuart and Sorenson 2003) making it more difficult to compare results.

Future research could further explore the two main findings in this paper. Do regions with high levels of social capital initially experience lower entry rates in every industry or is this an industry-specific finding? As we indicate in our theoretical discussion, most new industries are contested in their early stages. Hence, social capital and conformity in values and ideas as its by-product are expected to discourage entry in any new and contested industry. Second, can social capital be supportive of entry in new industries if a region already hosts related industries? Such a 'spillover' effect can be expected between industries as long as the institutions in place supporting related industries are supportive of the growth of a new industry. Finally, can the results obtained at the regional level be extrapolated to the national levels? That is, can one expect countries with higher social capital to be less entrepreneurial in setting up new industries? Finland and Sweden immediately come to mind as two important counter examples. Indeed, social capital at the national level may well play a very different role than social capital at the regional level, since countries with strong social capital may still leave room for various experimental subcultures. After all, the concept of social capital of a country remains a construct composed of an average of heterogeneous regions.

In sum, by studying social capital as a regional attribute we have theorized and tested how the effect of social capital on regional levels of entrepreneurship is moderated by the state of the industry. Our findings indicate that social capital should not be seen as a "holy grail" that promotes and benefits entrepreneurship, but rather as an opportunity that can be exploited as soon as more firms entering the market start to confederate.

References chapter 2

Akcomak, I.S., Ter Weel, B. (2007). How do social capital and government support affect innovation and growth? Evidence from the EU regional support programmes, UNU-MERIT Working Paper Series #2007-009, United Nations University. Available at http://ccp.merit.unu.edu/publications/wppdf/2007/wp2007-009.pdf (accessed 22 May 2011).

Aldrich, H.E., Fiol, C.M. (1994). Fools rush in? The institutional context of industry creation. Academy of Management Review 19 (4): 645 – 670.

Anderson, C.A., Shibuya, A., Ihori, N., Swing, E.L., Bushman, B.J., Sakamoto, A., Rothstein, H.R., Saleem, M. (2010). Violent video game effects on aggression, empathy, and prosocial behavior in eastern and western countries: a meta-analytic review. Psychological Bulletin 136 (2): 151 – 173.

Barnett, W.P., Sorenson, O. (2002). The red queen in organizational creation and development. Industrial and Corporate Change 11 (2): 289 – 325.

Baum, J.A.C., Shipilov, A.V. (2006). Ecological approaches to organizations. In S.R. Clegg, C. Hardy, T. Lawrence and W.R. Nord (eds.), Handbook of Organizational Study, 2nd Edition, London, UK: Sage Publications, pp. 55 – 110.

Beugelsdijk, S., Van Schaik, T. (2005). Differences in social capital between 54 Western European regions. Regional Studies 39 (8): 1053 – 1064.

Bigelow, L.S., Carroll, G.R., Seidel, M.D.L. (1997). Legitimation, geographical scale, and organizational density: regional patterns of foundings of American automobile producers, 1885-1981. Social Science Research 26: 377 – 398.

Bijker, W.E., Hughes, T.P., Finch, T.J. (eds.) (1987). The social construction of technological systems: New directions in the sociology and history of technology. Cambridge, Massachusetts: MIT Press.

Blume, S. (2010). The artificial ear: Cochlear implants and the culture of deafness. New Brunswick, New Jersey: Rutgers University Press.

Boltanski, L., Thévenot, L. (1991, 2006). On justification (translated by Catherine Porter). Princeton, New Jersey: Princeton University Press.

Braunerhjelm, P., Feldman, M. (eds.) (2006). Cluster genesis. Technology–based industrial development. Oxford, UK: Oxford University Press.

Breshnahan, T., Gambardella, A. (eds.) (2004). Building high-tech clusters: Silicon Valley and beyond. Cambridge, UK: Cambridge University Press.

Buenstorf, G., Klepper, S. (2010). Why does entry cluster geographically? Evidence from the US tire industry. Journal of Urban Economics 68 (2): 103 – 114.

Casey, T., Christ, K. (2003). Social capital and economic performance in the United States. Department of Humanities and Social Sciences, Rose-Hulman Institute of Technology. Available at http://www.rose-hulman.edu/~casey1/US%20Social%20Capital%20(Casey-Christ).pdf (accessed 21 May 2011).

Cattani, G., Pennings, J.M., Wezel, F.C. (2003). Spatial and temporal heterogeneity in founding patterns. Organization Science 14 (6): 670 – 685.

Cooke, P., Lazzeretti, L. (eds.) (2008). Creative cities, cultural clusters and local economic development. Cheltenham, UK: Edward Elgar.

DiMaggio, P.J., Powell, W. (1983). The iron cage revisited: institutional isomorphism and collective rationality in organizational fields. American Sociological Review 48: 147 – 160.

Elsbach, K.D., Sutton, R.I. (1992). Acquiring organizational legitimacy through illegitimate actions: A marriage of institutional and impression management theories. Academy of Management Journal 35 (4): 699 – 738.

Dincer, O., Uslaner, E. (2007). Trust and growth. Fondazione Eni Enrico Mattei, Nota di lavoro 73.2007. Available at http://ssrn.com/abstract=999922 (accessed 21 May 2011).

Fischer, C. (1975). Toward a subcultural theory of urbanism. American Journal of Sociology 80: 1319 – 1341.

Florida, R., Mellander, C., Stolarick, K. (2008). Inside the black box of regional development – Human capital, the creative class and tolerance. Journal of Economic Geography 8: 615 – 650.

Forster, W. (2005). The encyclopedia of game machines. Consoles, handhelds and home computers 1972 - 2005. New York, New York: Game Plan.

Greve, H.R. (2002). An ecological theory of spatial evolution: Local density dependence in Tokyo banking, 1894–1936. Social Forces 80 (3): 847 – 879.

Griffiths, M. (1999). Violent video games and aggression: A review of the literature. Aggression and Violent Behavior 4 (2): 203 – 212.

Hanna, J.L. (2005). Exotic dance adult entertainment: A guide for planners and policy makers. Journal of Planning Literature 20 (2): 116 – 134.

Hannan, M.T., Carroll, G.R. Dundon, E.A, Torres, J.C. (1995). Organizational evolution in a multinational context: entries of automobile manufacturers in Belgium, Britain, France, Germany, and Italy. American Sociological Review 60 (4): 509 – 528.

Harris, M.B. and R. Williams (1985). Video games and school performance. Education 105 (3): 306 – 309.

Hausman J.A., Hall, B.H., Griliches, Z. (1984). Econometric models for count data with applications to the patents R&D relationship. Econometrica 52: 909 – 938.

Helliwell, J.F., Putnam, R.D. (1995). Economic growth and social capital in Italy. Eastern Economic Journal 21 (3): 295 – 307.

Hite, J.M., Hesterly, W.S. (2001). The evolution of firm networks. Strategic Management Journal 22 (3): 275 – 286.

Johnson K.P., Kort, J.R. (2004). Redefinition of the BEA Economic Areas. Available at http://www.bea.gov/scb/pdf/2004/11November/1104Econ-Areas.pdf (accessed 21 May 2011).

Kent, S.L. (2001). The ultimate history of video games: From Pong to Pokemon - The story behind the craze that touched our lives and changed the world. New York, New York: Prima Publishing.

Lin, S., Lepper, M.R. (1987). Correlates of children's usage of videogames and computers. Journal of Applied Social Psychology 17: 72 – 93.

Meyer, J.W., Rowan, B. (1977). Institutionalized organizations: Formal structure as myth and ceremony, American Journal of Sociology 83: 340 – 363.

Miguel, E., Gertler, P., Levine, D.I. (2005). Does social capital promote industrialization? Evidence from a rapid industrializer. The Review of Economics and Statistics 87 (4): 754 – 762.

Portes, A., Landolt, P. (1996). The downside of social capital. The American Prospect 26: 18 – 22.

Portes, A. (1998). Social capital: Its origins and applications in modern sociology. Annual Review of Sociology 24: 1 – 24.

Putnam, R.D. (1993). The prosperous community: social capital and public life. American Prospect 13 (4): 35 – 42.

Putnam, R.D. (1995). Bowling alone: America's declining social capital. The Journal of Democracy 6 (1): 65 – 78.

Putnam, R.D. (2007). E pluribus unum: Diversity and community in the twenty-first century. The 2006 Johan Skytte Prize Lecture. Scandinavian Political Studies 30 (2): 137 – 174.

Ruef, M., Aldrich, H.E., Carter, N.M. (2003). The structure of founding teams: Homophily, strong ties, and isolation among U.S. entrepreneurs. American Sociological Review 68 (2): 195 – 222.

Rupasingha, A., Goetz, S.J., Freshwater, D. (2006). The production of social capital in US counties. The Journal of Socio-Economics 35: 83 – 10.

Segal, K.R., Dietz, W.H. (1991). Physiologic responses to playing a video game. American Journal of Diseases of Children 145 (9): 1034 – 1036.

Sine, W.D., Lee, B.H. (2009). Tilting at windmills? The environmental movement and the emergence of the U.S. wind energy sector. Administrative Science Quarterly 54 (1): 123 – 155.

Sorenson, O. (2003). Social networks and industrial geography. Journal of Evolutionary Economics 13 (5): 513 – 527.

Sorenson, O., Audia, P.G. (2000). The social structure of entrepreneurial activity: geographic concentration of footwear production in the United States, 1940–1989. American Journal of Sociology, 106: 424 – 462.

Stark, D. (2009). The sense of dissonance. Accounts of worth in economic life. Princeton, New Jersey and Oxford, UK: Princeton University Press.

Stuart, T.E., Sorenson, O. (2003). The geography of opportunity: Spatial heterogeneity in founding rates and the performance of biotechnology firms. Research Policy 32: 229 – 253.

Wenting, R., Frenken, K. (2011). Firm entry and institutional lock-in: An organizational ecology analysis of the global fashion design industry. Industrial and Corporate Change, in press.

Westlund, H., Adam, F. (2010). Social capital and economic performance: A meta-analysis of 65 studies. European planning studies 18 (6): 893 – 919.

Zelizer, V.R. (1979). Morals and markets: The development of life insurance in the United States. New York, New York: Columbia University Press.

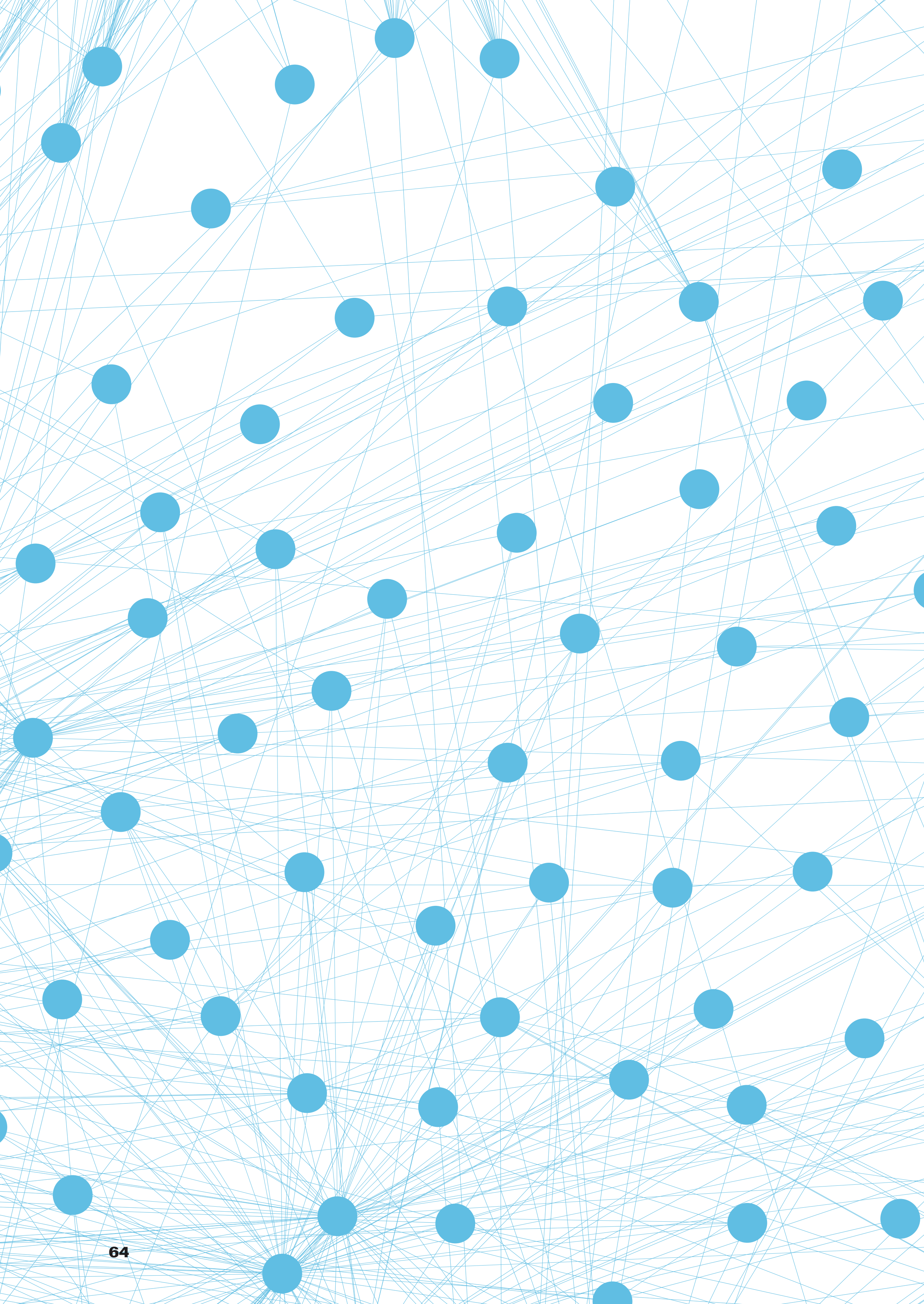
Zimmerman, M.A., Zeitz, G.J. (2002). Beyond survival: Achieving new venture growth by building legitimacy. Academy of Management Review 27 (3): 414 – 432.

NEWSPAPER ARTICLES
Wasting time (1982, January 24). The New York Times, p. 18.

Video games for the "basest instincts of man" (1982, January 28). The New York Times, p. 22

Ordovensky, P. (1990, August 28). SAT scores decline; verbal skills blamed. USA Today, p. 1A

Cohn, V. (1988, January 12). Doctors identify modern age disorders. The Washington Post, p. Z9



chapter 3
Localization externalities and modes of exit in project-based industries

CO-AUTHORED WITH KOEN FRENKEN AND RON BOSCHMA

Introduction

Economic geographers traditionally explain geographical clustering of firms as a result of localization externalities that stem from the co-location of firms within the same or related industries (Marshall 1920). Co-location allows firms to perform better and survive longer than firms that are located outside clusters. Even if scholars disagree about the exact definition and boundaries of a cluster (Martin and Sunley 2003), explanations of clusters based on localization externalities have gained an almost paradigmatic status in economic geography.

This view on clusters has recently been challenged in a study on the evolution of the U.S. automobile industry and its geographic concentration in Detroit (Klepper 2007). In this study, it was found that the higher survival probability of firms in the Detroit cluster could be attributed to the pre-entry experience of the founders of firms in the cluster. The genealogy of successful Detroit firms could be traced back to a few successful parent firms that passed on their capabilities to subsequent generations of spinoff firms. Importantly, co-location in Detroit area did not affect survival indicating that localization externalities were absent, a result that was also found in six follow-up studies on other industries.[15] The conclusion that co-location does not necessarily bring benefits also resonates earlier findings on negative localization externalities in metal-working (Appold 1995), footwear (Sorenson and Audia 2000), knitwear (Staber 2001) and biotechnology (Stuart and Sorenson 2003).

[15] These studies concern the British car industry (Boschma and Wenting 2007), the global fashion design industry (Wenting 2008), the U.S. tire industry (Buenstorf and Klepper 2009), the German machine tool industry (Buenstorf and Guenther 2011), the U.S. semiconductor industry (Klepper 2010) and the Dutch book publishing industry (Heebels and Boschma 2011).

Given the evidence across different industries, one would be tempted to conclude that localization externalities play no role in the evolution of clusters. However, the evidence for such a thesis is largely based on findings from manufacturing industries, leaving project-based industries rather unexplored. Various scholars have stressed that project-based industries rely upon localized interpersonal networks (Scott 2000; Grabher 2002), which are likely to set apart the spatial organization of these industries from the spatial organization of manufacturing industries. Distinguishing between negative and positive localization externalities, we expect that competition increases proportionally with cluster size, while the potential to recombine human resources in projects increases more than proportionally with cluster size. We test this hypothesis for data on 4,607 video game firms worldwide and find evidence that localization externalities positively affect firm survival only when a cluster exceeds a critical size.

In our analysis of firm survival, we differentiate between exits by failure and exit by acquisition, since the latter may be more often a sign of success rather than of failure (Cefis and Marsili 2007). Our findings show that most variables explaining firm survival also explain firm acquisition, indicating that acquisition is indeed best considered as a sign of business success rather than as business failure in the context of the video game industry. Our study suggests that evolutionary approaches to clustering should be more sensitive to industry specificities that are reflected not only in the exact nature of localization externalities but also in the different modes of performance.

The paper is organised as follows. The next section develops the main hypothesis against the background of the recent literature in evolutionary economic geography. We specifically pay attention to the subtleties of project-based industries. Section 3 discusses the operationalization of clustering and success by critically examining the various measurements of agglomeration externalities and business performance indicators. Section 4 introduces the method and materials and section 5 presents the results. We end with some concluding remarks.

SPATIAL CLUSTERING IN PROJECT-BASED INDUSTRIES

Since the end of the nineteenth century, the spatial concentration of industries attracted the attention from economic geographers. The cause of geographical concentration of industries is sought in agglomeration externalities that arise from the co-location of firms within similar or related industries, better known as localization externalities.[16] Most influential has been the account of Marshall (1920), who referred to benefits that co-locating firms from the same industry may exploit as a result of local access to specialized suppliers and buyers, a large and specialized labour pool, and local knowledge spillovers. Storper (1995) referred to another component of agglomeration externalities by introducing the idea of untraded interdependencies as crucial economic underpinnings of clusters. These untraded interdependencies, such as conventions, rules, norms and practices are place-specific and form an asset to local firms.

16 Agglomeration externalities specific to firms operating in the same or similar industries has become known under the label of localization externalities as to distinguish this type of agglomeration externalities from urbanization externalities stemming from co-location between any firm in a city or region (Appold 1995). For a recent review on empirical evidence on localization externalities, see Wennberg and Lindqvist (2010).

A more recent line of research argues that spinoff dynamics rather than localization economies are responsible for cluster formation. Klepper (2002; 2007; 2010) argues that new industries emerge from related industries when entrepreneurs exploit the relevant capabilities from related industries in the context of a new industry. With the subsequent growth of an industry, the share of spinoffs increases at the expense of other types of entrants, where spinoffs refer to firms founded by entrepreneurs who have previously worked for an incumbent firm as an employee. The dynamics of spatial clustering can now be understood as an evolutionary process. Firms are assumed to be heterogeneous in their capabilities, partly because of different pre-entry experience and partly because of idiosyncratic factors. Firms with capabilities that show the best fit with market demand and technological supply factors will grow fastest and produce most spinoff firms. Initially such firms are diversifiers from other industries that can leverage their capabilities from their core industry to the new industry. Then, following a Darwinian logic (Boschma and Frenken 2003; Boschma and Frenken 2011), these successful diversifiers produce more - and more successful - spinoffs. These spinoffs inherit a large part of the capabilities of their parent and they tend to locate in the same region as the parent firm, which causes a cluster to emerge as a result of a few successful firms starting to create many successful spinoffs (which, in turn, create successful spinoffs themselves).

The implication for our understanding of geographical clustering holds that clusters are expected to emerge even in the absence of localization economies. This has been confirmed by studies on the U.K. car industry (Boschma and Wenting 2007), the U.S. car industry (Klepper 2007), the global fashion industry (Wenting 2008), the U.S. tire industry (Buenstorf and Klepper 2009), the U.S. semiconductor industry (Klepper 2010), the German machine tool industry (Buenstorf and Guenther 2011) and the Dutch publishing industry (Heebels and Boschma 2011), which showed that being located in a cluster did not increase the survival probability of firms.

Instead, Klepper (2007) explained the emergence of a cluster by interacting the spinoff and the Detroit variables, showing that the increased likelihood to survive in the Detroit cluster was confined to spinoffs rather than firms without pre-entry experience. The emergence of the Detroit cluster, then, can be attributed to the exceptional capabilities of Detroit spinoffs which were inherited from selected parents in Detroit. This methodology was also followed in the studies on U.S. tire firms clustering in Akron, Ohio (Buenstorf and Klepper 2009) and Dutch publishing firms clustering in Amsterdam (Heebels and Boschma 2011).

In both cases, it was also found that spinoffs within the cluster outperformed spinoffs outside the cluster, suggesting that clusters emerged through the transmission of exceptionally fit capabilities from selected parent firms within the cluster.

The results on the absence of positive localization externalities resonate earlier findings that questioned the alleged benefits that firms accrue from co-location. For example, Appold (1995) found that localization externalities were negatively affecting the performance of U.S. metalworking firms. Similarly, Sorenson and Audia (2000) found that firms in clusters in the U.S. footwear industry were characterized by higher failure rates, because of stronger competitive pressures. This made them to conclude that geographical clustering of an industry is the result of higher founding rates, rather than lower failure rates. Staber (2001) found that failure rates of firms increase with the number of firms active in the same industry at a particular location, while failure rates decrease with the number of firms operating in complementary industries at a location. Also, Stuart and Sorenson (2003) found that U.S. biotechnology firms performed worse when co-located with other biotech firms in clusters. In all cases, the theoretical lines of reasoning attributed the absence of positive localization externalities to the disadvantages of clustering related to upward pressures on wages and prices due to increased competition for resources.

Despite the cumulative evidence in recent years suggesting that positive localization externalities played no role in the clustering of manufacturing industries, it would be premature to conclude that co-location cannot have net benefits in project-based industries either. While it is likely that the negative externalities stemming from co-location increase roughly linearly with the number of fellow competitors as suggested in the aforementioned studies, this does not rule out the possibility that the positive localization externalities follow a more complex pattern in the case of project-based industries. *Our main hypothesis holds that positive externalities stemming from co-location increase more than proportionally with the number of co-located firms in project-based industries.* We develop this hypothesis below within the context of the video game industry, but we believe that the theoretical argument holds in other project-based industries as well.

Video game development is organized in temporary project teams in which artistic expertise, commercial expertise and financial expertise capital are being recombined (Johns 2005; Tschang 2007). At the start of the industry in the 1970s, project teams consisted of only a few individuals, but this number rapidly grew reflecting the rising technological complexity of modern video game production. At present, most games even involve more than a 100 people during the whole process of conception, creation, marketing and distribution. A development house brings in the artistic expertise by providing professionals each with different artistic roles ranging from game play writers, programmers, sound engineers, and graphic artists. The publishing house provides upfront capital and as well as testers, distributors, marketers, financial managers and project managers. While in some cases, development and publishing is done in a single firm, more often a game results from formal collaboration between a developer and a publisher (De Vaan 2010).

The production of a video game is similar to production processes in other project-based industries, in which industry employees temporarily collaborate in projects in ever changing configurations and for many different employers over their career. Co-location in a cluster brings advantages for employees by accommodating a continuous stream of projects for which they could work. Being located in a cluster also provides benefits to employers who have access to a thick and flexible workforce with specialised skills. A similar logic of co-location has been described in more detail in case studies in related project-based industries including advertising (Grabher 2002), architecture (Kloosterman 2010), film (Scott 2000), new media (Girard and Stark 2002) and software (Ibert 2004).

Project-based industries are quite different from the ideal-type manufacturing industry that laid the foundation for evolutionary economics and its core concepts of routines as the main repository of knowledge (Nelson and Winter 1982). Routines underlie a firm's capabilities, and with the transmission of routines from parent to spinoff, capabilities are inherited from the parent by the spinoff (Klepper 2002). In project-based firms, organizational routines inherited by the founder will indeed be important, particularly the project-management routines that apply across projects. However, the impact of routines on firm performance is expected to be less apparent than in manufacturing because projects are one-off events and lessons drawn from one project do not necessarily carry over to the next project (Gann and Salter 2000). As a result, firms have to rely much more on their employee's own skills, their experience in previous collaborations, and their personal networks with fellow specialists in other firms (Engwall 2003). That is, the informal social network of industry employees is a second "repository of knowledge" alongside the organizational routines of firms (Grabher 2004).

The question is how the nature of localization externalities plays out in such project-based industries. Traditional negative localization externalities such as increasing congestion and high real estate prices are expected to play a minor role in project-based industries, because the main resource used in its production system is labour rather than bulky tangible inputs or land. However, competition between firms based on the demand for key creative individuals with specialized and exceptional skills is likely to be highly localised. Labour tends to be rather immobile in space (Gordon and Molho 1995; Breschi and Lissoni 2009; Eriksson 2011), which implies that firms compete for key employees with other co-located firms. As a result, each additional firm at a location forces all co-located firms to compete with one additional firm, leading to a proportional increase in competition. Following previous studies (Sorenson and Stuart 2000; Staber 2001; Sorenson and Audia 2003), we expect that due to the increase of competition the probability of survival will decrease linearly with the number of firms in a cluster.

While negative localization externalities are likely to be roughly proportional to cluster size, one may expect in project-based industries that the positive localization externalities increase more than proportionally with cluster size. The challenge for firms and employees alike is to assemble creative teams with complementary skills. Assembling the right team is crucial since a project's success depends critically on all different expertises that are being recombined. Logically, the number of possible team configurations increases non-linearly with cluster size. Hence, the potential to recombine diverse sets of expertise held by different employees rises more than proportionally with the size of a cluster (cf. Weitzman 1998). Or, in the words of Grabher (2002, p. 255): *"(t)he practice of project-based collaboration (…) maximizes recombinatory options between a diverse range of skill sets, biographical backgrounds and cultural orientations"*.

The advantage of clustering, then, comes from the fact that the number of possible team configurations increases non-linearly with cluster size.

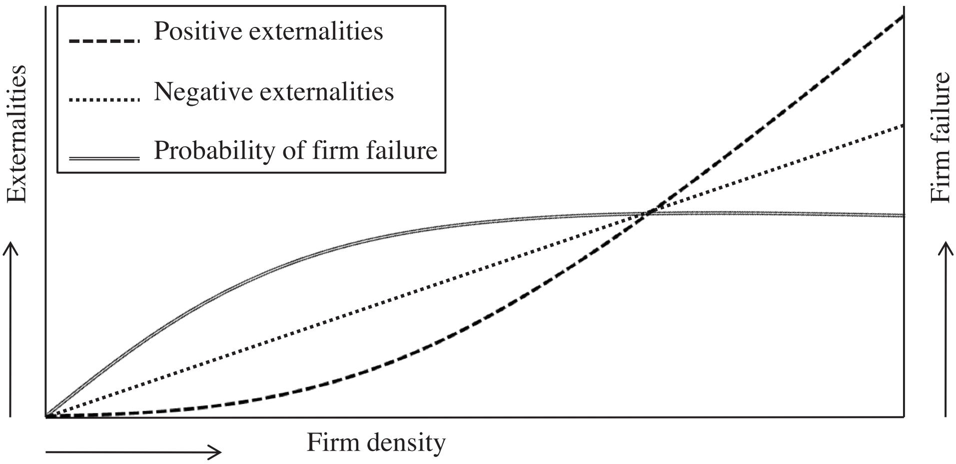
With the recombinatory potential of project team assemblies rising non-linearly with cluster size, the social networks across firm boundaries will also be more developed in larger clusters compared to smaller clusters. One of the main mechanisms through which social ties are created among employees is through joint participation in project teams. Past team members tend to remain in touch after the project for the purpose of informal knowledge, sharing even when employed at different firms (Breschi and Lissoni 2009). Given the larger number of firms and the higher rate of labour mobility between firms in clusters (Eriksson 2011), the social networks stemming from job-hopping will be much more extensive and much less redundant in larger clusters compared to smaller clusters.

More generally, the concepts of "community learning" (Brown and Duguid 1991) and "knowledge community" (Henry and Pinch 2000) apply well to the video game industry. These notions refer to the importance of employees' interaction in professional networks. Participation in such networks keeps a firm's employees up-to-date with the latest market trends and technological development. In order to become and remain member of a community, firms, employees and other actors need to be engaged in a continuous process of judging, being judged and sharing judgments. In this context, Storper and Venables (2004 p. 356) argue that *"(i)n such fields as fashion, public relations, and many of the arts (including cinema, television, and radio) there are international networks 'at the top,' but in the middle of these professions networks are highly localized, change rapidly, and information used by members to stay in the loop is highly context-dependent"*. Staying in the loop is a complex process because it requires tacit knowledge that can only be absorbed by face-to-face interaction. Hence, firms in larger clusters will have much more employees profiting from the information percolating in such informal professional networks (Grabher 2004).

With positive localization externalities increasing more than proportionally with cluster size and negative localization externalities increasing proportionally with cluster size, the joint effect on firm performance can be depicted as in Figure 3.1. The figure explains that once cluster size exceeds a critical threshold, co-location starts to enhance firm survival as the net effect of co-location becomes positive. It is this hypothesis that we will test below for all firms in the global video game industry.

One may object to this hypothesis that if co-location in larger clusters brings more than proportional more benefits than in smaller clusters, firms will re-locate from smaller to larger clusters leading to one single super-cluster. There are two opposing forces that render the emergence of a single cluster unlikely. First, as explained, the production process of a video game is characterized by the coalescence of art, technology and commerce. To the extent that art work is an expression of cultural values, norms and traditions, cultural-geographical boundaries play an important role in the industry. Indeed, many have stressed the increasing importance of space and place in creative industries based on symbolic knowledge, because of the symbiotic relationship between place, culture and the economy (Pratt 1997; Scott 1997; Asheim and Gertler 2005; Johns 2006; Asheim et al. 2007; Currid and Williams 2009). For example, Johns (2006, p. 173) argues that "cultural differences remain important considerations for publishers and developers. Despite relatively close cultural proximity, even some

FIGURE 3.1
Hypothesized relation



UK- and USA-produced games require localization – that is, adaptation in the gameplay, character design and other final product characteristics to better suit the specific demands of culturally different game consumers – before they are suitable for consumers". The consumer's taste in terms of art and cultural expression not only becomes known to publishers and developers through statistics about sales levels; more importantly, employees of both publishers and developers are often avid gamers, strongly embedded in local communities of other avid gamers, which provide them with information about the wants and needs of potential customers (Saltzman 2004). Second, as for any other industry, most entrepreneurs start their company in their home region or home country given their local knowledge and networks (Figueiredo et al. 2002; Stam 2007). Over time, firms and their employees will become part of the local community as well as develop strong ties with key clients, often local (Grabher 2002). Re-location will render it more costly to maintain these relationships in a meaningful way. At the same time, after entering a new cluster it will take time and effort to become part of the local community and to get linked to key local players, both employees and clients. These forms of local embeddedness render the probability of re-location unlikely despite the possible benefits that larger cluster may bring to a firm.

MEASURING LOCALIZATION EXTERNALITIES AND FIRM PERFORMANCE

As we will address the effect of localization externalities on firm performance, the manner in which we define and measure localization externalities and firm performance deserve special attention. Starting with localization externalities, previous studies on localization externalities in the evolutionary tradition have applied different indicators. Klepper (2007; 2010) and Wenting (2008) simply used dummies for cities in which clusters emerged over time, which obviously does not directly measure the effect of co-location. Rather, it defines clusters with the benefit of hindsight, by first observing in the data in which locations the industry eventually concentrated, and then entering these locations as dummies in the analysis. Boschma and Wenting (2007) and Heebels and Boschma (2011) measured localization externalities more directly in terms of the number of co-located firms in the same industry, but they measure this effect only at the time of entry. Even if one can argue that the benefits of co-location are especially important for small and young firms that have to rely more on cluster advantages to overcome the 'liability of newness' (Stinchcombe 1965) compared to larger and more established firms, in a survival analysis one ideally measures the effect of co-location at each moment in time. Following this reasoning, Buenstorf and Klepper (2009) and Buenstorf and Guenther (2011) measure localization externalities on a yearly basis, yet they use regional shares of firms rather than the absolute count of firms.

We will measure localization externalities by counting the number of firms present in each year and in each region. Since the firms in our dataset are located across the globe, the regionalization of the data requires a uniform regional classification. The Organization for Economic Co-operation and Development (OECD) offers such a uniform regionalization. *"Regions in OECD Member Countries have been classified according to two territorial levels (TL), to facilitate international comparability. The higher level (Territorial level 2) consists of macro-regions, while the lower level (Territorial level 3) is composed of micro-regions in the 30 OECD member countries. These levels are officially established, relatively stable and are used in most countries as a framework for implementing regional policies"* (OECD, 2010, p.3). The regional variables employed in this paper are all measured at the TL3 level, because this level represents labor market areas. In the US, TL3 regions represent economic areas as defined by the Bureau of Economic Analysis (BEA), while in Europe, TL3 regions are largely equal to the NUTS3 level.[17] By following this measurement strategy, we excluded 311 firm founding events from the analysis. These firms are located in regions outside the OECD regionalization.[18] Our final model includes a total number of 379 TL3 regions.

In order to exploit the fact that we have global coverage of the industry, we will assess not only the effect of agglomeration at the regional level, but also on higher scales of spatial aggregation.[19] Even if one would expect that external costs and benefits of co-location at the regional level are most important on theoretical grounds, co-location at higher levels of spatial aggregation may also be a source of externalities. In particular, as discussed above, national boundaries may play a role. Video games are cultural products and their meaning and success is mostly bounded by national markets. Indeed, the vast majority of all video games are initially only released in the country in which the game was produced. The more successful games are then released in multiple countries (Kent 2001).

Turning to performance, we follow most industry studies that measure performance as survival. Even if this measure has the advantage of being clearly defined by a (legal) event that is easily traceable in the past, there is increasing awareness that exit may not always indicate failure. In particular, in case of exit by acquisition, this may be actually a sign of success rather than failure (Cefis and Marsili 2007). Entrepreneurs often found firms with the specific objective of selling the firms at a later stage to larger incumbent firms who want to obtain capabilities that they find too expensive to develop in-house (Ranft and Lord 2002). In this way, incumbents can remain competitive in a rapidly changing technological environment despite their inability to push the technological frontier by themselves. For the seller, especially when this concerns a young entrepreneurial firm, an acquisition can represent a successful strategy to harvest economic returns and liquidate assets. This is especially the case for innovative firms that are backed up by venture capital, or for firms that aim to grow rapidly in the presence of managerial and financial constraints.

[17] More info on the regionalization can be found at http://www.oecd.org/dataoecd/32/4/42027551.pdf

[18] In order to test whether the omission of these 311 firm founding events affected our outcomes, we also estimated a model in which we created artificial regions based on distances between firms for all 311 firms. Firms within a 150 kilometer radius were placed in the same region. Since the vast majority of the 311 firms were Russian firms, we had no problem with 'overlapping regions' (firms that could be put in 2 or more regions). Including the artificial regions did neither alter the direction nor the significance of any of the explanatory variables in our models.

[19] In organizational ecology, density effects at both regional, national and global levels are taken into account (e.g. Hannan et al. 1995; Bigelow et al. 1997). Note, however, that such studies explain entry rates rather than survival.

Indeed, the video game industry is characterised by high rates of acquisition. Especially during the last decade, many founders set up a company with the purpose of selling their successful business to other firms in the industry (Rogers 2004). The financial compensation and the decreasing pressure are important motives for selling a successful business. From our data (further explained below), we observe that 355 firms and 179 subsidiaries in the video game industry were acquired in the 1972-2008 time frame, out of 4,607 firms and 1,229 subsidiaries ever started. In many cases these firms were young, well performing firms that either developed a "hit" video game or created a valuable proprietary technology. Indeed, our data show that young – as expressed through age – and well performing – as expressed through their pre-entry experience and quality of products – firms are more likely to be acquired than firms lacking these characteristics.

We will therefore conduct two separate survival analyses. First, we will estimate a *failure model* in which both firms that are alive at the end of the observed time period and acquired firms are treated as right censored observations (Klepper 2002; 2007). Second, we will estimate an *acquisition model*, where firms that were alive at the end of the observed time period and firms that had gone bankrupt are treated as right censored exits. Thus, in the first case the hazard refers to firms going bankrupt, while in the second case, the hazard refers to the likelihood of being acquired by another firm.

METHODS AND MATERIALS

The analyses in this paper are based on a unique, newly constructed database that contains information on firms that developed or published one or more computer games from the inception of the industry in 1972 to the end of our dataset in 2007. The database includes 91 platforms on which these computer games can be played. These 91 platforms[20] can be categorized into three types: game consoles, personal computers (PCs) and handhelds. Game consoles are computers specifically designed to play video games, PCs are computers that have multiple applications (which include gaming), and handhelds are small, mobile game consoles specifically designed for playing games.

We collected firm level data such as years of production, location and pre-entry experience of video game developers and publishers[21] from the inception of the industry in 1972 until the end of 2007. The aggregation of some of the firm level data resulted in industry level data, such as regional, national and global firm population levels. The data is a compilation of various data sources. The starting point was the Game Documentation and Review Project Mobygames.[22] The Mobygames website is a comprehensive database of software titles and covers the date and country of release of each title, the platform on which the game can be played, and the name of the publisher and developer of the game. Additionally, for 55% of all firms the Mobygames database provides a firm bio. In many of these bio's information of the location of the firm and the background of the entrepreneur is included. The database goes back until the inception of the industry in 1972, and the project aims to include all games that have ever been developed and published in the video game industry. To obtain data on entry, exit, location at the municipality level and pre-entry experience of all firms, and to control and monitor the quality of the Mobygames data, we also consulted the German Online Games Datenbank.[23] This online database is complementary to the Mobygames database in that it provides more detailed information on the location of companies and backgrounds of entrepreneurs. In the rare case that neither of the two databases provided this information or in the rare case that the

[20] A list of platforms and characteristics of the platforms is available and can be sent by the authors upon request.

[21] In the figures and the analyses in this paper publishers and developers are grouped together. One third of all firms only develops games, one third only publishes and one third does both. We also estimated three models that included each group separately, and the results remained statistically similar.

[22] The Game Documentation and Review Project Mobygames can freely be consulted at http://www.mobygames.com. The Mobygames database is a catalog of 'all relevant information about electronic games (computer, console, and arcade) on a game-by-game basis' (http://www.mobygames.com/info/faq1#a). The information contained in MobyGames database is the result of contribution by the website's creators as well as voluntarily contribution by Mobygames community members. All information submitted to MobyGames is checked by the website's creators and errors can be corrected by visitors of the website.

[23] The Online Games Datenbank can freely be consulted at http://www.ogdb.de.

information in the two databases was contradicting, other online or hardcopy resources were consulted. By combining the Game Documentation and Review Project Mobygames and the Online Games Datenbank, we were able to track down[24] 4,607 firms and 1,229 subsidiaries.[25]

Figure 3.2 shows the entry, exit and the global population figures for video game firms throughout the history of the industry. The figure clearly shows that the video game industry has been growing for many years, with 1983 and 2005 as years of a slight slowdown. Although entry of firms exceeds exit of firms in the majority of the time span, there is a clear connection between entry and exit of firms. Entry of firms seems to precede the exit of firms, which may be indicative for the competitive effect of an increase in population on exit. In Figure 3.3 we plotted the number of firms going bankrupt and the number of firms being acquired. The number of firms being acquired is steadily growing after the mid 1990s. In 2005, a total of 34 firms were acquired in the industry. Approximately 56% of all M&A activity took place within countries. The USA was most active both in terms of acquiring firms and of firms being acquired. Firms in the Los Angeles region were the most active acquirers, while firms in the San Francisco area were most likely to be acquired.

In figure 3.4, we plotted the annual number of entrants in the industry specified according to their pre-entry background. Experienced firms are firms that diversified from industries other than the video game industry and firms that were founded by entrepreneurs that previously headed or owned a firm in another industry. Spinoffs are firms founded by individuals previously employed by an incumbent firm in the video game industry. Startups are constituted by all other firms.[26] Initially, entrants in the industry were mainly startups and experienced firms, while since the mid 1990s the share of spinoffs among the total number of entrants is increasing. This finding is in line with other findings reflecting that especially spinoffs, with their pre-entry experience, can overcome entry barriers that rise over time (Klepper 1996).

[24] Both the Mobygames and the OGDB are crowd sourced databases. All entries to the databases are checked for accuracy by moderators of the websites and by its users. We argue that by combining both sources we constructed a highly accurate database, free from large errors and omissions. We also compared the coverage of firms in our dataset with the coverage provided by other proprietary datasets such as gamespot.com and allgames.com and found a much higher accuracy in our dataset.

[25] The data on subsidiaries is solely used to construct the firm population statistics and are neither included as cases in our analyses, nor as cases in our figures.

FIGURE 3.2
Entry and exit of publishers and developers in the video game industry

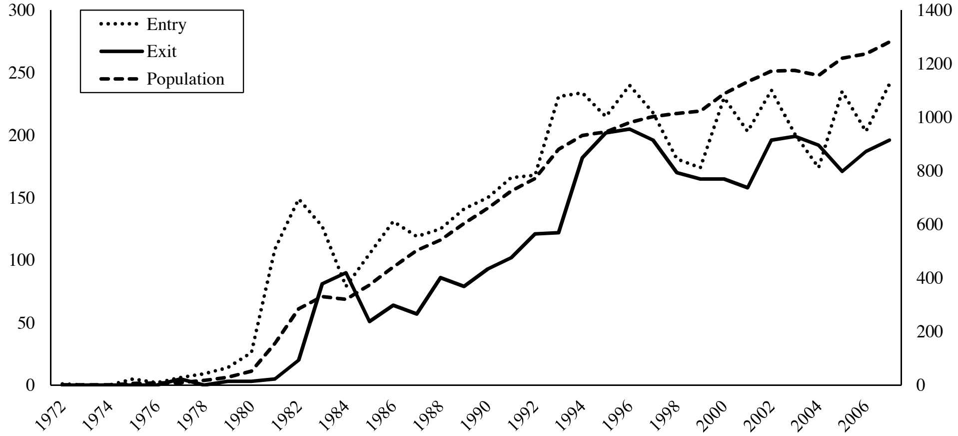


FIGURE 3.3
Publisher and developer exits from the video game industry by type of exit

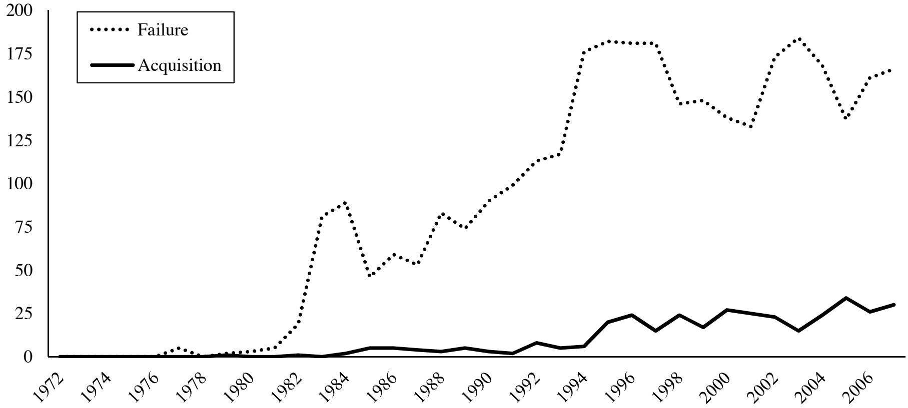
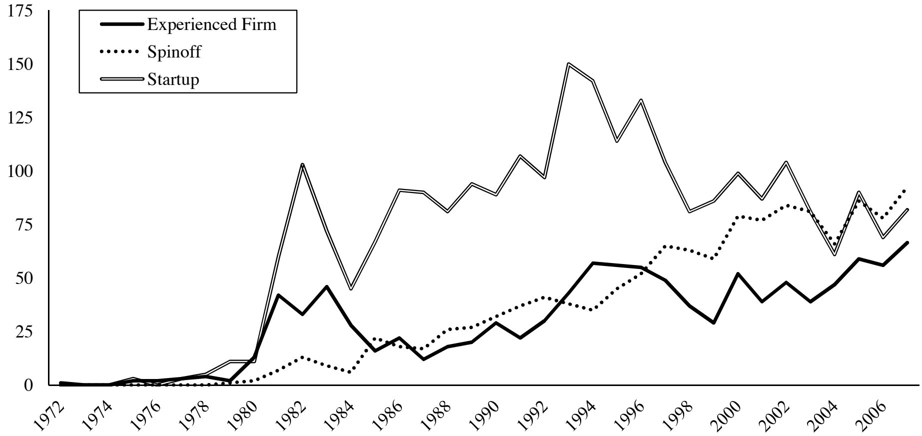


FIGURE 3.4
Entry of experienced firms, spinoffs and startups



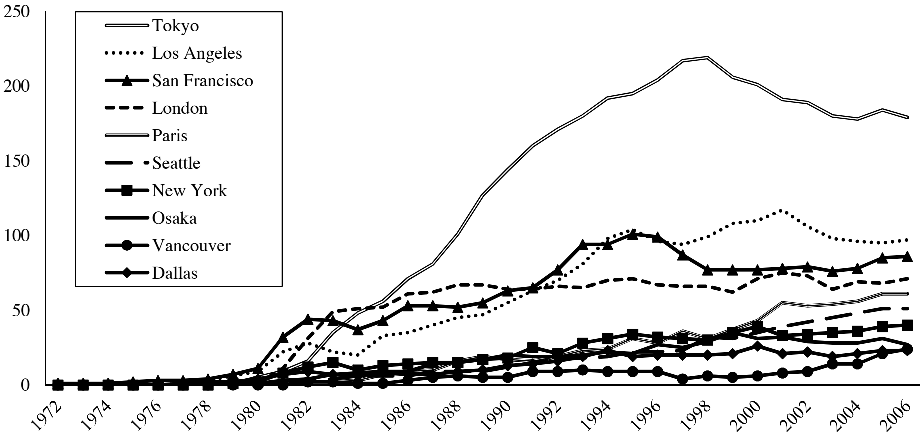
26 This data was collected through the Mobygames database and the OGDB. By using these data sources, 69 % off all firms could be classified in one of the three categories. For the remaining 31 % we used other sources such as books, websites (Linkedin) and games magazines. This search increased coverage to 98%. The final 2% was covered by sending e-mails and making phone calls to entrepreneurs, local authorities and industry insiders.

Following from previous studies (Boschma and Wenting 2007; Klepper 2007), one expects most spinoffs to locate close to their parent company, thus contributing to a clustering process. Calculating distances based on a straight line between two locations ("as the crow flies"), we find that the mean distance between the spinoff and the parent firm is quite large: 799 kilometers. However, the distribution of distances is highly skewed. No less than 71 percent of all spinoffs located within a radius of 150 kilometers from the parent firm and 90 percent of all spinoffs were located in the same country as the parent. The most common movement of spinoffs that relocated to another country were movements between the US, the UK and Australia, which obviously increase the mean distance between the parent firm and the spinoff substantially.

In figure 3.5 we plotted the annual population of video game producers in the 10 largest regions in 2007. Tokyo is by far the largest with a peak of 219 establishments in 1998. The second largest region in Japan is Osaka with a peak of 29 firms in

1998. The United States is very well represented in the population graph. San Francisco and Los Angeles rank second and third, with a maximum of 117 establishments in the Los Angeles region and a maximum of 101 establishments in the San Francisco region. Other US regions that appear in the top 10 of regions are New York, Seattle and Dallas. In addition, the Vancouver region in Canada ranks number 9 in 2007. So there seems to be not just a strong presence of US firms, but also a clear pattern of concentration along the North American west coast.

FIGURE 3.5
Annual number of firms in the top 10 regions worldwide



ESTIMATION

To test our hypotheses concerning failure and acquisition, we use two similarly specified hazard models.[27] Hazard models are used to model time-to-event data. In the field of industrial dynamics and organizational ecology, hazard models are widely used to test the determinants of firm failure (Agarwal and Gort 1996; Klepper 2002; 2007; 2010; Disney et al. 2003; Thompson 2005; Buenstorf and Klepper 2009). Hazard models take into account both the probability of occurrence of an event and the time-duration until the occurrence of an event. By censoring observations, hazard analysis also allows for the incorporation of cases that have artificially imposed ends of duration. Such an analysis is appropriate for our two models in which we are interested in the time to failure and the time to acquisition. As explained, while failure of a firm is a negative event, an acquisition event is considered here a positive negative. Thus, the sign of covariates are to be interpreted accordingly.

27 We also estimated a competing risk model taking into account the competing risks of failure and M&A. Such a model has the advantage of not treating either failure or M&A as a right-censored observation, but it cannot take into account a specific distribution of the baseline hazard rate. Also, one can argue that in our case failure and M&A are not truly competing risks. In any case, the outcomes of the competing risk model were similar to the outcomes from the two separate specifications.

Previous research (Klepper 2002; Buenstorf and Klepper 2009) and descriptive statistics from our dataset indicates that the hazard rate decreases monotonically with duration. Therefore, using a Gompertz specification to model our time-to-event data provides a good fit (Blossfeld et al. 2007). The Gompertz specification provides two parameters to include variables. One parameter allows the explanatory variables to affect the hazard rate proportionally at all ages, while the other parameter allows the explanatory variables to condition the effect of duration on the hazard rate. In our models, duration equals firm age. So, we specify both our failure model and our acquisition model accordingly:

$$h(\tau) = \exp(\beta_0 + \beta' c) \exp[(\gamma_0 + \gamma' x)\tau],$$

where $h(\tau)$ is the hazard of either failure or acquisition of the firm at age τ. In particular, we estimate the probability that an event – going bankrupt or being acquired – takes place conditional on the fact that it did not occur in the prior time frame. In the failure model, both firms that are alive at the end of the observed time period and acquired firms were treated as right-censored observations. In the acquisition model, firms that were alive at the end of the observed time period and firms that had gone bankrupt are treated as right-censored exits. In our specification, *c* is the vector of covariates that affect the hazard proportionally at all values of duration, *x* is the vector of covariates that condition how age affects the hazard, β_0 and γ_0 are scalar coefficients, and β' and are γ' vectors of coefficients. Also, all explanatory variables that change over time are lagged by one year.

DEPENDENT VARIABLE

The dependent variable in the hazard and the acquisition model is the hazard of exit or acquisition at age τ – $h(\tau)$ – which is a proxy for firm performance. Since we collected data on the entry and exit years of each video game firm from the inception of the industry in 1972 until December 31, 2007, we can determine firm age by counting the number of years between the first and last years of commercial production.

INDEPENDENT VARIABLES

The variable Spinoff includes firms that were founded by former employees of other firms within the video game industry. The variable Experienced Firm includes all firms that diversified from industries other than the video game industry and firms that were founded by entrepreneurs that previously headed or owned a firm in another industry. These entrepreneurs were typically former CEOs, CFOs or other types of leading managers. The reference group here comprises all other startups. This group of firms includes recently graduated entrepreneurs that had no former affiliation and lower level employees of firms outside the industry, who decided to start a venture in the video game industry. As discussed in section 2, the main argument in establishing these categories is the fact that firms differ in their prior exposure to relevant organizational routines and their ability to reuse them in a new setting. While spinoffs and experienced firms are able to build upon routines exposed to prior to founding, other startups do not have this advantage. To further probe the hypothesis on the performance of spinoff companies, we also included the variable *Years Parent Produced*, which quantifies the age of the parent firm at the time that the spinoff company is created. Following Klepper (2007), we use this variable as a measure of the parent firm's quality.

We included three types of location-specific variables that might affect the hazard of failure and acquisition. First, the variable *Top 4 Regions* is a 1-0 dummy variable, with *Top 4 Regions* equal to 1 for the four regions with the largest number of video game producers in 2007: Tokyo, San Francisco, Los Angeles and London. We construct this dummy following the use of the Detroit dummy in Klepper's (2007) study on the U.S. automobile industry. Second, we constructed several population variables where a firm enters the population at the year of entry and exits the population at the year of exit. The variable *Regional Firm Population* measures the yearly number of video game firms located in a firm's region excluding the firm itself. This is our localization externalities variable. The variable *National Firm Population* measures the number of video game firms located in the same country as the focal firm minus *Regional Firm Population. Global Firm Population* measures the number of video game firms in the previous year minus *National Firm Population*. Third, we used data on the number of inhabitants at the regional and national scale to control for potential consumer base. The variable *Regional Population* counts the absolute number of inhabitants in a firm's TL3 region in the previous year, while *National Population* counts the absolute number of inhabitants in country in the year prior to the current minus the *Regional Population* of the region where a firm is located. These data are obtained from the OECD statistics center which can be found at http://stats.oecd.org.[28]

[28] National population statistics are available for all years of our observations. Population statistics for some regions are difficult to obtain for the 1970s and the 1980s. We therefore used growth of the national population and the distribution of the regional population in the first five years of complete information to compute the regional population in the years in which data was missing. To check the robustness of our findings we used similar procedures for regions on which data was complete and compared them to the computed data. Outcomes indicate no significant statistical difference between the means of the computed populations and the means of the observed populations.

Finally, we included a number of firm level control variables. First, we created 3 dummy variables based on the time of entry of each firm. All firms are categorized into three cohorts – *Cohort 1, Cohort 2*, and *Cohort 3* – with the first cohort spanning 1972-1990, the second cohort spanning 1991-1998, and the third cohort spanning the period 1999-2007. The division is based on the introduction of new generations of consoles, in which we combine generation 1 and 2, generation 3 and 4, and generation 5 and 6 respectively (De Vaan 2010; Forster 2005). Cohort 3 is the omitted reference category. Second, the variable *Multi-activity* is a dummy variable equal to 1 if a firm was active in both publishing and developing of video games. Such firms are able to master two disciplines and they are able to spread risks. Third, the variable *Multi-Product* is a dummy variable that measures whether a firm is active in both the production of console games and the production of PC games, the two largest submarkets in the video game industry. Fourth, the variable # *Games* counts the yearly number of games produced by a firm. And fifth, we constructed the variable *Review Scores*, which measures the mean score received from game critics on the games produced by a firm in a particular year. A review source – either online or in print – is included in the measure if it has issued at least a hundred reviews, and if it reviews multiple platforms. Hence, the variable *Review Scores* is used as a proxy for the artistic success of video games and is expected to be a main determinant of firm success as well, as artistic success often, though not automatically, translates into commercial success. In the acquisition model, we also included two country dummies for *Japan* and *USA*. We included these two variables to control for country-specific institutions that affect acquisition rates, as Japanese firms are characterized primarily by attitudes of internal growth, while US firms are said to accomplish growth more often through external acquisitions (Odagiri and Hase 1989).

FINDINGS

In table 3.1 we present the descriptive statistics, while table 3.2 and table 3.3 present the estimation results of the failure model and acquisition model, respectively.

FAILURE MODEL

Starting from the failure model, we learn that spinoffs and experienced firms outperform other firms. We also observe that the years of production of the parents of spinoffs lower the hazard of failure. All this clearly indicates that, in line with previous findings, pre-entry experience matters for firm survival. Furthermore, the effects of *Experienced Firm* and *Spinoff* in the *x* vector are positive and significant, which implies that the initial advantage of experienced firms and spinoffs over other types of startups declines with firm age. This finding shows that pre-entry experience is especially important to overcome early-stage difficulties, known as liability of newness (Stinchcombe 1965). At later stages, pre-entry experience becomes less relevant, reflecting that a firm's environment becomes increasingly dissimilar from the environment in which the parent routines arose.

The second main finding holds that, contrary to all previous evolutionary studies, we find evidence for positive localization externalities. In model 2, we first tested for such externalities by using a dummy for the four main clusters, thus exactly replicating the research design of Klepper (2007). The positive and significant sign indicates that firms benefited from locating in one of the main clusters. Furthermore, these benefits are not confined to spinoffs in these clusters as shown by the insignificance of the interaction variable. That is, in addition to spinoffs other firms in the cluster were also able to benefit from being co-located with many others. The emergence of the four clusters can then not be explained by a localized process of capabilities transmission stemming from selected parents located in the cluster. Rather, these clusters seem to have benefited from pervasive localization externalities benefiting spinoffs and other firms alike. Note, however, that the advantage of cluster location is about eight times smaller than the advantage of being a spinoff. Thus, even though we find evidence for a positive cluster effect on firm survival, our study still supports the argument that pre-entry experience as such remains the main driver of firm success.

In model 4 we include the effect of *Regional Firm Population*, as our preferred measure of localization externalities, and in model 5 we add the quadratic term of this variable to test for the hypothesized non-linearities. The linear term increases the probability of failure while the quadratic term decreases the probability of firms. These results are consistent with our theory that negative localization externalities increase linearly with the number of firms in a cluster, while the positive localization externalities increase non-linearly with the number of firms in a cluster. In particular, initially the negative effects of an increase in number of co-locating firms outweigh the positive effects. Then, after a threshold of 55 firms, the positive effects of an increase in number of co-locating firms start to outweigh the negative effects. Interestingly, this threshold is almost similar to the threshold found by Folta et al. (2006) who studied the effect of clustering on firm failure in the biotech industry and found that firms started to benefit from co-locating after a threshold of 53 firms. We plotted the relation between cluster size and hazard rate in figure 3.6 and the graph shows a clear bell-shaped curve. Also note that the effect of *Top 4 Regions* is not significant anymore, reflecting that our preferred measure of localization externalities best captures the effects of clustering on performance.[29]

Further controls include *National Firm Population*, which has no effect on hazard rates, while *Global Firm Population*, surprisingly, lowers the hazard to exit where one would expect a negative effect resulting from an increase in competition. The firm-level control variables are all affecting firm survival in the expected direction. *Multi-activity* (being active in both publishing and development), *Multi-Product* (being active both in console and PC games) and # *Games* (yearly number of games) lower the failure hazard. These variables indicate a spread of risks by being active in two markets, in two sub-markets, or in the production of multiple games. Firms that produced artistically successful games (*Review Scores*) are also less likely to fail.

29 The variables Top4 Regions, ln (Regional Firm Population) and Regional Firm Population^2/100 show high levels of correlation. To test the robustness of our findings we both calculated the variance inflation factors – which did not indicate that our results are biased – and we estimated our models by leaving Top4 regions out of the specification. Theresults were statistically and interpretively similar to the findings presented in this paper.

TABLE 3.1
Descriptive statistics and correlations

	Variables	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1	Top 4 Regions	0.33	0.47	0	1	1.00																	
2	Regional Firm Population²/100	60.40	120.31	0	480	0.72	1.00																
3	ln(Regional Firm Population)	2.91	1.48	1	5	0.77	0.72	1.00															
4	ln(National Firm Population)	4.57	1.46	0	6	0.08	-0.05	0.12	1.00														
5	ln(Global Firm Population)	6.77	0.67	0	7	-0.12	0.12	0.05	-0.05	1.00													
6	ln(Regional Population)	14.99	1.23	10	17	0.67	0.49	0.70	0.17	-0.12	1.00												
7	ln(National Population)	18.36	1.01	12	20	0.36	0.15	0.33	0.79	-0.28	0.53	1.00											
8	Experienced Firm	0.27	0.44	0	1	0.03	0.01	0.04	-0.02	-0.07	0.08	0.02	1.00										
9	Spinoff	0.27	0.45	0	1	0.01	-0.01	0.04	0.14	0.17	-0.01	0.07	-0.37	1.00									
10	Years Parents Produced	2.23	4.64	0	28	0.05	0.03	0.09	0.15	0.19	0.04	0.10	-0.30	0.79	1.00								
11	Cohort 1	0.41	0.49	0	1	0.13	0.05	0.04	-0.04	-0.54	0.05	0.10	0.09	-0.21	-0.29	1.00							
12	Cohort 2	0.31	0.46	0	1	-0.01	0.04	0.00	0.06	0.19	0.03	0.00	-0.03	0.02	0.03	-0.57	1.00						
13	Multi-Activity	0.19	0.40	0	1	0.08	0.06	0.07	0.01	-0.12	0.07	0.06	0.10	-0.10	-0.11	0.27	-0.12	1.00					
14	Multi-Product	0.10	0.30	0	1	0.02	-0.02	0.05	0.04	0.05	0.01	0.01	0.06	0.02	0.00	0.12	-0.03	0.26	1.00				
15	# Games	5.70	23.82	0	878	0.04	0.01	0.07	0.04	0.01	0.04	0.04	0.12	-0.03	-0.05	0.16	-0.08	0.33	0.36	1.00			
16	Review Scores	2.52	1.20	0	5	0.05	0.03	0.06	0.02	0.04	0.04	0.03	-0.05	0.12	0.09	0.00	0.06	0.02	0.09	0.07	1.00		
17	Japan	0.18	0.39	0	1	0.52	0.75	0.51	-0.10	0.05	0.45	0.10	0.05	-0.07	-0.01	0.16	-0.03	0.09	-0.01	0.02	0.03	1.00	
18	USA	0.34	0.47	0	1	0.17	-0.20	0.09	0.61	-0.30	0.41	0.74	0.02	0.06	0.06	-0.03	0.06	0.00	0.00	0.01	0.05	-0.36	1.00

TABLE 3.2
Failure model, Robust standard errors: ** ≤ 0.01, * ≤ 0.05

VARIABLES	1		2		3		4		5	
TOP 4 REGIONS	-0.101	**	-0.118	**	-0.095	*	-0.160	*	-0.010	
	0.039		0.043		0.039		0.068		0.074	
TOP 4 REGIONS * SPINOFF			0.094							
			0.100							
REGIONAL FIRM POPULATION²/100									-0.001	**
									0.000	
LN(REGIONAL FIRM POPULATION)							0.044	*	0.084	**
							0.021		0.023	
LN(NATIONAL FIRM POPULATION)							0.051	*	0.029	
							0.026		0.026	
LN(GLOBAL FIRM POPULATION)							-0.156	**	-0.135	**
							0.038		0.039	
LN(REGIONAL POPULATION)							-0.031		-0.048	
							0.026		0.026	
LN(NATIONAL POPULATION)							0.009		0.029	
							0.044		0.044	
EXPERIENCED FIRM	-0.706	**	-0.706	**	-0.708	**	-0.717	**	-0.732	**
	0.064		0.064		0.064		0.066		0.066	
SPINOFF	-0.847	**	-0.872	**	-0.660	**	-0.666	**	-0.683	**
	0.068		0.073		0.094		0.096		0.096	
YEARS PARENTS PRODUCED					-0.022	**	-0.026	**	-0.026	**
					0.008		0.008		0.008	
COHORT 1	0.073		0.072		0.060		-0.156		-0.175	*
	0.065		0.065		0.065		0.087		0.088	
COHORT 2	0.309	**	0.308	**	0.301	**	0.222	**	0.228	**
	0.064		0.064		0.064		0.068		0.068	
MULTI-ACTIVITY	-0.261	**	-0.261	**	-0.263	**	-0.290	**	-0.277	**
	0.068		0.068		0.068		0.071		0.071	
MULTI-PRODUCT	-0.302	**	-0.301	**	-0.299	**	-0.325	**	-0.346	**
	0.104		0.104		0.104		0.106		0.106	
# GAMES	-0.058	**	-0.058	**	-0.058	**	-0.057	**	-0.058	**
	0.007		0.007		0.007		0.007		0.007	
REVIEW SCORES	-0.188	**	-0.188	**	-0.187	**	-0.187	**	-0.190	**
	0.014		0.014		0.014		0.014		0.014	
CONSTANT	-0.945	**	-0.940	**	-0.942	**	0.140		-0.086	
	0.057		0.057		0.056		0.724		0.724	
EXPERIENCED FIRM * T	0.060	**	0.060	**	0.061	**	0.060	**	0.061	**
	0.011		0.011		0.011		0.011		0.011	
SPINOFF * T	0.066	**	0.065	**	0.063	**	0.062	**	0.062	**
	0.013		0.013		0.013		0.013		0.013	
COHORT 1 * T	-0.062	**	-0.062	**	-0.064	**	-0.058	**	-0.052	**
	0.016		0.016		0.016		0.017		0.017	
COHORT 2 * T	-0.069	**	-0.070	**	-0.069	**	-0.063	**	-0.059	**
	0.017		0.017		0.017		0.018		0.018	
T	0.013		0.013		0.014		0.020		0.019	
	0.015		0.015		0.015		0.016		0.016	
OBSERVATIONS	20,794		20,794		20,794		19,698		19,698	
LOG-LIKELIHOOD	-5878.674		-5878.833		-5874.711		-5487.556		-5476.877	

FIGURE 3.6
Relation between hazard rate and population density

ACQUISITION MODEL

In table 3.3, we present the findings of the acquisition model. As one of the objectives is to compare these findings with the ones obtained in the failure model, we have included the exact same variables as in table 3.2. As we consider acquisition as a sign of success, we expect the covariates that explain survival (that is, with a negative sign in table 3.2) also explain the probability of being acquired (that is, with a positive sign in table 3.3).

In line with our expectations on the effect of pre-entry experience, we find indeed that spinoffs and experienced firms have higher hazards of acquisition. Thus, pre-entry experience increases the chance of survival as well as the chance of being acquired. The negative and significant effects of the *Experienced Firm* and *Spinoff* in the *x* vector also indicate that the effect pre-entry experience decreases with firm age as it does for firm survival in table 3.2. Unexpectedly, we find no effect of *Years Parents Produced* on the probability of being acquired.

With respect to the effects of location-specific variables on the risk of being acquired, we found no significant effect of being located in one of the top 4 clusters. Yet, *Regional Firm Population* and *National Firm Population* have a positive and significant effect on the probability of acquisition while *Global Firm Population* has no effect. These results imply that being located in the vicinity of many other video game firms increases the chances of being acquired. Whether this indeed reflects the positive localization externalities firms accrue from co-location, which raises their value as an acquisition target, is difficult to say. It could also reflect that acquisition activity is sensitive to geographical proximity, although this latter interpretation is unlikely given that only 21 percent of all acquisition took place within the same region and 56 percent in the same country but outside the region. As expected, being a US firm increases the risk of being acquired, while being a Japanese firm significantly lowers the risk of being acquired in all models except for one (Odagiri and Hase 1989).

With respect to the firm-level controls, we found that only *Multi-Product* firms and those with high *Review Scores* are more likely to be acquired, while *Multi-activity* and # *Games* had no effect. The positive effect of review scores, which

TABLE 3.3
Acquisition model, Robust standard errors: ** ≤ 0.01, * ≤ 0.05

Variables	6	7	8	9	10
Top 4 Regions	-0.141	-0.192	-0.144	-0.160	-0.042
	0.133	0.165	0.133	0.191	0.218
Top 4 Regions * Spinoff		0.135			
		0.250			
Regional Firm Population^2/100					-0.002
					0.002
ln(Regional Firm Population)				0.166 **	0.199 **
				0.067	0.074
ln(National Firm Population)				0.232 *	0.221 *
				0.098	0.098
ln(Global Firm Population)				-0.241	-0.230
				0.159	0.160
ln(Regional Population)				-0.155	-0.172
				0.087	0.089
ln(National Population)				-0.271	-0.255
				0.165	0.165
Experienced Firm	0.964 **	0.964 **	0.966 **	1.029 **	1.025 **
	0.213	0.213	0.213	0.219	0.219
Spinoff	0.908 **	0.878 **	0.772 **	0.766 **	0.759 **
	0.210	0.218	0.264	0.272	0.272
Years Parents Produced			0.015	0.012	0.011
			0.017	0.017	0.017
Cohort 1	-0.748 **	-0.748 **	-0.720 **	-0.837 *	-0.860 *
	0.224	0.224	0.227	0.315	0.316
Cohort 2	-0.519 **	-0.520 **	-0.505 **	-0.498 *	-0.495 *
	0.217	0.217	0.218	0.229	0.229
Multi-Activity	0.077	0.077	0.081	0.096	0.092
	0.144	0.144	0.144	0.146	0.146
Multi-Product	0.530 **	0.530 **	0.526 **	0.486 **	0.479 **
	0.146	0.146	0.146	0.147	0.147
# Games	0.000	0.000	0.000	0.000	-0.001
	0.002	0.002	0.002	0.002	0.002
Review Scores	0.172 **	0.172 **	0.172 **	0.179 **	0.178 **
	0.052	0.052	0.052	0.054	0.054
Japan	-1.211 **	-1.206 **	-1.229 **	-1.086 **	-0.813 **
	0.263	0.263	0.263	0.321	0.391
USA	0.487 **	0.482 **	0.477 **	0.562 *	0.551 *
	0.118	0.119	0.119	0.277	0.278
Constant	-5.427 **	-5.413 **	-5.431 **	1.864	1.733
	0.239	0.241	0.240	3.072	3.076
Experienced Firm * t	-0.093 **	-0.093 **	-0.093 **	-0.097 **	-0.096 **
	0.023	0.023	0.023	0.023	0.023
Spinoff * t	-0.079 **	-0.080 **	-0.076 **	-0.078 **	-0.077 **
	0.025	0.025	0.025	0.025	0.025
Cohort 1 * t	0.009	0.009	0.009	-0.004	-0.002
	0.032	0.032	0.032	0.036	0.036
Cohort 2 * t	0.060	0.060	0.059	0.048	0.049
	0.037	0.037	0.037	0.039	0.039
t	0.142 **	0.142 **	0.142 **	0.162 **	0.161 **
	0.031	0.031	0.031	0.033	0.033
Observations	20,794	20,794	19,698	19,698	19,698
Log-Likelihood	-1090.527	-1090.381	-1090.145	-1033.447	-1032.855

provides the best proxy for the quality of games, strengthens our belief that, indeed, acquisition is more often a sign of success than of failure. Indeed, acquisition can be motivated by getting hold of games code and trademarks as to be able to develop sequel versions.

In sum, comparing the results on failure and on acquisition, we can conclude that the main determinants of firm survival from our theoretical perspective, being pre-entry experience and review scores, are also the main determinant of the risk of being acquired. This confirms our assumption that - for most firms - the event of being acquired should be considered as a sign of success.

CONCLUDING REMARKS

Evolutionary scholars have put forward a new theory of spatial clustering based on the spatial dimension of transmission of organizational routines between parent firms and spinoff firms, and have found evidence for a range of industries that spinoff dynamics, rather than localization externalities, explain the spatial concentration of industries. The main argument we have put forward in our study holds that, while negative localization externalities may well be proportional to the number of fellow competitors in line with recent empirical evidence, positive localization externalities may rise non-linearly as a consequence of social network interactions within clusters.

We developed this hypothesis within the context of project-based industries where social networks function as an important repository of knowledge alongside organizational routines at the firm level. Paraphrasing Grabher (2002), we posited that project-based collaboration maximizes “recombinatory options” between a diverse range of skilled experts and that the potential for recombining expertise in project configurations rises non-linearly with the size of the cluster. Our empirical analysis on the video game industry indeed provides evidence that, while the number of competitors in a region lowers firm performance, its non-linear effect reflecting the recombinatory potential suggests a performance-enhancing effect. We thus suggest that, apart from the organizational routines that spinoff firms take with them from their parent firms, firms also benefit from variety in employee’s expertises and personal networks in geographic clusters, and these benefits are expected to outweigh the negative localization externalities once a cluster reaches a critical scale allowing for rich network interactions. More generally, we can conclude that localization externalities in clusters are likely to be both positive and negative, with the former outweighing the latter when cluster size exceeds a critical threshold. This finding highlights the difference between traditionally organized manufacturing industries and modern project-based industries. Mainly, the relative reliance of these industries on skilled labour is very different which sets apart the process of spatial clustering.

In our analysis of firm survival, we differentiated between exits by failure and exit by acquisition as the latter are more often a sign of success rather than of failure. From the empirical analysis, we concluded that being acquired is best considered as a sign of success rather than as business failure, as the main determinants explaining survival (pre-entry experience, quality of games) also explain the probability of being acquired. As a result, the second conclusion that we draw from our study holds that evolutionary studies, and other approaches relying on survival analysis, should be more careful in distinguishing between the causes of exit and the associated economic effects.

In conclusion, our study suggests that studies in evolutionary economic geography should be more sensitive to industry specificities that are reflected in the exact nature of agglomeration externalities as well as the different modes of performance. In particular, project-based industries have very specific features that render these different from the manufacturing logic on which much theorising in evolutionary economics has been based. Social networks function as a second repository of knowledge next to organizational routines, and the extent to which firms have access to such networks will greatly affect their ability to survive.

References chapter 3

Agarwal, R., Gort, M. (1996). The evolution of markets and entry, exit and the survival of firms. Review of Economics and Statistics 69 (4): 567 – 574.

Appold, S.J. (1995). Agglomeration, interorganizational networks, and competitive performance in the U.S. metalworking sector. Economic Geography 71 (1): 27 – 54.

Asheim, B., Coenen, L., Moodysson J., Vang, J. (2007). Constructing knowledge-based regional advantage: implications for regional innovation policy. International Journal of Entrepreneurship and Innovation Management 7 (2-5): 140 – 155.

Asheim, B., Gertler, M. (2005). The geography of innovation: regional innovation systems. In Fagerberg J., Mowery D. and Nelson, R. (eds.), The Oxford Handbook of Innovation, Oxford, UK: Oxford University Press, 291 – 317.

Blossfeld, H.P., Golsch, K., Rohwer, G. (2007). Event history analysis with Stata. Mahwah, New Jersey: Lawrence Erlbaum Associates.

Boschma, R.A., Frenken, K. (2003). Evolutionary economics and industry location. Review for Regional Research 23: 183 – 200.

Boschma, R., Frenken, K. (2011). The emerging empirics of evolutionary economic geography. Journal of Economic Geography 11 (2): 295 – 307.

Boschma, R.A., Wenting, R. (2007). The spatial evolution of the British automobile industry: Does location matter? Industrial and Corporate Change 16 (2): 213 – 223.

Breschi S., Lissoni, F. (2001). Knowledge spillovers and local innovation systems: A critical survey. Industrial and Corporate Change 10 (4): 975 – 1005.

Breschi, S., Lissoni, F. (2009). Mobility of skilled workers and co-invention networks: An anatomy of localized knowledge flows. Journal of Economic Geography 9 (4): 439 – 468.

Brown, J.S., Duguid, P. (1991). Organizational learning and communities-of-practice: Toward a unified view of working, learning, and innovation. Organization Science 2 (1): 40 – 57.

Buenstorf, G., Guenther, C. (2011). No place like home? Relocation, capabilities, and firm survival in the German machine tool industry after World War II. Industrial and Corporate Change 20 (1): 1 – 28

Buenstorf, G., Klepper, S. (2009). Heritage and agglomeration: the Akron tyre cluster revisited. The Economic Journal 119: 705 – 733.

Cefis, E., Marsili, O. (2006). Survivor: The role of innovation on firms' survival. Research Policy 35: 626 – 641.

Currid, E., Williams, S. (2009). The geography of buzz: Art, culture and the social milieu in Los Angeles and New York. Journal of Economic Geography 9 (5): 1 – 29.

Disney, R., Haskel, J., and Heden, Y. (2003). Entry, exit and establishment survival in UK manufacturing. The Journal of Industrial Economics 51 (1): 91 – 112.

Engwall, M. (2003). No project is an island: linking projects to history and context. Research Policy 32: 789 – 808.

Eriksson, R. (2011). Localized spillovers and knowledge flows: How does proximity influence the performance of plants? Economic Geography 87 (2): 127 –152

Figueiredo, O., Guimaraes. P., Woodward. D. (2002). Home-field advantage: location decisions of Portuguese entrepreneurs. Journal of Urban Economics 52: 341 – 361.

Folta, T.B., Cooper, A.C., Baik, Y. (2006). Geographic cluster size and firm performance. Journal of Business Venturing 21: 217 – 242.

Gann, D.M., Salter, A.J. (2000). Innovation in project-based, service-enhanced firms: the construction of complex products and systems. Research Policy 29 (7-8): 955 – 972.

Girard, M. and Stark, D. (2002). Distributing intelligence and organizing diversity in new media projects. Environment and Planning A 34 (11): 1927 – 1949.

Gordon, I.R, Molho, I. (1995). Duration dependence in migration behaviour: cumulative inertia versus stochastic change. Environment and Planning A 27 (12): 1961 – 1975.

Grabher, G. (2002). The project ecology of advertising: Tasks, talents, and teams. Regional Studies 36 (5): 245 – 262.

Grabher, G. (2004). Learning in projects, remembering in networks? Communality, sociality, and connectivity in project ecologies. European Urban and Regional Studies 11 (2): 99 – 119.

Heebels, B., Boschma, R. (2011). Performing in Dutch book publishing 1880-2008. The importance of entrepreneurial experience and the Amsterdam cluster. Journal of Economic Geography, in print.

Henry, N., Pinch, S. (2000). Spatialising knowledge: Placing the knowledge community of motor sport valley. Geoforum 31 (2): 191 - 208.

Ibert, O. (2004). Projects and firms as discordant complements. Organizational learning within the Munich software ecology. Research Policy 33 (10): 1529 – 1546.

Johns, J. (2006). Video games production networks: value capture, power relations and embeddedness. Journal of Economic Geography 6: 151 – 180.

Kent, S.L. (2001). The ultimate history of video games: From Pong to Pokemon - The story behind the craze that touched our lives and changed the world. New York, New York: Prima Publishing.

Klepper, S. (1996). Entry, exit, growth and innovation over the product life cycle. American Economic Review 86: 562 – 583.

Klepper, S. (2002). The capabilities of new firms and the evolution of the US automobile industry. Industrial and Corporate Change 11: 645 – 666.

Klepper, S. (2007). Disagreements, spinoffs, and the evolution of Detroit as the capital of the U.S. automobile industry. Management Science 53 (4): 616 – 631.

Klepper, S. (2010). The origin and growth of industry clusters: the making of Silicon Valley and Detroit. Journal of Urban Economics 67: 15 – 32.

Kloosterman, R.C. (2010). Building a career: labour practices and cluster reproduction in Dutch architectural design. Regional Studies 44 (7): 859 – 871.

Marshall, A. (1920). Principles of Economics, 8th edition. London, UK: Macmillan.

Martin, R., Sunley, P. (2003). Deconstructing clusters: chaotic concept or policy panacea? Journal of Economic Geography 3 (1): 5 – 35.

Nelson, R.R., Winter, S.G. (1982). An evolutionary theory of economic change. Cambridge, UK: Belknap Press.

Odagiri, H., Hase, T. (1989). Are mergers and acquisitions going to be popular in Japan? An empirical study. International Journal of Industrial Organization 7: 49 – 73.

OECD (2010). Territorial grids of OECD member countries. http://www.oecd.org/dataoecd/32/4/42027551.pdf

Pratt, A.C. (1997). The cultural industries production system: a case study of employment change in Britain, 1984–1991. Environment and Planning A 29 (11): 1953 – 1974

Ranft, A.L., Lord, M.D. (2002). Acquiring new technologies and capabilities: A grounded model of acquisition implementation. Organization Science 13 (4): 420 – 441.

Rogers, D.L. (2004). The end game: How top developers sold their studio. Gamasutra Features, http://www.gamasutra.com/features/20040303/rogers_01.shtml.

Saltzman, M. (2003). Game creation and careers: Insider secrets from industry experts. Indianapolis, Indiana: New Riders Publishing

Scott, A.J. (1997). The cultural economy of cities. International Journal of Urban and Regional Research, 21 (2): 323 – 339.

Scott, A.J. (2000). The cultural economy of cities; Essays on the geography of image-producing industries. London, UK: Sage.

Sorenson, O., Audia, P.G. (2000). The social structure of entrepreneurial activity: geographic concentration of footwear production in the United States, 1940-1989. American Journal of Sociology, 106 (2): 424 – 462.

Staber, U. (2001). Spatial proximity and firm survival in a declining industrial district: The case of knitwear firms in Baden-Wuttemberg. Regional Studies 35 (4): 329 – 341.

Stam, E. (2007). Why butterflies don’t leave. Locational behavior of entrepreneurial firms. Economic Geography 83 (1): 27 – 50.

Stinchcombe, A.L. (1965). Social structure and organizations. In J.G. March (ed.), Handbook of Organizations, Chicago, Illinois: Rand McNally Company, pp. 142 – 193.

Storper, M. (1995). The resurgence of regional economies, ten years later: The region as a nexus of untraded interdependencies. European Urban and Regional Studies 2 (3): 191 – 221.

Storper, M., Venables, A.J. (2004). Buzz: face-to-face contact and the urban economy. Journal of Economic Geography 4: 351 – 370.

Stuart, T.E., Sorenson, O. (2003). The geography of opportunity: Spatial heterogeneity in founding rates and the performance of biotechnology firms. Research Policy 32 (2): 229 – 253.

Thompson, P. (2005). Selection and firm survival: Evidence from the shipbuilding industry, 1825–1914. Review of Economics and Statistics 87: 26 – 36.

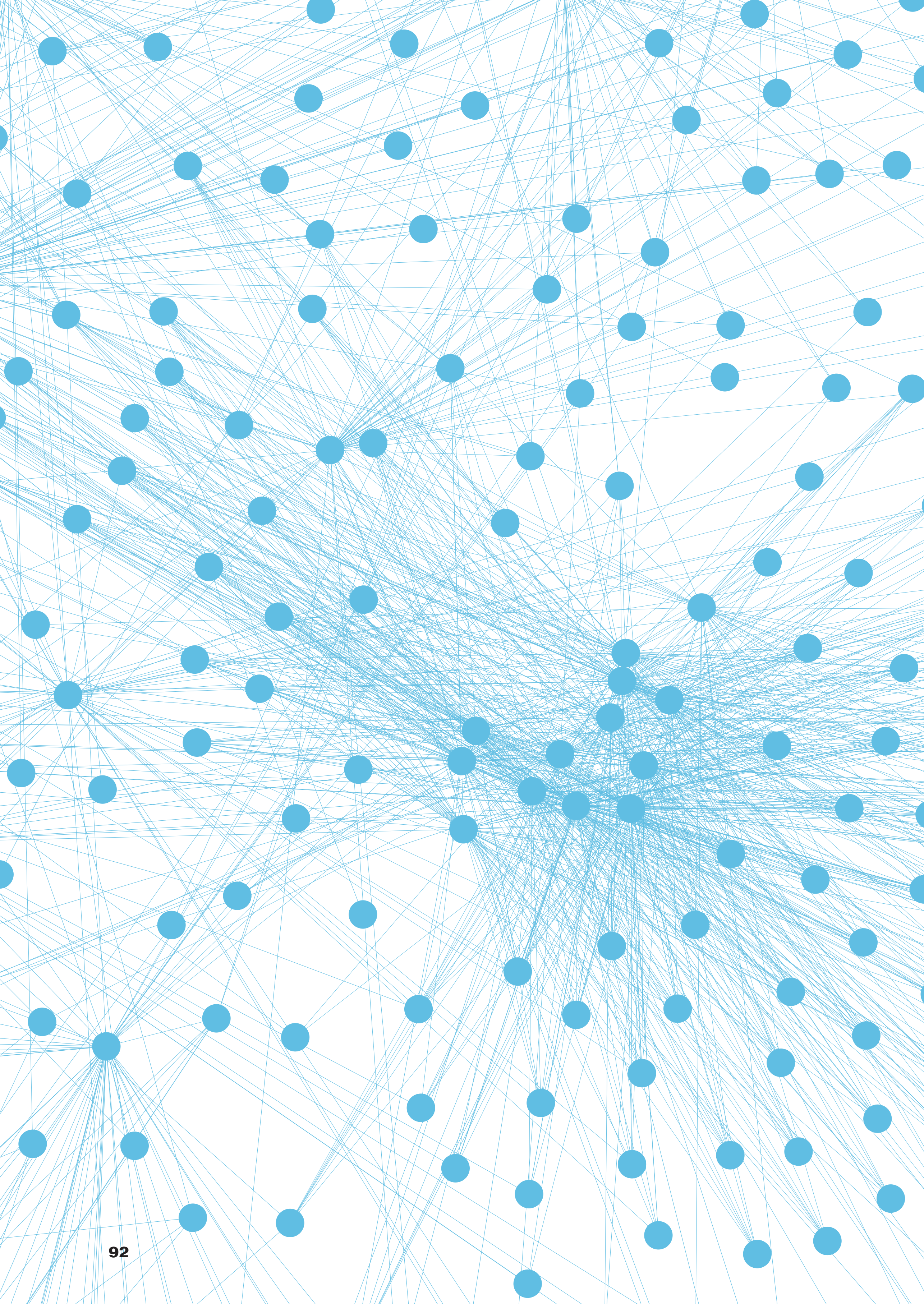
Tschang, F.T. (2007). Balancing the tensions between rationalization and creativity in the video games industry. Organization Science 18: 989 – 1005.

Vaan, M. de (2010). Interfirm networks and firm performance in the face of technological discontinuities, working paper, Utrecht University.

Wennberg, K., Lindqvist, G. (2010). The effect of clusters on the survival and performance of new firms. Small Business Economics 34: 221 – 241.

Wenting, R. (2008). Spinoff dynamics and the spatial formation of the fashion design industry, 1858-2005. Journal of Economic Geography 8: 593 – 614.

Weitzman, M.L. (1998). Recombinant growth. The Quarterly Journal of Economics 113 (2): 331 – 360.



chapter 4
The dynamics of interfirm networks along the industry life cycle

CO-AUTHORED WITH PIERRE-ALEXANDRE BALLAND AND RON BOSCHMA

Introduction

Interfirm networks have increasingly become the focus of study in economic geography (Grabher 2001; Morrison 2008; Bergman 2009; Ter Wal and Boschma 2009; Boschma and Frenken 2010; Vicente et al. 2011). While research on interfirm networks as a means to explain firm performance and regional competitiveness has grown exponentially, relatively little is known about how interfirm networks come into being, how their structure changes over time, and how spatial patterns affect this process. Scholars have started to investigate how interfirm network formation in terms of tie initiation takes place (see for example Rosenkopf and Padula 2008; Ahuja et al. 2009; Cassi and Plunket 2010; Balland 2011; Broekel and Boschma 2011), but applied research on the spatial and temporal dimension of network formation remains sparse (Ter Wal 2011). In this paper, we analyze the formation of an interfirm network by using longitudinal data and adopting a long-term perspective.

Our main objective is to provide a detailed account of the underlying mechanisms of network dynamics along the life cycle of an industry (Klepper 1996; Audretsch and Feldman 1996). We aim to make three contributions. First, the industry life cycle approach has provided a rich account of the changing nature of competition among firms, but questions about the changing nature of collaboration have been left unanswered (Malerba 2006; Ter Wal and Boschma 2011). A few studies have investigated the dynamics in network structure (e.g. Bonaccorsi and Giuri, 2001; Orsenigo et al., 2001, Gay and Dousset, 2005), but not the driving forces. Second, scholars have argued that the level of similarity between attributes of actors is crucial in the process of tie formation (McPherson et al. 2001). We build on the French proximity school to investigate which forms of proximity (like geographical proximity) that drove the formation of the interfirm network (Boschma and Frenken 2010). Although it has been shown empirically that different forms of proximity influence network formation (Balland 2011; Broekel and Boschma 2011), it is crucial to investigate whether the effect of these drivers changes or remains stable along the industry life cycle (Ter Wal 2011). And finally, we aim to contribute to the literature on networks in creative industries. Creative industries are characterized by project-based production in which local buzz is considered to be highly important (Grabher 2001). By means of investigating a particular creative industry, we test which drivers are crucial in network formation, and whether these effects change as the industry evolves in space.

In this paper, we analyze network formation in the global video game industry from 1987 to 2007. The analyses are conducted for the total population of firms that developed or published one or more video games for a video game console and the co-production of a video game is what represents the formation of a network tie. The video game industry is often referred to as a creative industry. Typical to such a creative industry is its project-based production in which new video games are jointly developed (Caves 2000). Also, the video game industry has a 35 years long history which allows us to track and follow tie formation processes from the very beginning of the industry. We analyze collaboration in the production of video games for four generations of video game consoles, starting in 1987. Yearly relational matrices are constructed for analyzing underlying mechanisms of network dynamics within each generation: 1987-1992, 1993-1998, 1999-2004, 2005-2007.

The paper focuses on two research questions: (1) which proximity dimensions, among other factors, drive the formation of network ties in the global video game industry?; and (2) do the effects of these driving forces increase or decrease as the industry evolves? We employ a stochastic actor-oriented model (Snijders 2001) to analyze the evolution of the interfirm collaboration network. This approach allows for the simultaneous evaluation of 3 sets of driving forces: (1) individual characteristics which affect, for instance, the capacity to exploit external knowledge; (2) relational structures that display endogenous structural mechanisms that reproduce themselves over time; and (3) similarity between attributes of firms (like being proximate in cognitive or geographical terms). Our findings indicate that the forces that drive the formation of network ties are indeed dependent on the state of development of an industry. Firms tend to partner over shorter distances and with more cognitively similar firms as the industry matures.

The paper is organized as follows. Section 2 presents a brief literature review on the main drivers of interfirm network dynamics. Then, section 3 describes the data collection and provides descriptive statistics of the longitudinal network database. The stochastic actor-oriented model, the different variables and the model specification are detailed in section 4. In section 5, we present the main empirical results. Section 6 concludes and discusses implications for further research.

DRIVERS OF THE INTERFIRM NETWORK ALONG THE INDUSTRY LIFE CYCLE

There is increasing attention for a relational approach in economic geography (Bathelt and Glückler, 2003). While the earlier work on relational issues in economic geography has generated very rich and contextual narratives of the spatial processes at hand, various scholars have recently identified flaws in this literature by criticizing its lack of formalization, and its metaphorical accounts of relational processes (e.g. Giuliani and Bell 2005; Grabher 2006; Cantner and Graf 2006; Glückler 2007; Sunley 2008). We argue that social network analysis, which allows for a quantitative investigation of interorganizational interactions, provides a framework to deal with these flaws.

In the last decade, network analysis has gained an increasing amount of attention from scholars in economic geography (Ter Wal and Boschma 2009). One of the main research questions is: what drives a network tie? Traditionally, one looks at the similarity of actors' attributes, in which the similarity between connected actors is compared with the similarity between non-connected actors (McPherson et al. 2001). Sociologists refer to the term homophily for explaining the tendency of social groups to form around actors that have similar tastes, preferences, ethnic background or social status. We follow the terminology of proximity introduced by the French proximity school (Rallet and Torre 1999; Carrincazeaux et al. 2008), and we link proximity to the formation of network linkages (Boschma and Frenken 2010). Boschma (2005) proposed an analytical distinction in five dimensions of proximity, in which cognitive, organizational, institutional, social and geographical proximity reduce collaboration costs or risks, and do therefore increase the likelihood of actors to form partnerships. That is, actors are more likely to collaborate with others when they have similar knowledge bases, when they share similar norms and values, when they belong to the same business group, when they are embedded in the same social context, or when they are located in the same geographical area.

It is not necessarily true that all forms of proximity act as important drivers of network formation. In economic geography, a crucial question is whether geographical proximity influences the likelihood of tie formation (Morgan 2004). By employing Boschma's (2005) proximity framework, one can isolate the effect of geographical proximity from other forms of proximity, as geographical proximity is just one potential driver of network formation, and not necessarily the most important one (Boschma 2005). Although a great deal of interactions take place between agents that are geographically proximate (see e.g. Weterings 2005; Suire and Vicente 2009; Hoekman et al. 2010), this might be caused by other forms of proximity. Moreover, other forms of proximity may act as substitutes for geographical proximity in network formation, as studies have empirically demonstrated (see e.g. Singh 2005; Agrawal et al. 2006; Ponds et al. 2007; Sorenson et al. 2006; Breschi et al. 2010).

In addition to these proximity dimensions, the literature has argued that individual characteristics of organizations may also influence the likelihood to collaborate (Cassiman and Veugelers 2002). Indeed, changes in the network result from decisions of organizations with heterogeneous characteristics such as age or size. Organizations establish relationships in order to access resources that they do not have themselves. For example, larger firms are often argued to be better able to gain access to financial resources, while smaller firms are often argued to be more flexible. As a result, large organizations might turn to smaller organizations to respond more rapidly to unexpected situations, while smaller firms might turn to larger firms to gain access to financial resources. Another important determinant of collaborations is the experience of the firm. The more experience a firm accumulates over the years, the richer its functional knowledge base and the more valuable its knowledge about potential partners. As a result, experienced firms will be more likely to be able to identify fruitful collaborations and attract potential collaborators.

Apart from proximity and individual characteristics, network formation may also be influenced by endogenous structural network effects. Endogenous or path-dependent network formation describes how current network structures influence its future evolution. Two of the most prominent structural effects are transitivity and preferential attachment. Transitivity – or triadic closure – is a local network force that induces two unconnected nodes that are connected to one common node to connect themselves (Davis 1970; Holland and Leinhardt 1971). Positive transitivity implies that organizations that have a partner in common are more likely to partner themselves, thereby effectuating triadic closure. The role of the common partner here is crucial. The partner can provide information to both partners in order to reduce uncertainty about the competences and the trustworthiness of the potential partner (Uzzi 1996; Cowan et al. 2007). Preferential attachment describes the attractiveness of central actors comparatively to others. It has been shown recently that new nodes entering the network indeed tend to form ties with incumbent nodes according to their degree distribution (Barabási and Albert 1999).

When analyzing the driving forces behind interfirm network formation, scholars often adopt a static approach, explaining the structure of the network at one point in time (e.g. Autant-Bernard et al. 2007; Rosenkopf and Padula 2008; Ozman 2009; Ahuja et al. 2009; Glückler 2010; Broekel and Boschma 2011). Little attention has been devoted so far to the changing nature of network formation over time (Powell et al. 2005). One reason that causes this lack of attention is that it requires complete network data over a long period of time and complex statistical models. Therefore, research on the spatial and temporal dimension of network formation has remained sparse (Glückler 2007; Boschma and Frenken 2010). Only very recently, studies focus on network dynamics in a spatial setting, like the dynamics in knowledge networks in a Chilean wine cluster (Giuliani 2010), or the dynamics in co-inventor networks in French genomics (Cassi and Plunket 2010) and German bio-tech (Ter Wal 2011).

To study network dynamics, we believe that the industry life cycle approach provides a useful framework. This is not because the industry life cycle approach has fully incorporated network dynamics in their models. On the contrary, the industry life cycle approach has mainly been preoccupied with firm population dynamics in which the evolution of competitive structures over an industry's lifespan is examined and how these relate to the nature of the products that are produced in these industries (Gort and Klepper 1982; Abernathy and Clark 1985; Klepper 1997; Neffke et al. 2011). Typically, the evolution of the population of firms in an industry follows an S-curve, starting by just a few firms entering the industry, followed by a period of strong growth in the number of new entrants which, after some time, levels off and eventually decreases. However, while entry and exit of firms and the changing nature of competition are inextricably interwoven with changing network structures, this domain of research has remained largely unexplored (Malerba 2006; Ter Wal and Boschma 2011). There are a few studies that have investigated dynamics in networks structures in the aircraft-engine industry (e.g. Bonaccorsi and Giuri 2001) and pharmaceuticals (Orsenigo et al. 2001), but these studies have not analyzed the driving forces behind the network dynamics.

Changes in the pattern of entry and exit of firms and the nature of competition along the industry life cycle mark some implications for the study of network evolution. Due to the entry and exit of firms, the nodes in a network come and go, and relationships are created and dissolved (Boschma and Frenken 2010). In order to fully capture and understand the forces that drive formation of network ties, an understanding of the changing industrial settings and the interaction between firm population and industry setting is required. According to Orsenigo et al. (2001), the network of strategic alliances in biotechnology is characterized by stable core-periphery patterns during the industry life cycle, because the formation of new alliances depends on the network of prior alliances, among other factors. And when the nature of competition in an industry changes from product innovation to price cuts, firms tend to collaborate with similar partners to secure efficient and smooth interactions. Such a pattern is frequently observed in various industries, as mimetic isomorphism within the population of firms tends to guide the industry towards the establishment of a dominant design (DiMaggio and Powell 1983; Utterback and Suárez 1993). The emergence of a dominant design allows production to become more standardized and firms to exploit scale economies. This type of competition requires very specialized, industry-specific knowledge, skills and machinery, and little access to new and diverse sources of knowledge (Neffke et al. 2011).

If industries are subject to continuous flows of new firms entering the industry resulting from disruptive technological change (Rosenkopf and Tushman 1994; Rosenkopf and Padula 2008), interfirm network structures are likely to be less stable. Also, the patterns of tie formation between new entrants and incumbent firms in the industry are argued to be decisive in determining firms' success rates. For example, incumbent firms can increase the size of the population of firms that have adopted a specific technology by entering into a partnership with new entrants (Chandler 1997; Rosenkopf and Padula 2008). Another feature of partnerships between incumbents and new entrants is that innovations are often introduced by new entrants which exert pressure on the yet existing pool of firms.

Incumbent firms can team up with the new entrants in order to gain access to the innovative product or technology.

NETWORK FORMATION IN CREATIVE INDUSTRIES

The aforementioned studies on interfirm networks concern either engineering industries, with a focus on vertical networks between suppliers and buyers, or high-tech industries (biotech, telecommunications) in which the focus is strategic alliance networks. The insights provided by these studies are unlikely to apply to creative industries, because in creative industries collaboration patterns are extremely important but less subject to processes of knowledge codification and product standardization.

Production in creative industries is highly dependent on the interaction between multiple autonomous agents (Caves 2003). Industries such as feature film production (Mezias and Mezias 2000), advertising (Grabher 2001) and book publishing (Heebels and Boschma 2011) are based on project-based production systems involving creative and business-oriented entrepreneurs. Success of these entrepreneurs is dependent on their embeddedness in interfirm networks, communities and scenes (Grabher 2001). Within each project, the functional activities are distributed over the firms involved. The firms involved are continuously updating each other, exchanging ideas and negotiating decisions. The products that come out of these projects are unique: each product differentiates itself by introducing more or less novel – stylistic – elements.

Interfirm collaborations in creative industries serve not only as conduits of information flows but also as hierarchies of reputation and status (Currid 2007; Heebels and Boschma 2011). Reputation and status are extremely important in the production of cultural products. The main reason is that cultural production is associated with great uncertainty. Nobody knows a priori whether a cultural product will be accepted or rejected by the larger audience (Caves 2003), and hits can easily be followed by flops. Gaining access to partners with high levels of status is likely to enable firms to capture the attention and fulfill the needs of a large audience.

While various scholars have argued that the weightlessness of ideas is likely to diminish the role of geography (Friedman 2005), others have stressed the overall importance of space and place because of the symbiotic relationship between place, culture and economy (Pratt 2000; Scott 1997; Johns 2005). The latter strand of literature argues that geographical proximity, urban culture and local buzz are extremely important for cultural industries and are likely to set apart the spatial organization of cultural industries from other industries. Scott (2004) argues that a large share of all interfirm partnerships in creative industries can be found in larger cities.

In summary, we have identified three main drivers of interfirm network formation (i.e. proximity mechanisms, individual characteristics and structural endogenous network structures). We will test which ones have been responsible for the formation of the co-production network in the global video game industry, and we will explicitly focus on the (in)stability of these forces as this industry evolves. By doing so, we reconcile insights provided by the industry life cycle approach and insights from network analysis. Moreover, though our focus on the video game industry, we will be able to unravel more of the subtleties that are specific to creative industries. In that respect, we see this study as an explorative and early attempt to provide insights on the dynamics of network formation over the life cycle of a creative industry.

EMPIRICAL SETTING

The video game industry is typically referred to as a creative industry to stress the importance of both creative human capital in the production process and the one-off nature of the final product (Tschang 2007). Each video game differentiates itself from any other video game by introducing new gameplays, new perspectives, new genre combinations, new characters or enhanced graphics. Therefore all video games are essentially novel and its success depends on whether consumers are prepared to pay for the quality of the product innovation (Delmestri et al. 2005).

Like other creative industries, the video game industry is made up of firms that generate creative content and firms that recognize, finance and market the creative content (Tschang 2007). The production of a video game is carried out as a project involving a development company and a publishing company, although some development companies publish their own games and some publishing companies set up in-house development studios. Developers *"are charged with the creative development of a game code"* (Johns 2005, p. 169) by providing programming skills, artistic designs and insights on the gameplay[30], while publishers are responsible for managing, funding and marketing the video game project by providing the project management, market insights, marketing skills and financial capital (Tschang 2007). The production of video games is organized in temporal projects in which employees of the developer and the publisher gather to create a new video game. The production process of a video game is characterized by the coalescence of art and technology and involves character designers, graphic artists, programmers, and managers, project leaders and marketers.

We define two firms as having a network tie if both firms were involved in the production of a video game. In most cases, such a network tie is established through the co-production of video games involving a firm with a clear profile as a publisher and a firm with a clear profile as a developer. As shown in table 4.1, more than 75 % of all video games are produced by at least two companies, while the rest is produced by one company.

[30] Gameplay is 'the formalized interaction that occurs when players follow the rules of a game and experience its system through play' (Salen and Zimmerman 2003, p. 303). Amiga CD32, Jaguar, Neo Geo CD, PC-FX, Saturn, Sega 32X, PlayStation, Nintendo 64, Dreamcast, GameCube, PlayStation 2, Xbox, Xbox 360, PlayStation 3, and Wii.

[31] Throughout the paper, the term 'video games' is used to describe games played using a video game console linked to a television or monitor, rather than PC (Personal Computer) games or other digital hardware.

TABLE 4.1
Collaboration patterns along the video game industry life cycles

	GEN 1	GEN 2	GEN 3	GEN 4	GEN 5	GEN 6
YEARS COVERED	1972 - 1981	1982 - 1986	1987 - 1992	1993 - 1998	1999 - 2004	2005 - 2007
NUMBER OF FIRMS	21	166	510	1035	1029	757
NUMBER OF GAMES	212	916	2526	5525	8406	4857
GAMES PER FIRM (MEAN)	10.095	5.518	4.953	5.338	8.169	6.416
NO. OF GAMES INVOLVING						
- SINGLE FIRM	128	508	806	1394	1112	455
- TWO FIRMS	84	398	1659	3937	6841	4018
- THREE FIRMS	0	10	58	188	437	355
- FOUR FIRMS	0	0	3	6	15	16
- FIVE FIRMS	0	0	0	0	1	8
- SIX FIRMS	0	0	0	0	0	5

The analyses in this paper are based upon a unique, newly constructed database that contains information on all firms that developed or published one or more video games[31] for a video game console[32]. We collected firm level data such as years of production, number of games produced, location, ownership structures[33] and game level data such as co-production partners, production year, computer platform compatibility and genre. The data was collected starting from the inception of the industry in 1972 until 2007. The data is a compilation of various data sources. The starting point was the Game Documentation and Review Project Mobygames[34]. The Mobygames website is a comprehensive database of software titles and covers the date and country of release of each title, the platform on which the game can be played, and the name of the publisher and developer of the game. The database goes back until the inception of the industry in 1972, and the project aims to include all games that have ever been developed and published in the video game industry. To obtain data on entry, exit, and location of firms and to control and monitor the quality of the Mobygames data we also consulted the German Online Games Datenbank[35]. This online database is complementary to the Mobygames database in that it provides more detailed information on the location of companies and backgrounds of entrepreneurs. In the rare case that neither of the two databases provided this information or in the rare case that the information in the two databases was contradicting, other online or hardcopy resources were consulted.

Video games are produced for one or more video game consoles such as the XBOX 360. Each of the video game consoles introduced in the industry can be categorized into chronological generations (GEN). While the technological specifications of the video game consoles within a GEN show a strong resemblance, the technological specifications of consoles from different GENs are highly dissimilar. Each subsequent GEN of consoles shows a significant improvement in technological specifications and allows the producers of video games to produce games that are significantly different than the games produced for the prior GEN. In other words, the introduction of a new GEN of consoles leads to a change in the design rules for video games (Baldwin and Clark 2000).

The introduction of new video game consoles, innovation in the production of video games and other industry-specific dynamics have generated high levels of turbulence in the industry. In Figure 4.1, we plotted the entry and exit of all firms[36] in the video game industry. Until the mid 1990s, the population of firms grew rapidly, after which the population has remained largely stable.

For the empirical analyses, we set the start of a new generation at the year in which the first game of a new generation is released. Generation 1 covers the years 1972-1981, generation 2 covers the years 1982-1986, generation 3 covers the years 1987-1992, generation 4 covers the years 1993-1998, generation 5 covers the years 1999-2004, and generation 6 covers the years 2005-2007. In our analyses, we focus on generations 3, 4, 5 and 6. We exclude generation 1 and 2 from the empirical analysis, because the level of stability[37] of the network was too low[38]. Such instability keeps the approximation algorithm we use to model the network dynamics from converging, which will produce unreliable results. In order to improve the stability for generation 3, 4, 5 and 6, we excluded firms that developed only one game in the entire sample of games. In addition, we limited our analysis to the games produced by two firms. Including games developed by more than two firms would have generated two problems. First, it is impossible to assess which partners are actually collaborating. We would have to assume

32 'A video game console is an interactive entertainment computer or electronic device that produces a video display signal which can be used with a display device (a television, monitor, etc.) to display a video game. The term video game console is used to distinguish a machine designed for consumers to buy and use solely for playing video games from a personal computer, which has many other functions, or arcade machines, which are designed for businesses that buy and then charge others to play' (http://en.wikipedia.org/wiki/Video_game_console, 04/23/2010). The consoles in the database include the Odyssey, Channel F, Atari 2600, Odyssey 2, Intellivision, Atari 5200, ColecoVision, Vectrex, NES, Sega Master System, Atari 7800, TurboGrafx-16, Genesis, TurboGrafx CD, Neo Geo, SNES, CD-I, Sega CD, 3DO, Amiga CD32, Jaguar, Neo Geo CD, PC-FX, Saturn, Sega 32X, PlayStation, Nintendo 64, Dreamcast, GameCube, PlayStation 2, Xbox, Xbox 360, PlayStation 3, and Wii.

33 We collected data not only for the headquarters of each firm, but also its subsidiaries. Throughout the text we will refer to these subsidiaries as firms and in the empirical modeling we will use the legal relation between headquarter and its subsidiaries as a factor that explains their collaboration.

that all partners are equally connected which might not always be the case. Second, each game produces a clique in which all firms involved are fully connected. This could artificially increase the level of network closure and bias the estimation of transitivity. Because such games are marginal[39] during the period considered, we opted for excluding them from the analyses. The final dataset used for our empirical examination comprises 21,314 games involving 1,358 unique firms from 1987 to 2007.

The resulting network involves *n* actors and can be represented as a *n*n* matrix *x = (xij)*, where *xij = 1* represents the joint production of a video game by firm *i* and firm *j (i, j = 1, …, n)*. The network dynamics within the four different generations are analyzed separately. For the construction of the longitudinal relational database, it is assumed that ties are active during the year of release of a given video game. As such, if a game is released in 2005 by actor *i* and actor *j* (regardless of the month), then we assume that a relation exist between *i* and *j* for the year 2005, and only for this year. It means that the tie will be dissolved in 2006 if *i* and *j* do not release a game together again. Moreover, relations are not directed because we assume that ties are always reciprocated. All relations are also dichotomized[40], which means that *xij = 1* even if the number of games produced by *i* and *j* is > 1 during a given year. For technical reasons, each generation corresponds to a set of yearly matrices with the same n*n size, with n=349 for generation three, n=664 for generation four, n=724 for generation five, and n=479 for generation six, but actors are allowed to leave or enter the network[41].

The resulting network dynamics are summarized in table 4.2. We can observe that the network becomes more stable over time, because the proportion of ties maintained compared to the number of ties created or dissolved from one year to another is increasing. Table 4.3 provides some descriptive statistics about the longitudinal network data, including the number of firms and the number of ties for each year included in the statistical analysis. The number of firms is increasing, but also the average degree. This means that firms not only produce more games (table 4.1), but also collaborate with an increasing number of different partners.

MODELING NETWORK DYNAMICS

The empirical investigation of network dynamics is concerned with complex relational structures that require specific statistical models (Snijders 2001). A fundamental property of network structures is the existence of conditional dependencies between observations, especially between dyads that have actors in common (Rivera et al. 2010). By nature, such network dependencies violate standard statistical procedures like OLS and logistic regressions that assume independence among observations. Correlation between observations can lead to unreliable estimations of parameter coefficients and standard errors (Steglich et al. 2010). Therefore, a class of statistical network models based on Markov random graph has been developed to model structural dependencies. Although the first generation of statistical network models was restrictive in terms of effects (Wasserman and Pattison 1996), more realistic models have been implemented with recent advances in Markov chain Monte Carlo simulation procedures. So far, Stochastic Actor-Oriented Models (SAOM) are the most promising class of models allowing for statistical inference of network dynamics (Snijders et al. 2010). In this paper, we use SAOM implemented in the SIENA[42] statistical software (Ripley et al. 2011). A brief description of the general principles of SAOM and details of the model specification follows below.

34 The Game Documentation and Review Project Mobygames can freely be consulted at http://www.mobygames.com. The Mobygames database is a catalog of 'all relevant information about electronic games (computer, console, and arcade) on a game-by-game basis' (http://www.mobygames.com/info/faq1#a). The information contained in MobyGames database is the result of contribution by the website's creators as well as voluntarily contribution by Mobygames community members. All information submitted to MobyGames is checked by the website's creators and errors can be corrected by visitors of the website.

35 "Online Games Datenbank" can freely be consulted at http://www.ogdb.de

36 This figure only includes headquarters.

37 Ties that are maintained from one observed moment (year) to another.

38 Achieving such a level of stability would have required additional assumptions on the length of ties.

39 See table 1 : 5,1% of the total of games developed from 1987 to 2007 (1092/21314).

40 The statistical model used can only run dichotomized networks

FIGURE 4.1
Entry, exit and population totals in the video game industry

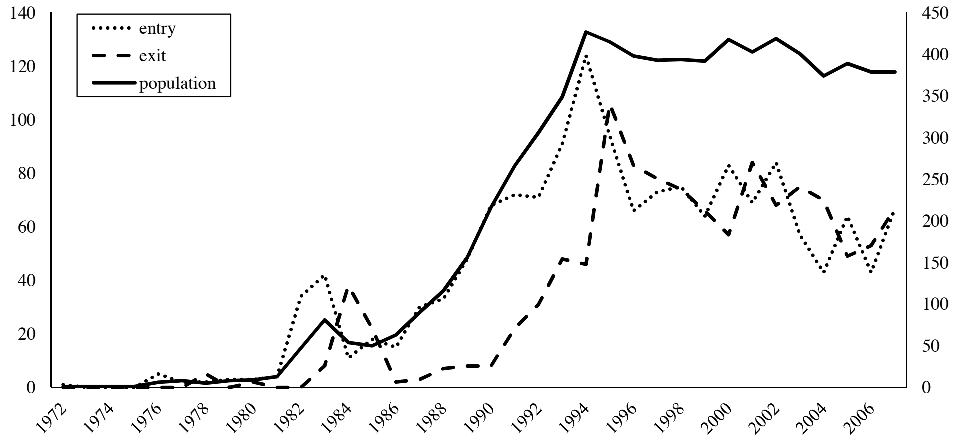


TABLE 4.2
Collaboration patterns along the video game industry life cycles

	Observed Period	Ties Created	Ties Dissolved	Ties Maintained	Firms Entry	Firms Exit
Generation 3	1987 - 1988	132	92	28	52	1
	1988 - 1989	242	114	46	45	0
	1989 - 1990	402	180	108	45	4
	1990 - 1991	412	368	142	20	7
	1991 - 1992	492	394	160	0	23
Generation 4	1993 - 1994	734	566	282	61	14
	1994 - 1995	554	800	216	54	42
	1995 - 1996	584	572	198	42	46
	1996 - 1997	648	546	236	25	49
	1997 - 1998	478	628	256	0	51
Generation 5	1999 - 2000	754	468	324	55	10
	2000 - 2001	566	770	308	56	23
	2001 - 2002	872	502	372	35	37
	2002 - 2003	762	794	450	26	53
	2003 - 2004	678	796	416	0	65
Generation 6	2005 - 2006	508	526	300	17	16
	2006 - 2007	594	504	304	0	32

41 We used the method described in Huisman and Snijders (2003) to represent actors entering/leaving the industry. We also used the method of structural zeros (Ripley et al., 2011) as a robustness check which led to the same results.

STOCHASTIC ACTOR-ORIENTED MODELS (SAOM)

Besides explicitly representing network dependencies, SAOM are dynamic models that offer the possibility to include a variety of effects related to the heterogeneity of actors or their proximity. SAOM have been identified as a promising model in economic geography (Ter Wal and Boschma 2009; Maggioni and Uberti 2011), and applied to analyze the dynamics of global and regional knowledge networks (Giuliani 2010; Balland 2011; Ter Wal 2011).

TABLE 4.3
Network structural descriptive statistics

OBSERVED YEAR	NUMBER OF FIRMS	NUMBER OF TIES	AVERAGE DEGREE	DENSITY
1987	187	120	0.642	0.003
1988	238	160	0.672	0.003
1989	283	288	1.018	0.004
1990	324	510	1.574	0.005
1991	337	554	1.644	0.005
1992	314	652	2.076	0.007
1993	482	848	1.759	0.004
1994	529	1016	1.921	0.004
1995	541	770	1.423	0.003
1996	537	782	1.456	0.003
1997	513	884	1.723	0.003
1998	462	734	1.589	0.003
1999	552	792	1.435	0.003
2000	597	1078	1.806	0.003
2001	630	874	1.387	0.002
2002	628	1244	1.981	0.003
2003	601	1212	2.017	0.003
2004	536	1094	2.041	0.004
2005	462	826	1.788	0.004
2006	463	808	1.745	0.004
2007	431	898	2.084	0.005

SAOM are based on three principles that can appear more or less realistic depending on the nature of the network analyzed. First, the evolution of network structures is modeled as the realization of a continuous-time Markov chain, i.e. a dynamic process where the network in *t+1* is generated stochastically from its configuration in *t*. Since change probability depends on the current state of the network and not on its past configurations, relevant information about joint history or intensity of collaborations can be included as an exogenous variable to make this assumption more realistic (Steglich et al. 2010). Second, time runs continuously between observations which means that observed change is assumed to be the result of an unobserved sequence of micro steps. In each step, actors can change only one tie variable at a time, inducing that a group of actors cannot decide to start relationships simultaneously. Third, and more importantly, it is assumed that network dynamics is the result of choices of actors based on their preferences and constraints, i.e. the model is "actor-oriented". Network structures change because actors develop strategies to create ties with others (Jackson and Rogers 2007), based on their awareness of the network configuration. This assumption is plausible in the context of the video game industry in which firms are able to determine their strategic decisions, and information on collaborations of other firms is available for intellectual property rights purposes. In SAOM, actors drive the dynamics of networks because at stochastically determined moments they can change their relations with other actors by deciding to create, maintain or dissolve ties. More formally, these opportunities are determined by a rate function in which opportunities to collaborate occur according to a Poisson process with rate λ_i for each actor *i*. Given that an actor *i* has the opportunity to

42 This class of models is often referred to directly as SIENA models. SIENA stands for "Simulation Investigation for Empirical Network Analysis". The RSiena package is implemented in the R language and can be downloaded from the CRAN website: http://cran.r-project.org/web/packages/RSiena/.

make a relational change, the choice for this actor is to change one of the tie variables x_{ij}, which will lead to a new state $x, x \in C(x^0)$. At this stage, a traditional logistic regression is used to model choice probabilities (Snijders et al. 2010):

$$P\{X(t) \text{ changes to } x | i \text{ has a change opportunity at time } t, X(t) = x^0\}$$

$$= p_i(x^0, x, v, w) = \frac{\exp(f_i(x^0, x, v, w))}{\sum_{x' \in C(x^0)} \exp(f_i(x^0, x', v, w))}$$

When actors have the opportunity to change their relations, they choose their partners by trying to maximize their objective function, with random perturbations. For the analysis of non-directed networks, different types of models are implemented in SIENA. We model the creation of linkages by using the *unilateral initiative and reciprocal confirmation model*, which is the most realistic for analyzing collaboration networks (Van de Bunt and Groenewegen 2007; Balland 2011; Ter Wal 2011). In a first stage, actor *i* can only attempt to maximize its objective function by trying to produce a video game with actor *j*, but this collaboration is only realized if actor *j* accepts on the basis of its own objective function[43]. Thus, changes in network ties are modeled according to a utility function at the node level which is the driving force of network dynamics. The objective function describes preferences and constraints of firms: to be linked with others that are geographically proximate might be one (Carayol and Roux 2009). More formally, collaboration choices are determined by a linear combination of effects, depending on the current state (x^0), the potential new state (x), individual attributes[44] (v) and proximity (w) :

43 In other specifications, one actor can impose unilaterally the creation of a tie to another one.

44 For the analysis, individual and proximity variables are centered around the mean.

$$f_i(x^0, x, v, w) = \sum_k \beta_k s_{ki}(x^0, x, v, w)$$

As proposed by Snijders (2001), the estimation of the different parameters β_k of the objective function is achieved by the mean of an iterative Markov chain Monte Carlo algorithm based on the method of moments. The stochastic approximation algorithm simulates the evolution of the network and estimates the parameters β_k that minimize the deviation between observed and simulated networks. Over the iteration procedure, the provisional parameters of the probability model are progressively adjusted in a way that the simulated networks fit the observed networks. The parameter is then held constant to its final value, in order to evaluate the goodness of fit of the model and the standards errors.

A major strength of SAOM is that a large variety of variables can be included in the specification of the objective function to model preferences and constraints of actors. As discussed above, we consider three sets of drivers of network formation: (1) structural effects (i.e. density, transitivity, preferential attachment); (2) individual characteristics of actors (i.e. profile, size, experience); and (3) proximity mechanisms (i.e. geographical, organizational, institutional, cognitive, social) which will be discussed one by one below (see table 4.4 and table 4.5).

STRUCTURAL EFFECTS

We include three variables that measure the effects of structural network properties and explain how the structure of the video game network influences its further evolution. First, the density effect can be interpreted as the constant term in regression analysis, indicating the general tendency to form linkages. This variable should always be included in SAOM to control for the cost of relations (Snijders et al. 2010), and indicates why all nodes are not able to be fully connected to all others (McPherson et al. 2001). Density is measured by the out degree of firms:

$$D_i = \sum_j x_{ij}$$

Transitivity is an important structural effect for network dynamics, concerned with the tendency towards network closure. It can be measured in several ways, but the most straightforward is based on the number of transitive triplets of actors, i.e. the number of times an actor *i* is tied with two actors that are partners themselves (Ripley et al. 2011):

$$T_i = \sum_{j<h} x_{ij}\, x_{ih}\, x_{jh}$$

Preferential attachment considers that actors with a large number of relations are more attractive. As such, it is measured by the number of relations of the actor to whom *i* is tied. More precisely, we take the square root of the degree of alter in order to decrease the degree of collinearity with other structural variables:

$$PA_i = \sum_j x_{ij} \sqrt{\sum_h x_{jh}}$$

INDIVIDUAL CHARACTERISTICS

To control for the heterogeneity of firms in their capacity to collaborate, we include size and experience of actors. Size is based on the natural logarithm of the number of games a firm has produced during the last five years. We consider all the games produced, regardless of the number of partners involved. The experience of a firm is measured by the number of years the firm has been active in the video game industry (i.e. the age of the firm).

Profile similarity is a variable that accounts for the fact that firms perform the role of either publisher or developer in the development process. The tendency to publish is obtained by dividing for each actor i the number of games in which i has the role of publisher, divided by the total number of games in which i was involved[45]. We multiplied this ratio by ten, allowing the variable to range from 0 to 10. Thus, we control for the fact that publishing oriented firms are likely to collaborate with developers and developing oriented firms with publishers[46]:

$$PS_{ij} = 1 - \frac{(|v_i - v_j|)}{r_v}$$

45 From the date of entry to the date of exit of the industry.

46 Where v is the tendency to publish and r_v is the difference between the highest and the lowest value of the tendency to publish variable

PROXIMITY DIMENSIONS

We follow the seminal analytical distinction in five dimensions of proximity proposed by Boschma (2005). *Institutional proximity* measures whether two firms are exposed to the same institutional framework. Sharing similar formal or informal institutions increases the likelihood of actors to start a partnership. In the case of the video game industry, the national level is especially important as it refers to common intellectual property right regimes, languages and video game culture. As such, we follow previous studies measuring institutional proximity as a binary measure, equal to 1 if the two firms belong to the same country and 0 if not (Hoekman et al. 2009).

TABLE 4.4
Operationalization of the variables

VARIABLES	OPERATIONALIZATION
DENSITY	Out degree
TRANSITIVITY	Transitive triplets
PREFERENTIAL ATTACHMENT	Square root of degree of alter
INSTITUTIONAL PROXIMITY	Same country (dummy)
GEOGRAPHICAL PROXIMITY	Inverse of Physical distance (natural log)
ORGANIZATIONAL PROXIMITY	Same group of firms (dummy)
SOCIAL PROXIMITY	Same games produced previously (nb)
COGNITIVE PROXIMITY	Same genres of VG
PROFILE SIMILARITY	Similarity of profile (developers/publishers)
SIZE	No of Games produced previously (natural log)
EXPERIENCE	Number of years since entry

[47] Not computed for firms at distance 0 but directly replaced by 0.

Geographical proximity is measured by the inverse of the natural logarithm of the physical distance ('as the crow flies') between two firms[47] in kilometers. More precisely, we obtained a maximum of 10 and a minimum of 0 by computing the natural logarithm of the distance between firms. We subtracted the log of distance from 10, in order to have a proximity measure rather than a distance measure. As a result, the variable ranges from 0 for the most distant firms to 10 for the closest ones:

$$PG_{ij} = 10 - \ln(dist_{ij})$$

Organizational proximity is defined as membership of a larger business group. We created a 1-0 dummy variable equal to 1 if the two organizations involved in the production of the video game belong to the same legal entity, and 0 otherwise. In our dataset, we identified all firm ownership structures allowing us to distinguish between the main office (headquarters) of each firm and its subsidiaries. As a result, we were able to identify whether two organizations involved in the production of a video game shared the same owner(s) and did therefore belong to the same legal entity.

Boschma (2005) defined *social proximity* in terms of socially embedded relations between agents at the micro-level. More in particular, social proximity refers to the extent to which agents share prior mutual relationships. Such relationships carry information about potential future partners, and thereby increase the probability to engage in future collaborations. Social proximity can be measured on the basis of the number of previous collaborations (Ahuja et al. 2009). We count the number of games that two actors have produced together during the five previous years. In order to compute this measure, we also considered games that have been produced by more than two firms. We must note here that social proximity could also be classified as a structural endogenous network formation mechanism. Indeed, prior social interaction is given by the model.

Cognitive proximity refers to the similarity in the distribution of knowledge endowments across two agents (Nooteboom 1999). Contrary to most empirical studies, we adopt an asymmetric, directed measure of cognitive proximity[48]. We follow Balland et al. (2011) who shows that adopting a featural rather than a distance approach allows us to account for the fact that actor *i* might be more cognitively proximate to *j* than *j* to *i*. To construct such a directed measure of proximity, we rely on information on the stylistic elements used in the video games produced by companies in the 5 years prior to the focal year. Each video game is categorized into one or multiple stylistic elements. Such elements range from genres such as action or simulation to perspectives such as first-person perspective or top-down. The genres that firms have covered represent the cognitive framework upon which firms operate. In order to calculate the cognitive proximity between two firms we measured the number of genres that firm i and firm j share divided by the total number of genres covered by firm i and firm j respectively. As a result the measure will be asymmetric.

48 Neffke and Svensson Henning (2008) use a similar argument to conceptualize asymmetric related variety.

TABLE 4.5
Descriptive statistics of the dyadic and individual variables

	Generation 3				Generation 4				Generation 5				Generation 6			
	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max	Mean	SD	Min	Max
Proximity																
Institutional	0.34	0.47	0	1	0.28	0.45	0	1	0.24	0.43	0	1	0.23	0.42	0	1
Geographical	2.66	2.94	0	10	2.40	2.64	0	10	2.20	2.41	0	10	2.01	2.12	0	10
Organizational	0.00	0.03	0	1	0.00	0.02	0	1	0.00	0.03	0	1	0.00	0.04	0	1
Social	0.01	0.31	0	78	0.01	0.34	0	49	0.01	0.39	0	133	0.05	1.23	0	251
Cognitive	1.61	2.33	0	10	2.55	2.85	0	10	2.41	2.72	0	10	3.42	2.93	0	10
Profile similarity	0.55	0.33	0	1	0.57	0.37	0	1	0.61	0.41	0	1	0.59	0.42	0	1
Size	1.78	1.09	1	7	2.39	1.27	1	7	2.43	1.33	1	7	3.28	1.51	1	8
Experience	3.70	3.27	0	16	5.80	4.48	0	22	7.21	5.91	0	28	9.95	6.93	0	31

EMPIRICAL RESULTS

Results of parameter estimations are presented in table 4.6. The network dynamics of the video game industry from 1987 to 2007 are modeled separately for each generation (3, 4, 5 and 6), in order to evaluate the changing influence of network drivers over time. All parameter estimations are based on 1,000 simulation runs, and convergence of the approximation algorithm is excellent for all the variables of the different models[49] (t-values < 0.1). The parameter estimates of SAOM can be interpreted as non-standardized coefficients obtained from logistic regression analysis (Steglich et al. 2010). Therefore, the β reported in table 4.6 are log-odds ratio, corresponding to how the log-odds of tie formation change with one unit change in the corresponding independent variable. In order to test if the difference between coefficients along the different generations was statistically significant, we visualize the 95% confidence intervals for the different coefficients (see figure 4.2). We found little or no overlap of the confidence intervals of generation 3 and generation 6, and confidence intervals of some effects even do not overlap from one generation to another. In sum, our analysis suggests that the influence of drivers of network formation is relatively stable but their weights do significantly change over time as the industry evolves.

49 Convergence check can be used to evaluate the goodness of fit of SAOM, by indicating the deviation between observed values and simulated values. To achieve such a good level of convergence, we excluded preferential attachment from the analysis because this effect was too highly correlated with the other structural mechanisms.

TABLE 4.6
Estimation results: parameter estimates and standard deviations

	Generation 3 N = 349			Generation 4 N = 664			Generation 5 N = 724			Generation 6 N = 479		
	β		SD	β		SD	β		SD	β		SD
Structural effects												
Density	-1.957	***	0.022	-2.209	***	0.015	-2.456	***	0.021	-2.362	***	0.043
Transitive triads	0.654	*	0.331	0.653	***	0.045	0.632	***	0.031	0.700	***	0.067
Proximity effects												
Institutional	0.098	***	0.038	0.140	***	0.025	0.133	***	0.023	-0.042		0.046
Geographical	0.017	***	0.003	0.026	***	0.002	0.025	***	0.002	0.045	***	0.005
Organizational	1.854	***	0.100	1.533	***	0.096	1.450	***	0.071	1.104	***	0.135
Social	0.186	***	0.038	0.079	***	0.011	0.081	***	0.011	0.044	***	0.010
Cognitive	-0.002		0.003	0.002		0.002	0.023	***	0.003	0.025	***	0.006
Individual effects												
Profile similarity	-0.735	***	0.050	-0.820	***	0.035	-1.097	***	0.032	-1.181	***	0.059
Size	0.206	**	0.067	0.206	***	0.003	0.166	***	0.009	0.065	***	0.015
Experience	-0.003		0.005	-0.005		0.014	0.004	***	0.001	0.020	***	0.002

The first two rows of table 4.6 report the effects of the structural network variables density and transitive triads on tie formation. We found a negative and significant impact of the density effect. This variable measures the costs of linkages which inhibit firms to be fully connected. For the transitivity variable, we found a positive and significant effect for all generations. This result indicates that firms are more likely to produce video games with partners of partners. Moreover, this effect appears to be rather stable over time, indicating that transitive patterns do not increase with the degree of maturity of the industry. This is in contrast to Ter Wal (2011), who showed an increasing importance of triadic closure in co-inventor networks in German biotech, which he associated with increasing codification of knowledge in biotech.

Row 3 to 7 in table 4.6 report the influence of proximity mechanisms on partner selection. We evaluate whether firms tend to collaborate with firms that have similar attributes. Institutional proximity is positive and significant for generation 3, 4 and 5. This means that, even when controlling for physical distance, firms located in the same country are more likely to produce a game together. However, this effect is decreasing after generation 4, and is not significant anymore in the last generation. This suggests that national institutional regimes are becoming less important over time as drivers of network ties. In that context, it is interesting to find a positive and significant impact of geographical proximity for all generations. The weight of this coefficient is even increasing over time. This finding contradicts the result found at a national level in German co-inventor networks in biotech, which showed a deceasing importance of geographical proximity as time passed by (Ter Wal 2011). While this latter result has been associated with increasing codification of knowledge in biotech, this process is unlikely to take place in a creative industry like video games. An additional explanation is that video games have become more technologically complex which requires more interfirm collaboration at shorter geographical distances (Sorenson et al. 2006).

The results also demonstrate that organizational proximity is an important factor of collaboration: this effect is positive and significant for all generations. Nevertheless, it is interesting to note that this effect is decreasing over time, probably because business groups tend to diversify over time. Social proximity also is a strong predictor of the likelihood that two firms will co-produce a video game. However, this effect is clearly decreasing over time, meaning that previous collaborations is still an important driver of network formation in the video game industry, but to a lesser extent.

The effect of cognitive proximity seems to be strongly influenced by the industry life cycle. While this effect was not significant during generation 3 and 4, it becomes positive and significant for generation 5 and 6. This may reflect the fact that developing new video games has become more technologically complex, and therefore requires more cognitive proximate partners over time, as well as more geographically proximate partners, as noticed earlier.

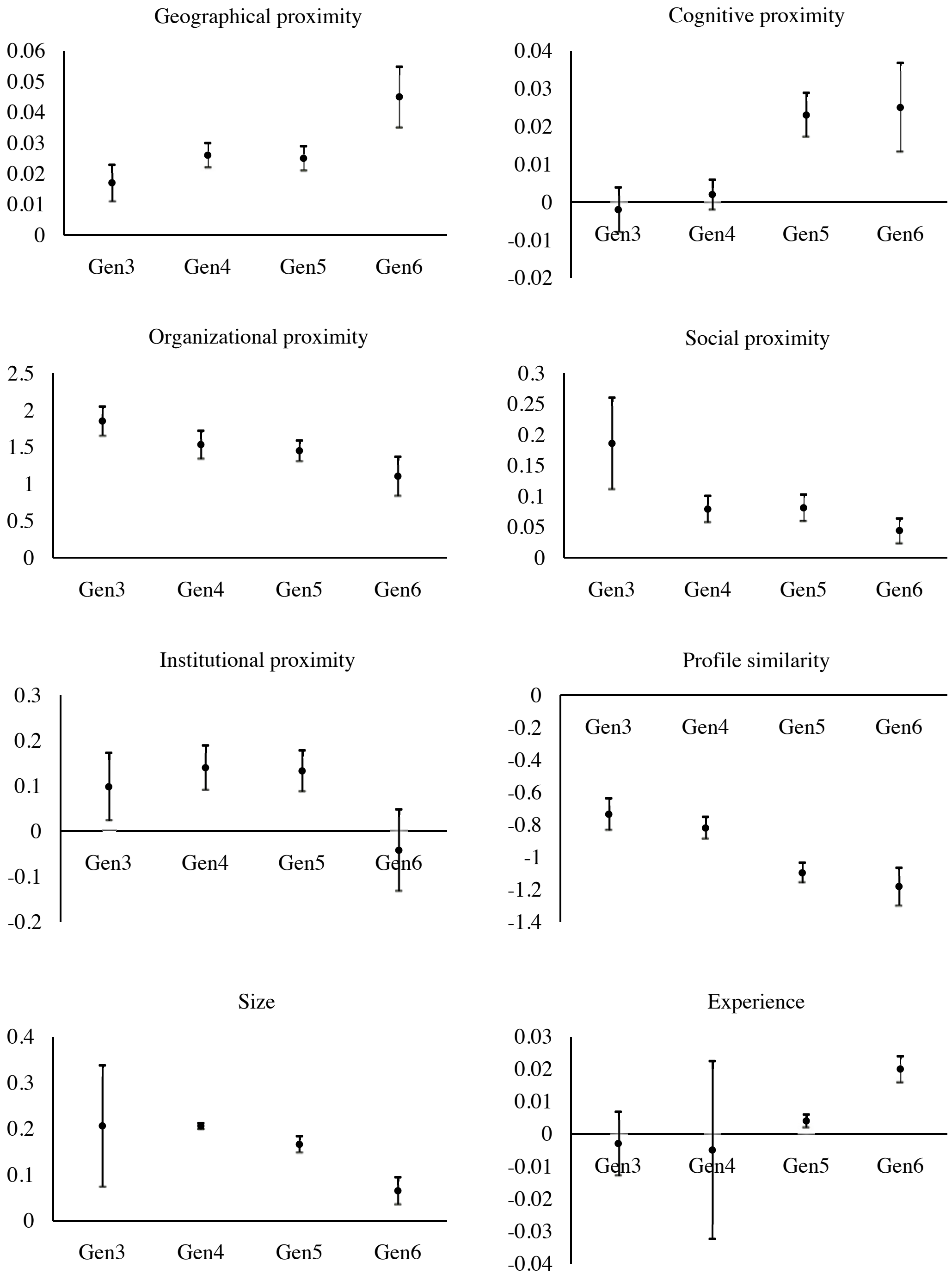
With respect to the individual characteristics, profile similarity is negative and significant for all generations. It shows that developers are more likely to collaborate with publishers, and vice versa. It is interesting to observe that this negative effect is increasing, showing that actors tend to specialize in their publisher/developer role over the industry life cycle. Size of firms is positive and significant for all generations, but this effect is decreasing. And finally, experience is not significant for the early stages of the industry, but it becomes a clear advantage at later stages

CONCLUSION AND DISCUSSION

In this paper, we have analyzed the network dynamics in an evolving industry, a topic that is still relatively unexplored. We have employed a Stochastic Actor-Oriented Model to analyze the evolution of drivers of interfirm network formation in the global video game industry. By bringing together literature on industrial dynamics, network theory and economic geography, we have explored how network formation in a creative industry is influenced by different forms of proximity, alongside individual characteristics and structural endogenous network structures. Taking a dynamic perspective on networks, we found strong evidence that the effects of the main drivers of network formation changed as the video game industry evolved in the period 1987-2007. Broadly speaking, tie formation became increasingly a function of geographical, cognitive proximity and being experienced, but to a lesser extent to organizational, social and institutional proximity.

The increasing coefficient of geographical proximity clearly shows that firms are more likely to partner with firms over shorter geographical distance as the video game industry evolved. This may reflect the fact that we deal with a creative cultural industry in which local buzz is crucial (Storper and Venables 2004). The project-based and flexible nature of production makes the video game industry less exposed to processes of standardization and increasing codification of knowledge which might have relaxed the necessity to be geographically proximate. An additional explanation might be found in the increasing technological complexity of video game development which requires more interfirm collaboration at shorter geographical distances (Sorenson et al. 2006). Interestingly, the effect of Institutional proximity decreased and even lost its significance over time, while geographical proximity became more important. Clearly, the national institutional regime has lost its meaning as a driver of network ties as the video game business evolved.

FIGURE 4.2
Drivers of network dynamics over the industry life cycle



Another important finding is that cognitive proximity was not a determinant of tie formation in the first generations, but the network formation in later generations was clearly driven by similarities in genre portfolios of firms. This may reflect the fact that developing new video games became more technologically complex and therefore required more cognitive proximate partners over time. Another explanation for this finding might be found in the fact that boundaries between video game genres and styles became better defined and video game firms started to specialize over time.

This is in line with another outcome of our analysis. That is, experienced firms were more likely to attract partners than firms with little experience but only so in later generations. A first possible explanation is that the effect of experience on attracting partners is only apparent above a certain threshold. Another explanation might be found on the consumer side of the video game value chain. The ever increasing number of video games that are released each year requires consumers to acquire larger amounts of information in order to assess the quality of all video games available. Rather than acquiring information of all video games, the consumer might rely more on reputation and status of experienced video game producers.

As mentioned earlier, we see this study as an explorative and early attempt to analyze the dynamics of network formation along the life cycle of a creative industry. In that respect, there are a number of challenges for future research. First, we have focused on drivers of network formation based on secondary network data which enabled us, among others things, to focus on networks dynamics from a long-term perspective. What is still needed is to conduct a more qualitative approach based on survey data that could deepen our understanding of the motives behind networking in video gaming. Second, we need more similar studies for other types of industries, and see whether the same drivers of network formation over time hold in these contexts. As discussed earlier, creative industries might be different from other industries. Third, our study showed that firms find their collaboration mainly within their own region, that they work together with firms with similar portfolios, and that they are likely to partner with experienced firms. While such a pattern might be highly profitable in the short to medium run, in the long run this pattern may cause these firms (and their regions) to become vulnerable for external shocks (Neffke et al. 2011). In other words, we need more understanding what these types of networking really mean for the performance of firms and regions.

References chapter 4

Abernathy, W., Clark, K.B. (1985). Mapping the winds of creative destruction. Research Policy 14: 3 – 22.

Agrawal, A., Cockburn, I., McHale, J. (2006). Gone but not forgotten: Knowledge flows, labor mobility, and enduring social relationships. Journal of Economic Geography 6: 571 – 591.

Ahuja, G., Polidoro, Jr. F., Mitchell, W. (2009). Structural homophily or social asymmetry? The formation of alliances by poorly embedded firms. Strategic Management Journal 30: 941 – 958.

Audretsch, D., Feldman, M. (1996). Innovative clusters and the industry life cycle. Review of Industrial Organization 11: 253 – 273.

Autant-Bernard, C., Billand, P., Frachisse, D., Massard, N. (2007). Social distance versus spatial distance in R&D cooperation: Empirical evidence from European collaboration choices in micro and nanotechnologies. Papers in Regional Science 86: 495 – 519.

Baldwin, C.Y., Clark, K.B. (2000). Design rules: The power of modularity. Cambridge, Massachusetts: MIT Press.

Balland, P.A. (2011). Proximity and the evolution of collaboration networks: Evidence from research and development projects within the Global Navigation Satellite System (GNSS) industry. Regional Studies, in press.

Balland, P.A., Boschma, R., Frenken, K. (2011). Dynamics of proximity and innovation networks: An evolutionary approach. Working Paper, Utrecht University, Department of Economic Geography.

Barabási, A.L., Albert, R. (1999). Emergence of scaling in random networks. Science 286: 509 – 512.

Bathelt, H., Glückler, J. (2003). Toward a relational economic geography. Journal of Economic Geography 3: 117 – 144.

Bergman, E. (2009). Embedding network analysis in spatial studies of innovation. The Annals of Regional Science 43: 559 – 565.

Bonaccorsi, A., Giuri, P. (2001). Network structure and industrial dynamics: The long-term evolution of the aircraft-engine industry. Structural Change and Economic Dynamics 12: 201 – 223.

Boschma, R., Frenken, K. (2010). The spatial evolution of innovation networks: a proximity perspective. In R. Boschma and R. Martin (eds.), The handbook on evolutionary economic geography. Cheltenham, UK: Edward Elgar, pp. 120 – 135.

Boschma, R. (2005). Proximity and innovation: a critical assessment. Regional Studies 39: 61 – 74.

Breschi, S., Lenzi, C., Lissoni, F., Vezzulli, A. (2010). The geography of knowledge spillovers: the role of inventors' mobility across firms and in space. In R. Boschma and R. Martin (eds), The handbook on evolutionary economic geography. Cheltenham, UK: Edward Elgar, pp. 353-369.

Breschi, S., Lissoni, F. (2001). Knowledge spillovers and local innovation systems: A critical survey. Industrial and Corporate Change 10: 975 – 1005.

Broekel, T., Boschma, R.A. (2011). Knowledge networks in the Dutch aviation industry: the proximity paradox. Journal of Economic Geography, in press.

Cantner, U., Graf, H. (2006). The network of innovation in Jena. An application of social network analysis. Research Policy 35: 463 – 480.

Carayol, N., Roux, P. (2009). Knowledge flows and the geography of networks: A strategic model of small world formation. Journal of Economic Behavior and Organization 71: 414 – 427.

Carrincazeaux, C., Lung, Y., Vicente, J. (2008). The scientific trajectory of the French School of Proximity: Interaction- and institution-based approaches to regional innovation systems. European Planning Studies 16: 617 – 628.

Cassi, L., Plunket, A. (2010). The determinants of co-inventor tie-formation. Proximity and network dynamics. Papers in Evolutionary Economic Geography, no. 10.15, Utrecht University, Utrecht.

Cassiman, B., Veugelers, R. (2002). Spillovers and R&D cooperation: Some empirical evidence. American Economic Review 92: 1169 – 1184.

Caves, R.E. (2000). Creative industries; Contracts between art and commerce. Cambridge, Massachusetts: Harvard University Press.

Caves, R.E. (2002). Contracts between art and commerce. Journal of Economic Perspectives 17: 73 –83.

Chandler, D. (1997). The computer industry. The first half-century. In D.B. Yoffie (ed.), Competing in the age of digital convergence, Cambridge, Massachusetts: Harvard Business School Press, pp. 37 – 122.

Cohen, W.M., Levinthal, D.A. (1990). Absorptive capacity: A new perspective on learning and innovation. Administrative Science Quarterly 35: 128 – 152.

Cowan, R., Jonard, N., Zimmermann, J.B. (2007). Bilateral collaboration and the emergence of networks. Management Science 53: 1051 – 1067.

Currid, E. (2007). The Warhol Economy: How fashion, art and music drive New York City. Princeton, New Jersey: Princeton University Press.

Davis, J.A. (1970). Clustering and hierarchy in interpersonal relations: testing two graph theoretical models on 742 sociomatrices. American Sociological Review 35: 843 – 852.

Delmestri, G., Montanari, F., Usai, A. (2005). Reputation and strength of ties in predicting commercial success and artistic merit of independents in the Italian film industry. Journal of Management Studies 42: 975 – 1002.

DiMaggio, P.J., Powell, W.W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. American Sociological Review 48: 147 – 160.

Friedman, T.L. (2005). The world is flat. A brief history of the globalized world in the twenty-first Century. London, UK: Penguin Books.

Gay, B., Dousset, B. (2005). Innovation and network structural dynamics: Study of the alliance network of a major sector of the biotechnology industry. Research Policy 34: 1457 – 1475.

Giuliani, E. (2010). Network dynamics in regional clusters: The perspective of an emerging economy, Papers in Evolutionary Economic Geography 10.14, Section of Economic Geography, Utrecht University.

Giuliani, E., Bell, M. (2005). The micro-determinants of meso-level learning and innovation: Evidence from a chilean wine cluster. Research Policy 34: 47 – 68.

Glückler, J. (2007). Economic geography and the evolution of networks. Journal of Economic Geography 7: 619 – 634.

Glückler, J. (2010). The evolution of a strategic alliance network – Exploring the case of German stock photography. In R. Boschma and R. Martin (eds.), The handbook on evolutionary economic geography, Cheltenham, UK: Edward Elgar, pp. 298 – 315.

Gort, M., Klepper, S. (1982). Time paths in the diffusion of product innovations. Economic Journal 92: 630 – 653.

Grabher, G. (2006). Trading routes, bypasses, and risky intersections: Mapping the travels of “networks” between economic sociology and economic geography. Progress in Human Geography 30: 163 – 189.

Grabher, G. (2001). Ecologies of creativity: the village, the group, and the heterarchic organisation of the British advertising industry. Environment and Planning A 33: 351 – 374.

Heebels, B., Boschma, R. (2011). Performing in Dutch book publishing 1880–2008. The importance of entrepreneurial experience and the Amsterdam cluster. Journal of Economic Geography, in press.

Hoekman, J., Frenken, K., Tijssen, R. (2010). Research collaboration at a distance: changing spatial patterns of scientific collaboration within Europe. Research Policy 39: 662 – 673.

Hoekman, J., Frenken, K., Van Oort, F. (2009). The geography of collaborative knowledge production in Europe. Annals of Regional Science 43: 721 – 738.

Holland, P.W., Leinhardt, S. (1971). Transitivity in structural models of small groups. Comparative Group Studies 2: 107 – 124.

Huisman, M.E., Snijders, T. (2003). Statistical analysis of longitudinal network data with changing composition. Sociological Methods & Research 32: 253 – 287.

Jackson, M., Rogers, B. (2007). Meeting strangers and friends of friends: How random are social networks? American Economic Review 97: 890 – 915.

Johns, J. (2005). Video games production networks: value capture, power relations and embeddedness. Journal of Economic Geography 6: 151 – 180.

Klepper, S. (1996). Entry, exit, growth, and innovation over the Product Life Cycle. American Economic Review 86: 562 – 583.

Klepper, S. (1997). Industry life-cycles. Industrial and Corporate Change 6: 145 – 182.

Maggioni, M., Uberti, E. (2011). Networks and geography in the economics of knowledge flows. Quality and Quantity 45, in press.

Malerba, F. (2006). Innovation and the evolution of industries. Journal of Evolutionary Economics, 16: 3 – 23.

Malmberg, A., Maskell, P. (2006). Localized learning revisited. Growth and Change 37: 1 – 18.

McPherson, M., Smith-Lovin, L., Cook, J.M. (2001). Birds of a feather: Homophily in social networks. Annual Review of Sociology 27: 415 – 444.

Mezias, J., Mezias, S. (2000). Resource partitioning, the founding of specialist firms, and innovation: the American feature film industry, 1912–1929. Organization Science 11: 306 – 322.

Morgan, K. (2004). The exaggerated death of geography: Learning, proximity and territorial innovation systems. Journal of Economic Geography 4: 3 – 21.

Morrison, A. (2008). Gatekeepers of knowledge within industrial districts: Who they are, how they interact. Regional Studies 42: 817 – 835.

Neffke, F., Svensson Henning, M. (2008). Revealed relatedness: Mapping industry space. Papers in Evolutionary Economic Geography 08.19, Section of Economic Geography, Utrecht University.

Nooteboom, B. (1999). Innovation, learning and industrial organizations. Cambridge Journal of Economics 23 (2): 127 – 150.

Orsenigo, L., Pammolli, F., Riccaboni, M. (2001). Technological change and network dynamics – lessons from the pharmaceutical industry. Research Policy 30: 485 – 508.

Ozman, M. (2009). Interfirm networks and innovation: a survey of literature. Economics of Innovation and New Technology 18: 39 – 67.

Ponds, R., Van Oort, F., Frenken, K. (2007). The geographical and institutional proximity of research collaboration. Papers in Regional Science 86: 423 – 443.

Powell, W.W., White, D., Koput, K.W., Owen-Smith J. (2005). Network dynamics and field evolution: the growth of interorganizational collaboration in the life sciences. American Journal of Sociology 110: 1132 – 1205.

Pratt, A. (2000). New media, the new economy and new spaces. Geoforum 31: 425 – 436.

Rallet, A., Torre, A. (1999). Is geographical proximity necessary in the innovation networks in the era of the global economy? GeoJournal 49: 373 – 380.

Ripley, R., Snijders, T., Preciado Lopez, P. (2011). Manual for RSiena, University of Oxford, Department of Statistics; Nuffield College, May 1.

Rivera, M., Soderstrom, S., Uzzi, B. (2010). Dynamics of dyads in social networks: Assortative, relational, and proximity mechanisms. Annual Review of Sociology 36: 91 – 115.

Rosenkopf, L., Tushman, M. (1994). The co-evolution of technology and organization. In J. Baum and J. Singh (eds.), Evolutionary dynamics of organizations, NewYork, New York: Oxford University Press, pp. 403 – 424.

Rosenkopf, L., Padula, G. (2008). Investigating the microstructure of network evolution: alliance formation in the mobile communications industry. Organization Science 19: 669 – 687.

Salen, K., Zimmerman, E. (2003). Rules of play: Game design fundamentals. Cambridge, Massachusetts: MIT Press.

Scott, A.J. (1997). The cultural economy of cities. International Journal of Urban and Regional Research 21: 323 – 339.

Scott, A.J (2004). Cultural-products industries and urban economic development. Urban Affairs Review 39: 461 – 490.

Singh, J. (2005). Collaborative networks as determinants of knowledge diffusion patterns. Management Science 51: 756 – 770.

Snijders, T. (2001). The statistical evaluation of social network dynamics. In M. Sobel and M. Becker (eds.) Sociological Methodology. Boston, Massachusetts and London, UK: Basil Blackwell, pp. 361 – 395.

Snijders, T., Van De Bunt, G., Steglich, C. (2010). Introduction to actor-based models for network dynamics. Social Networks 32: 44 – 60.

Sorenson, O., Rivkin, J., Fleming, L. (2006). Complexity, networks and knowledge flow. Research Policy 35: 994 – 1017.

Steglich, C., Snijders, T., Pearson, M. (2010). Dynamic networks and behavior: Separating selection from influence. Sociological Methodology 40: 329 – 393.

Storper, M., Venables, A. (2004). Buzz: face-to-face contact and the urban economy. Journal of Economic Geography 4: 351 – 370.

Suire, R., Vicente, J. (2009). Why do some places succeed when others decline? A social interaction model of cluster viability. Journal of Economic Geography 9: 381 – 404.

Sunley, P. (2008). Relational economic geography: A partial understanding or a new paradigm? Economic Geography 84: 1 – 26.

Ter Wal, A. (2011). The spatial dynamics of the inventor network in German biotechnology: Geographical proximity versus triadic closure. Papers in Evolutionary Economic Geography 11.02, Section of Economic Geography, Utrecht University.

Ter Wal, A., Boschma, R. (2009). Applying social network analysis in economic geography: theoretical and methodological issues. The Annals of Regional Science 43: 739 – 756.

Ter Wal, A., Boschma, R. (2011). Co-evolution of firms, industries and networks in space. Regional Studies 45: 919 – 933.

Tschang, F.T. (2007). Balancing the tensions between rationalization and creativity in the video game industry. Organization Science 18: 989 – 1005.

Utterback, J.M., Suarez, F.F. (1993). Innovation, competition, and industry structure. Research Policy 22: 1 – 21.

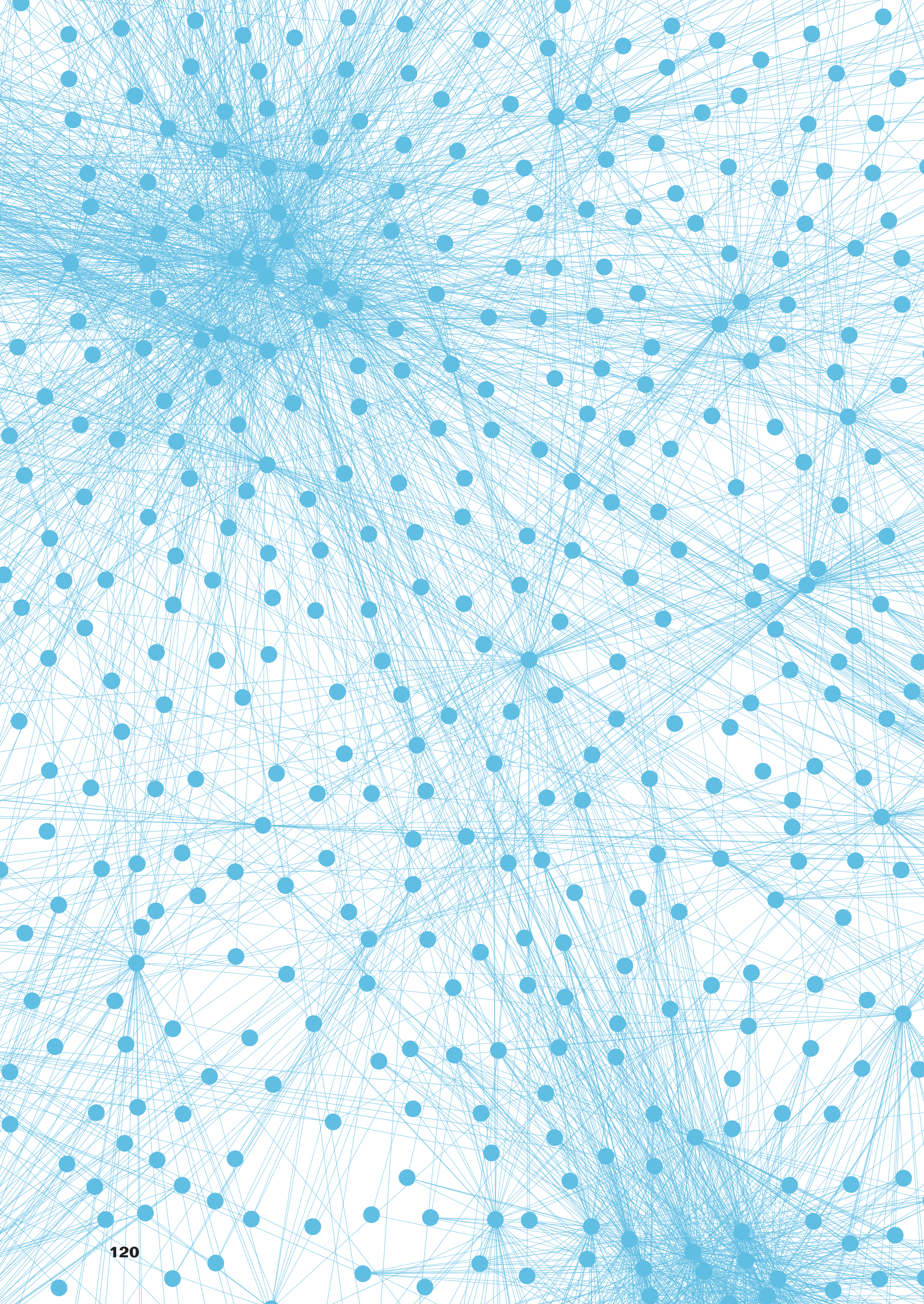
Uzzi, B. (1996). The sources and consequences of embeddedness for the economic performance of organizations: The network effect. American Sociological Review 61: 674 – 698.

Van De Bunt, G.G., Groenewegen, P. (2007). An actor-oriented dynamic network approach: the case of interorganizational network evolution. Organizational Research Methods 10: 463 – 482.

Vicente, J., Balland, P.A., Brossard, O. (2011). Getting into networks and clusters: Evidence from the Midi-Pyrenean Global Navigation Satellite Systems (GNSS) collaboration network. Regional Studies 45: 1059 – 1078.

Wasserman, S., Pattison, P. (1996). Logit models and logistic regressions for social networks: An introduction to Markov random graphs and p*. Psychometrika 61: 401 – 426.

Weterings, A. (2005). Do firms benefit from spatial proximity? Testing the relation between spatial proximity and the performance of small software firms in the Netherlands, Netherlands Geographical Studies 336, KNAG: Utrecht.



chapter 5
Interfirm networks in periods of technological turbulence and stability

Introduction

An extensive stream of research in various fields of the social sciences is dedicated to investigating how interactions between firms affect firm performance (e.g. Powell et. al 1996; Uzzi 1996; Rothaermel and Deeds 2004; Phelps 2010; Vedres and Stark 2010). One of the main premises in this research holds that rather than depending on firm-internal capabilities and resources, firms interact with other firms to gain access to inputs that enable them to be more successful. The fact that external linkages provide firms with a broader scope of accessible inputs and the fact that access to these inputs is highly flexible, cause firms to increasingly rely on other firms – raising their network relations to be one of the most important sources of competitive advantage.

In addressing the relation between interfirm networks and firm performance scholars of networks have found themselves in a quest to identify the optimal configuration of network partners. Structural patterns – such as closure and structural holes – and relational characteristics – such as weak and strong ties – have been used to explain why some firms fail to survive while others don't (Gulati and Gargiulo 1999). Recently, scholars of networks have started to identify some of the possible avenues for improvement of this work (Rodan and Galunic 2003; Butts 2009; Phelps 2010) by arguing that network analytic research could benefit from more attention for the context and content of relations and for its temporal dimension. This paper aims to make such a contribution by explicitly integrating theories from network analytic research and insights found in research on the technological evolution of industries. This latter stream of research highlights the temporal dimension of technological and competitive industrial settings. In particular, it shows how new technologies prompt firms to shift their focus from exploitation to exploration (March 1991) and it shows how new technologies affect the entry and exit of firms (Utterback and Abernathy 1975; Tushman and Anderson 1986; Klepper 1996). By combining these two strands of literature – interfirm networks and evolution of industrial settings – I explicitly explore how the relation between network ties and firm performance depends on and is moderated by the varying technological settings in an industry.

First, since industries that experience high levels of technological turnover are also characterized by high levels of firm entry and exit (Tushman and Anderson 1986; Tushman and Rosenkopf 1992; Klepper 1996), I examine how the failure of a firm's network partners affects the life chances of these firms by taking into account the importance and strength of network ties. Second, I explicitly measure and explore the diversity of information and knowledge present within a firm's ego network (Rodan and Galunic 2003; Baum, Calabrese and Silverman 2000; Phelps 2010) and I hypothesize how the benefits that may arise from such diversity are moderated by the changes in technological settings in an industry. Stressing the importance of technological change along an industry's lifespan allows me to provide a more dynamic and detailed analysis of the benefits and hazards that can arise from reliance on network relations. Hence, the main contribution of this paper is to show how the quality and quantity of network relations affect firm performance while accounting for changing technological conditions.

This paper employs a newly constructed dataset of all firms that have ever developed one or more video games for a video game console during the period 1972 – 2007. The empirical analysis concerns a hazard analysis of all 1,301 video game developers and 190 video game publishers that have been involved in the co-production of a video game. I use this co-production network to calculate detailed measures of developers' network linkages and its changing set of publishing partners. Since its inception in 1972, the video game industry has undergone six waves in which a generation of game consoles was replaced by a new generation of game consoles. Each new generation creates challenges and opportunities for the developers of video games by introducing new technological standards and thereby allowing firms to explore the boundaries of the new standards. The improvements in technology of next-generation game consoles allow game developers to create video games that are significantly different from the games produced for the prior-generation consoles. As a result, the production of video games – around the release of a new generation of consoles – is characterized by the exploration of the creative boundaries of the new technology (Kent 2001). Once the boundaries are explored, video game production shifts towards exploiting the knowledge and ideas that were generated during the exploration phase (March 1991; Klepper 1996). By using these insights I show how waves of generations of consoles created turbulence in the video games industry and how this turbulence moderated the effect of network relations on firm survival.

INTERFIRM NETWORKS AND TECHNOLOGICAL CHANGE

This section develops a more comprehensive theory of the effect of interfirm networks on firm survival by acknowledging the changing technological conditions in the global video game industry. I first briefly review the literature on interfirm networks. Then I integrate the core concepts of this literature in a framework of technological change and I argue why this extension is important. Lastly, I develop hypotheses about how the effect of network relations on firm survival changes as new technologies are introduced in the global video game industry.

INTERFIRM NETWORKS AS A SOURCE OF COMPETITIVE ADVANTAGE

As firms find themselves competing in environments that are subject to change, access to external sources of competitive advantages through network relations is argued to benefit firms in overcoming challenges and exploiting opportunities. Network relations allow firms to internalize capabilities and resources held by the partner firm and to generate valuable knowledge during the interaction with the partner firm when complementary ideas and insights are combined. Although there is little debate on the idea that network relations can be beneficial for firms competing for scarce resources, the optimal configuration and composition of network ties is vividly debated. Broadly speaking, the debate on the optimal configuration and composition of network ties is persistently present in two related lines of research and each is characterized by two seemingly opposing views (Moran 2005).

The first line of research stresses the importance of network structure by arguing that the value of a firm's access to network partners is dependent on the structure in which these relations are embedded. On the one hand, Coleman (1988; 1990) argues that actors embedded in densely connected, cohesive groups – or closed networks – are most likely to be successful because this cohesion enables the creation of social capital, trust and shared identity. Cohesion implies that an actor's alters are also connected, a property that can be leveraged by each actor in the group and reduces the likelihood of actions that undermine the interests of the group as a whole. Indeed, defective behavior by any of the actors in a densely connected sub-network is likely to be noticed by others and can effectively be sanctioned by the other members of the group. As a result, cohesive network structures reduce uncertainty about behavior of alters, and actors are more likely to cooperate intensively and share valuable knowledge. Alternatively, Burt (1992; 2005) introduced an opposing view that stresses the importance of non-redundant network ties. In his view, the absence of ties among one's alters rather than the presence determines the variation in power among actors in a network. The absence of such ties – or structural holes – safeguards the differences and diversity in an actor's ego network. Indeed, when an actor's alters are themselves unacquainted, these alters are more likely to provide access to diverse and non-redundant sources of information. Additionally, the absence of ties among egos alters puts ego in the powerful position of a broker that allows for enhanced control over the dissemination and use of information. Both Coleman's closure thesis (Ahuja 2000; Dyer and Nobeka 2000), and Burt's structural hole thesis (Baum et al. 2000; McEvily and Zaheer 1999) have been supported by empirical research.

A second line of research highlights the relational characteristics of a focal firm's network ties. Such characteristics include the strength, intensity and nature of network ties and are theoretically independent from the structural features of the tie. The arguments made in this stream of research are largely built on Granovetter's (1973) distinction between weak ties and strong ties. Granovetter showed that weak ties are more likely than strong ties to act as bridges to novel and diverse ideas, information and insights. Hence, the strength of weak ties stems from their greater likelihood to serve as a bridge between unfamiliar groups of actors, which subsequently increases the probability that such ties provide diverse rather than redundant ideas, information or insights. The weak tie thesis is widely supported (Constant et. Al. 1996; Levin and Cross 2004). Alternatively, strong ties have also been identified as carriers of important and valuable information (Krackhardt 1992; Bian 1997; Uzzi 1997; Ruef 2002). Krackhardt (1992) introduced the notion of philos to describe network ties that are characterized by intense interaction over longer time spans between two actors. This intensity and duration between two network partners facilitates trust but it also allows network partners to better understand each other and quickly respond to needs of the network partner. While this argument does not per se dismiss the arguments made in favor of weak ties, many research projects tend to position the two ideas as substitutes rather than complementary.

While empirically and theoretically different, both the structural and the relational approach distinguish between network ties that can provide diverse and non-redundant information and network ties that provide highly reliable information with little uncertainty. In both lines of research support has been provided for the benefits generated by non-redundant/weak ties and for the benefits generated by redundant/strong ties. In this paper I extend this debate by stressing the importance of contextual factors and by reconciling the theories on network configurations and theories on turbulence in technology. I turn to these theories next.

HOW TECHNOLOGICAL CHANGE MODERATES THE EFFECT OF NETWORK TIES

In an attempt to unravel the conundrum caused by the ambiguity in research findings on the benefits of interfirm networks, this study integrates ideas on network relations with theory on transitions in technologies upon which an industry is build. The reason for doing so is that one of the factors causing the ambiguity surrounding the effect of interfirm networks on firm performance may be found in the lack of attention for changing technological[50] conditions.

[50] In addition to technological change, changes in other dimensions such as institutions or the natural environment may also alter the effect of network relations.

Linking theory on network embeddedness and technological change is a logical extension to the literature on interfirm networks because throughout the evolution of an industry firms need to alter their capabilities and resources in order to become or remain successful. Thus, if firm success indeed depends on network partners, a transition from one technological paradigm to the other may require specific network configurations. Indeed, shifts in technological trajectories represent a change in the order of worth (Boltanski and Thévenot 1987; March 1991; Stark 2009). Orders of worth refer to the criteria of valuation and evaluation imposed upon a population of firms. Firms that are unable to meet the new criteria brought forward by the change in technology are likely to fail. As a result, throughout an industry's lifespan the introduction of new technologies strongly affect the entry and exit patterns of firms.

Typically, the evolution of a population of firms in an industry follows an S-curve, starting by just a few firms entering the industry, followed by a period of strong growth in the number of new entrants which, after some time, levels off and eventually decreases (Gort and Klepper 1982; Abernathy and Clark 1985; Klepper 1996). However, industries can also rejuvenate as a result of firms introducing new technologies. In this case, the new technology opens up new opportunities, and lowers barriers to entry, often leading to firms entering the industry (Tushman and Anderson 1986). Such changes in technology are based upon shifts in the design rules or parameters that underlie the technology used by firms in the industry. These rules or parameters determine the boundaries within which the product design can be carried out (Baldwin and Clark 2000). Research on the relation between firm survival and technological change can be roughly divided into two subfields. The first perspective is highly technologically deterministic and mainly focuses on the nature of the change in technology. The main argument is that the level of competence destruction or disruptiveness of the technological change determines which firms will survive and which firms will not (Tushman and Anderson 1986; Henderson and Clark 1990; Christensen 1997). The second perspective argues that firm internal characteristics, such as investments in the new technology, complementary assets, entry timing or experience, are the main drivers of heterogeneity in firm performance (Mitchell 1991; Tripsas 1997; Hill and Rothaermel 2003; King and Tucci 2002). This paper follows the approach of the latter perspective and provides a complementary insight due to its focus on how firm survival during and in between technologically turbulent periods is affected by the composition of the firm's network ties.

Powell, Koput and Smith-Doerr (1996, p. 117) already argued that "new technologies are both a stimulus to and the focus of a variety of cooperative efforts that seek to reduce the inherent uncertainties associated with novel products or markets." Consistent with this argument one might hypothesize that the composition of network ties of a firm has a changing effect on firm performance as new technologies are being introduced. This paper focuses on two main dimensions of network composition.

First, technological change influences the failure of firms and creates heterogeneity in the failure among network partners. As a result, technological change exerts strong influences on the value of a firm's network of collaboration partners (Glasmeier 1991). Network partners that are unable to cope with the new design rules brought about by the new technology may cease to exist and are no longer available as a source of competitive advantage for the focal firm. There are various reasons for why the failure of network partners may harm firms. For example, each unique combination of partnering firms is argued to generate relational rents (Dyer 1998). These relational rents can be viewed as the result of a competence that resides within the specific setting of the collaborative agreement. A prime example of such relational rents is the level of routinization. Similar to firm level routines, collaborative settings may also allow for the emergence of routines. As shown by evolutionary economists, routines function as a coordination and control device and 'fitter' routines are argued to increase survival (Nelson and Winter 1982). While relational rents arise between collaborating firms in any industry, this is especially so in cultural industries like the video game industry (Lampel, Lant and Shamsie 2000; Tschang 2007). The collaborative search for value added in cultural industries (Lampel et al. 2000) is largely tacit and routinized collaborative settings increases mutual understanding (Polanyi 1966; Nonaka 1994). Another reason may be that finding and assessing possible new substitute network partners is a costly and time consuming process (Podolny 1994; Beckman et al. 2004). The difficulty to find high level network partners and the ambition to maintain the same level of external competence may make firms vulnerable to the failure of firms in their ego network.

Moreover, the failure of a weakly tied network partner may entail different changes in the survival chances of firms than the failure of strongly tied network partners. Both sociologists and psychologists have provided detailed accounts on the differences between weak and strong ties and found that repeated exchanges between actors often lead to emotional attachment and mutual affection (Durkheim 1915; Zajonc 1968). Uzzi and Lancaster (2003) highlight the idea that strong ties allow actors to achieve familiarity levels that would not be possible among weakly tied actors. In line with this finding, other studies show that durable and intensive relationships allow for smoother transfer of information (Hansen 1999; Larson 1992; Bidwell and Fernandez-Mateo 2010). Along a different line of reasoning, Sorenson and Waguespack (2006) find that in the motion picture industry prior relations do not only increase the likelihood of repeating the interaction, but prior relations also increase the allocation of resources into the partnership. The study finds that the net effect (after controlling for the increase of allocated resources) of prior relations on the performance of firms was negative. In other words, in addition to smoother communication and increased levels of familiarity, the reinforcement and repetition of network ties may also generate a lock-in into the relationship.

The effect of tie strength on the performance of firms is likely to depend on the technological setting of the industry. In stable technological eras, the failure of strongly tied partners may be more detrimental than the failure of weakly tied firms. During these stable periods firms mostly benefit from exploiting their existing competences (March 1991) and the fact that strongly tied partners are more familiar with the focal firm than weakly tied partners, makes them better candidates to jointly improve these existing competences and technologies. Another reason why the failure of strongly tied network partners during stable periods might represent a more harmful event than the failure of weakly tied partners is that employees of a strongly tied failed firm can disclose more valuable information. As firms fail, their employees move to other existing companies or establish new companies which may exploit the knowledge that is transferred from the failed firm to the new firms. In other words, as relational rents increase with the duration and intensity of a collaboration, the loss of strongly tied network partners during technologically stable epochs is likely to represent a more harmful event than the loss of weakly tied network partners. I therefore propose:

HYPOTHESIS 1

DURING PERIODS OF TECHNOLOGICAL STABILITY THE FAILURE OF STRONGLY TIED NETWORK PARTNERS HAS A STRONGER POSITIVE EFFECT ON FIRM MORTALITY THAN THE FAILURE OF WEAKLY TIED NETWORK PARTNERS

In periods of technological turbulence the effect of partner failure on firm survival is likely to be different. Various studies have found that firms have the tendency to reinforce existing network ties in the face of uncertainty in the market (Podolny 1994; Beckman, Haunschild and Phillips 2004). If an increasing amount of time, investments and other resources are devoted to existing network ties, the initiation of new network ties becomes less likely. As Sorensen and Waguespack (2006) showed, firms can become locked in into existing relationships. Such lock in involves the routinization of opportunity identification or the routinization of problem solving (Nelson and Winter 1982). In periods that require identification and exploration of new ideas, stable and routinized behavior is likely to represent a weakness rather than a strength. In a similar line of reasoning, Rothaermel (2001) argued that in order to fully explore the opportunities provided by new technologies, firms often benefit from an unbiased approach provided by new network ties. Hence, if strongly tied partners manage to survive, firms are less likely to initiate ties with new firms. Then as a result, the failure of strong ties may actually provide benefits in technologically turbulent eras. The effect of failure of weakly tied partners on the survival of firms is expected to remain unaltered. Therefore I propose:

HYPOTHESIS 2

DURING PERIODS OF TECHNOLOGICAL TURBULENCE THE FAILURE OF STRONGLY TIED NETWORK PARTNERS HAS A NEGATIVE EFFECT ON FIRM MORTALITY AND THE FAILURE OF WEAKLY TIED NETWORK PARTNERS HAS A POSITIVE EFFECT ON FIRM MORTALITY

Second, in order to fully explore the boundaries of new technologies, access to diverse and divergent ideas allows firms to be more creative and more innovative. Indeed, new technologies prompt firms to explore the boundaries of these technologies (March 1991) and research on creativity and innovation has highlighted the idea that diversity rather than homogeneity guides firms in doing so. Building on Schumpeter’s (1942) notion of “neue kombinationen” it is argued that novelty comes from the recombination or rearrangement of existing ideas, technologies, strategies, genres, etc. (Stark 1996; 2009; Vedres and Stark 2010). Automobiles, for example, emerged after recombining knowledge of engine technology and carriage building, while rock-and-roll emerged out of rhythm and blues, folk, country and gospel (Schumpeter 1942; Flemming et al. 2007).

Because the underlying structures and principles of styles, ideas, technologies and genres are based on different rules, traditions and cognitive frameworks, recombination is most likely to occur in places where firms – which have cognitive boundaries – intersect and interact (Vedres and Stark 2010). At the firm level, relations to diverse external partners can serve as important conduits for the transfer and creation of new ideas. Relations to diverse partners can provide opportunities for knowledge sharing, learning and the creation of novel ideas. Also, being connected to many diverse network partners allow firms to compare among qualitatively different pieces of information. Since technological turbulence is associated with uncertainty about the future it raises the importance of comparing among different alternatives.

The measurement of diversity of network relations is far from straightforward. Until recently, diversity of network partners has mainly been proxied by studying the structure of network relations in which an actor is embedded. Both structural holes and weak ties are argued to provide diversity in ideas to firms because both types of linkages are assumed to connect two or more dissimilar groups. While this assumption may hold in most contexts, a recent stream of research calls for a more direct measure of diversity (Rodan and Galunic 2003; Flemming et al. 2007; Phelps 2010). Stirling (2007) argues that diversity is a system level variable that should take into account the variety of elements, the balance of elements and the disparity of elements in a system. An increase in variety, balance and disparity is argued to increase the diversity of a system. Thus, each firm's network is represented as a system and the firms in the network are the elements in this system. Following this line of reasoning, I propose:

HYPOTHESIS 3

DURING PERIODS OF TECHNOLOGICAL TURBULENCE, BEING CONNECTED TO DIVERSE NETWORK PARTNERS REDUCES THE LIKELIHOOD OF FIRM MORTALITY

Notwithstanding the benefits that diverse network partners can provide in eras in which exploration of new ideas yields high premiums, epochs of stable technological trajectories are likely to promote the benefits of more similar network partners. Indeed, the exploitation of existing ideas, rather than the exploration of new ideas involves the use of existing information to improve the efficiency of current activities that are yet mastered by the firm. In doing so, a set of more redundant and specialized network partners can incrementally improve these existing ideas and competences. In a similar line of reasoning, information theorists stressed that precise and reliable information can be obtained from multiple sources that can provide somewhat redundant pieces of information (Shannon 1957). Hence, access to such partners allows firms to make refinements to proven innovations and exploit prior exploration processes by providing more efficiency (March 1991). Therefore I propose:

HYPOTHESIS 4

DURING PERIODS OF TECHNOLOGICAL STABILITY, BEING CONNECTED TO NETWORK PARTNERS WITH DIVERSE EXPERIENCES INCREASES THE LIKELIHOOD OF FIRM MORTALITY

In sum, the previous discussion identifies how the effects of network composition on firm performance are dependent on changes in technological settings in the video game industry. This line of reasoning is largely related to March's (1991) discussion on exploration versus exploitation and extends this seminal work by relating it to network composition. Making the distinction between the effects of diversity of partners and the failure of differently tied network partners also highlights the difference between the level of routinization of a collaborative agreement and the value of network partners as repositories of knowledge and other resources (Amit and Schoemaker 1993). By applying these ideas to interfirm networks between video game developers and video game publishers in the global video game industry this paper sheds light on how the set of partnerships between developers and publishers affects the performance of these publishers. In the next section I will describe the subtleties of the empirical context in which the hypotheses are tested.

THE VIDEO GAME INDUSTRY

The analyses in this paper are based on information on firms producing video games. The video game industry is typically referred to as a creative industry to stress both the importance of creative human capital in the production process and the one-off nature of the final product (Tschang 2007). The success of video games is associated with great uncertainty. Nobody knows a priori whether a video game will be accepted and embraced or rejected and shunned by the larger audience (Caves 2002) and hits can easily be followed by flops. To become a success, a video game needs to capture the attention of a large audience and fulfill the needs of this audience. While marketing budgets and social influence among peers have a strong effect on the ability of a video game to capture the attention of consumers (DeVany and Walls 1999; Salganik et al. 2006), fulfilling the needs of consumers is more dependent on the intrinsic quality of the video game relative to other video games. Each video game differentiates itself from any other video game by introducing a unique set of game plays, perspectives, genre combinations, characters or graphics.

Similar to other creative industries, the video game industry consists of firms that generate creative content and firms that recognize, finance, and market the creative content (Caves 2000; Tschang 2007). The production of a video game is carried out as a project involving a development company and a publishing company, although development companies may publish their own games and publishing companies may set up in-house development studios in order to capture a larger percentage of the value added. Developers *"are charged with the creative development of a game code"* (Johns 2005, p. 169) by providing programming skills, artistic designs and insights on the gameplay[51] while publishers are responsible for managing, funding and marketing the video game project by providing the project management, market insights, marketing skills and financial capital (Tschang 2007).

[51] Gameplay is "the formalized interaction that occurs when players follow the rules of a game and experience its system through play" (Salen and Zimmerman 2003, p. 303).

The position of publishers as funders of the development of video game projects and the fact that publishers tend to be large, multinational firms makes them the more powerful node in the collaboration. Their power and the increasing investments needed to produce a good video game allows and forces publishers to heavily influence the type of game the developer makes. *"The publishers' greatest influence may be at the conceptualization or preconceptualization stage, when the publisher decides on the genre it wants, in effect subjugating the initial creative process to a rational decision"* (Tschang 2007, p. 994). Although the vast majority of publishers seek to exploit prior success and bring only incremental innovations to a game, some publishers also engage in a portfolio diversification strategy by hiring innovative independent studios for their projects (Tschang 2007).

In order to play a video game, one requires a video game console. Each of the video game consoles introduced in the industry can be categorized into chronological generations. While the technological specifications of the video game consoles within a generation show a strong resemblance, the technological specifications of consoles from different generations are highly dissimilar[52]. Each subsequent generation of consoles shows a significant improvement in technological specifications and allows the producers of video games to produce games that are significantly different than the games produced for the prior generation. In other words, the introduction of a new generation of consoles leads to a change in the design rules for video games (Baldwin and Clark 2000). Industry insiders have argued that the improvements in technology offered by the introduction of a new game console allowed for the production of significantly different video games. Todd Hollenshead, CEO of id Software claims that *"technology is a gating factor to the experience of playing games. Whether it is visual quality or character interactions, you have to have the processing power to make more sophisticated and interesting entertainment."* Chris Charla, executive producer of development of a large video game developer, argued that "every generation you see certain, break-out, new properties. It's because characters are designed around the limitations of the system." The VP of another large video game company stated that *"each transition to new generations of hardware has always been accompanied by the introduction of these new and original game concepts that become defining games for that particular generation"* (Gaudiosi 2005, p.1).

52 See figure 1 in the appendix for an overview of all consoles plus its technological specifications.

Video game developers, rather than video game publishers, are directly affected by the changes in technology. The creative processes undertaken by video game developers are all structured around the technological limits of a game console and shifts from generation to generation are therefore expected to require a modification of these structures. However, in order for video game developers to make their game into a success the game needs to be recognized, supported, reviewed and marketed by a video game publishers. Therefore, this study analyzes the performance of video game developers as a function of its network linkages with publishers.

Hence, the hypotheses proposed in the previous section are tested in the context of the collaboration between a developer and a publisher and how this partnership relates to the survival of the developer. The hypotheses on the failure of network ties do therefore focus on the failure of publishers and how this affects the survival of developers. I expect that the failure of a strongly tied publisher negatively affects the survival of developers in technologically stable periods, and that this effect is the opposite in technologically turbulent periods. Similarly, I expect that relations to diverse publishers benefit developers in turbulent eras, while the effect is reversed in stable eras.

DATA AND EMPIRICAL ANALYSIS

DATA DESCRIPTION

The analyses in this paper are based upon a unique, newly constructed database that contains information on all firms that developed or published one or more video games[53] for a video game console[54]. I constructed a longitudinal database that starts at the inception of the industry in 1972 and runs until the end of 2007. The database contains game level data on the publisher and developer involved in producing the game and the stylistic elements used in the game. I also collected firm level data such as years of production, number of games produced, location and pre-entry experience of video game developers and publishers.

The data is a compilation of various data sources. The starting point was the Game Documentation and Review Project Mobygames[55]. The Mobygames website is a comprehensive database of software titles and covers the date and country of release of each title, the platform on which the game can be played, and the name of the publisher and developer of the game. The database goes back until the inception of the industry in 1972, and the project aims to include all games that have ever been developed and published in the video game industry. To obtain data on entry, exit, location and pre-entry experience of firms and to control and monitor the quality of the Mobygames data I also consulted the German Online Games Datenbank[56]. This online database is complementary to the Mobygames database in that it provides more detailed information on the location of companies and backgrounds of entrepreneurs. In the rare case that neither of the two databases provided this information or in the rare case that the information in the two databases was contradicting, other online or hardcopy resources were consulted. By combining the Game Documentation and Review Project Mobygames and the Online Games Datenbank I was able to track down 1,559[57] firms - 1,301 developers and 190 publishers - that developed or published a total of 22,408 video games for a video game console.

Figure 5.1 presents the annual number of firms entering and exiting the video game industry. In the first eight years of the industry nearly all games were developed and published by the manufacturer of the console and both population and entry and exit of firms was low. In 1980 the business model changed when Activision, Inc., an Atari spin off, entered the video games industry. Contrary to the dominant practice, Activision Inc. focused solely on developing and publishing of video games. After the founding of Activision Inc. many other game developers and publishers followed. Many of these new entrants were North American firms. However, with the introduction of the Nintendo Entertainment System in Japan in 1983, a high number of Japanese firms entered the industry.

In 1983 the US demand for video games and video game consoles dropped and both entry and exit decline and remained low until 1985. In 1985 entry starts rising again and this rise of entry coincides with the release of the Nintendo Entertainment System (NES) in the US and in Europe[58]. After the release of the NES the industry population continued to grow for many years, after which the population growth came to a halt in 1994.

Video game consoles are categorized into six generations. I follow Forster's (2005) categorization, who categorizes video game consoles based on the instruction word length (in bits) of the central processing unit (CPU), the clock speed of the CPU and the Random Access Memory (RAM). Figure 5.2 presents the number of games that are produced for a specific generation in each year. At the start of each

[53] Throughout the paper, the term 'video games' is used to describe games played using a video game console linked to a television or monitor, rather than PC (Personal Computer) games or other digital hardware.

[54] 'A video game console is an interactive entertainment computer or electronic device that produces a video display signal which can be used with a display device (a television, monitor, etc.) to display a video game. The term video game console is used to distinguish a machine designed for consumers to buy and use solely for playing video games from a personal computer, which has many other functions, or arcade machines, which are designed for businesses that buy and then charge others to play' (http://en.wikipedia.org/wiki/Video_game_console, 04/23/2010). The consoles in the database include the Odyssey, Channel F, Atari 2600, Odyssey 2, Intellivision, Atari 5200, ColecoVision, Vectrex, NES, Sega Master System, Atari 7800, TurboGrafx-16, Genesis, TurboGrafx CD, Neo Geo, SNES, CD-I, Sega CD, 3DO, Amiga CD32, Jaguar, Neo Geo CD, PC-FX, Saturn, Sega 32X, PlayStation, Nintendo 64, Dreamcast, GameCube, PlayStation 2, Xbox, Xbox 360, PlayStation 3, and Wii.

generation a number of consoles is released and during these periods new video game developers and publishers enter the industry and produce an increasing number of video games.The shift from generation 1 to generation 2 is characterized by the introduction of Dynamic Random Access Memory (DRAM). The introduction of DRAM significantly improved the processing speed of computers and game developers were able to create more advanced game codes. Also, the shift from generation 1 to generation 2 marked the transition from joystick to video game controllers. The controllers of generation 2 video game consoles allowed for more sophisticated movements on the screen. These two innovations lead to the introduction of three dimensions[59] (3D) and the introduction of side-scrolling[60] and the subsequent introduction of narrative gameplays, fantasy worlds, and adventurous action. The increased game development opportunities led to the release of some of the most successful video games in the history of video gaming, such as Mario Bros. and Sonic the Hedgehoc (Kent 2001). The shift from generation 2 to generation 3 was characterized by the introduction of the CD-ROM. The CD-ROM provided advantages over cartridges, such as lower costs, higher loading speed and the ability to contain more information. Producers of video games were therefore able to produce games that required large volumes of bits, allowing them to use more advanced graphics and more extensive gameplays. The shift from generation 3 to generation 4 was marked by the entry of Sony with the Sony Playstation. The consoles in the fourth generation were characterized by strongly improved processors which allowed for the introduction full 3D video games. Additionally, this shift changed the industry's prevalent business model. In order to produce a video game for a particular console, a license is needed from the console manufacturer and only few firms have a license for all consoles in the market. Therefore, the vast majority of all firms produce games for only one or two consoles per generation. While in generation 2 and generation 3 console manufacturers were cautious in granting licenses, the entry of Sony and its introduction of the Sony Playstation in generation 4 marked the start of a different regime. As a result, many new firms entered the industry and a wide variety of games became available for the generation 4 consoles. The shift from generation 4 to generation 5 was mainly accompanied by the strong improvements in graphic representation and games became visually far more advanced (Kent 2001; Forster 2005). A prime example of a game that fully exploited the extended limits of the video game console was Halo, produced by Bungie Studios and Microsoft Game Studios. Halo was graphically very advanced and became an instant hit. After two generations of dominance by Sony's Playstation, the start of generation 6 marked the comeback of Nintendo, with its release of the Nintendo Wii. The innovations allowed by the introduction of the Nintendo Wii are mainly based on the ability of active gaming, meaning that the user is able to physically interact with the console and other players. Figure 5.3 plots the number of consoles in the market in each year. Each console enters the figure in its release year and exits the figure in the year after it is abandoned by its manufacturer.

The main peaks in the graph – 1983, 1991, 1994, 2001 and 2006 – coincide with the introduction of the most popular consoles in each generation: the NES, the SNES, the Playstation, the Playstation II and the Wii. On average, the lulls in between two peaks last for about 5 years.

55 The Game Documentation and Review Project Mobygames can freely be consulted at www.mobygames.com. The Mobygames database is a catalog of 'all relevant information about electronic games (computer, console, and arcade) on a game- by-game basis' (www.mobygames.com/info/faq1#a). The information contained in Moby-Games database is the result of contribution by the website's creators as well as voluntarily contribution by Moby-games community members. All information submitted to Moby-Games is checked by the website's creators and errors can be corrected by visitors of the website.

56 "Online Games Datenbank" can freely be consulted at www.ogdb.de

57 The Mobygames database reports the parties credited on the video game. However, two different parties do not always imply that there are two separate firms involved. In many of the cases, a label or subsidiary of a parent firm is not correctly indicated to be part of a larger legal entity. Therefore, I meticulously collected data on all ownership structures in the video game industry and also how these structures changed over time as a result of mergers or acquisitions. Initially, the Mobygames database identified 2561 unique names of credited entities, a number that I reduced to 1560 by taking into account ownership structures.

58 Nintendo had released its Nintendo Famicom in Japan two years earlier and this introduction gave rise to the number of entrants in Japan.

59 While technical innovations in the RAM theoretically allowed for 3D, most of the video games in GEN 2 were Pseudo 3D. Pseudo 3D uses 2D graphics and adds depth and layers to represent 3 dimensional worlds (MacEachren 1995).

60 In side-scrolling games the action is taken out of the single screen view and placed in an environment that can be explored by moving to the side of the screen. The action is viewed from a side view camera angle and in nearly all side-scrolling games the purpose is to move from the left to the right (Kent 2001).

NETWORK DEFINITION

I used information on the co-production of video games to construct the interfirm network. A tie between two firms is created if these firms have co-produced a video game. While some video games are both published and developed by one firm, the dominant strategy is to co-produce a video game with two firms (see figure 5.4).

Since the early 1980s an average of about 60% of all video games are co productions involving an independent publisher and developer. I used this co production data to construct a network in which the firms represent the nodes and the co-production of a video game represents an edge. A typical[61] co-production of a video game entails intensive interaction between publisher and developer of the game. In the first phase, both firms engage in an extensive negotiation about the characteristics that will eventually set the game apart from competing games. After that, the developer will start the development of the game code, while constantly updating the publisher and discussing challenges and opportunities After the game is produced, the game is thoroughly tested and reviewed by professional testers. Once the video game is released, the publisher and developer continue to collaborate mainly to deal with bugs in the video game or provide customer service.

I constructed yearly cumulative adjacency matrices based on a five year moving window. The presence of a tie between two firms in the network implies that these firms have collaborated in any of the years t-4 to year t. Thus, the adjacency matrix follows a five year moving window in which collaborations that were initiated more than five years ago are dropped from the matrix. A particular matrix entry X_{ij} corresponds to a sum, for the five-year period, of the number of times a developer in row *i* co-produced a video game with a publisher in column *j*. Thus, the value of X_{ij} corresponds to the frequency of ties between developer *i* and publisher *j*. The networks include a total of 7,494 unique games creating a total of 7,442 firm pairs. The use of a 5 year moving window was inspired by research on alliances (Kogut 1988; Gulati 1999). Although collaborations in the video game industry do not fully resemble the typical alliance, I argue that the use of a five year moving window is appropriate for the video game industry for two reasons. First, the development of a video game usually spans several months and sometimes even years, followed by a period in which publisher and developer communicate about

FIGURE 5.1
Firms entering and exiting the video game industry per year

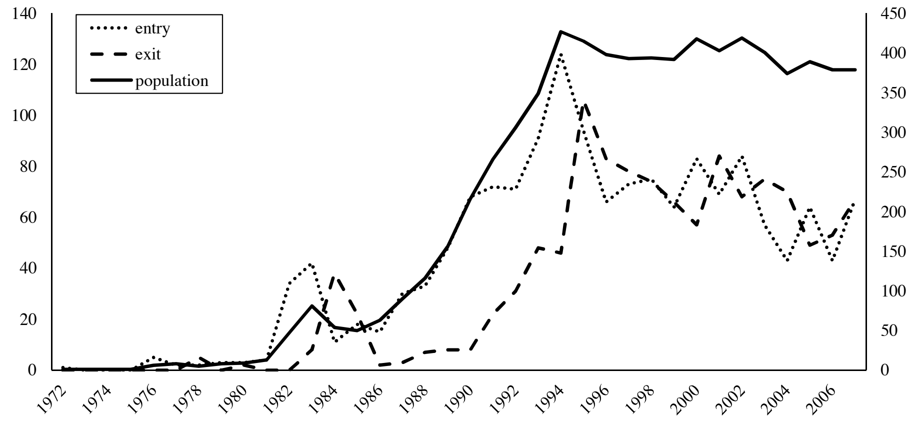


FIGURE 5.2
Number of games produced per generation

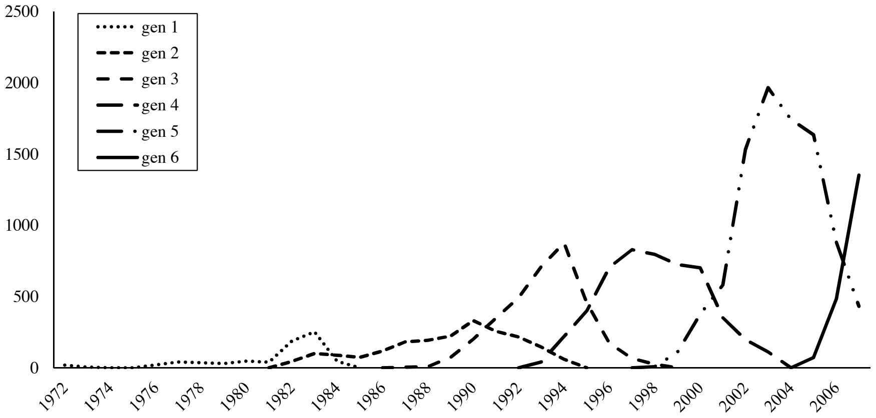
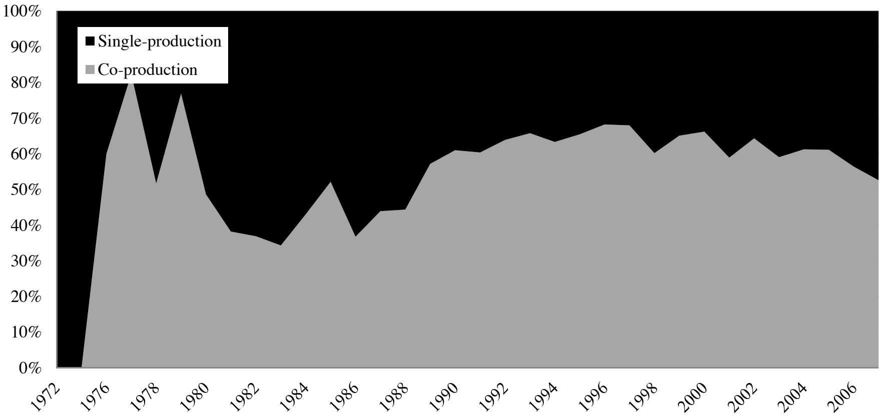


FIGURE 5.3
Total number of consoles and turbulence in the market per year

FIGURE 5.4
Co-productions versus single-productions as a share of the total



61 Not all video game projects are organized in a similar fashion. While in some projects the interaction between publisher and developer is very intensive, other projects are more loosely organized. However, orienting interviews with representatives of both publishers and developers revealed that the large investments required to successfully release a video game urge these firms to intensify the interaction.

sales, bugs, and consumer feedback (Kent 2001). Second, firms may informally consult network partners from their recent past to gain insights on how to deal with the challenges and opportunities provided by introductions of new technologies. Unless network ties are renewed these benefits will be depreciated to zero after five years (Dyer and Singh 1998).

EMPIRICAL ANALYSIS

To test the hypotheses developed in the theoretical framework I employ hazard rate methodology. Hazard rate methodology is a member of the event history analysis class and can be used to explain why firms are at higher risk of experiencing an event than other firms (Hosmer and Lemeshow 1999). In this paper, the data on firm survival is dichotomous and is updated annually and can therefore be correctly modeled through the use of Gompertz models for panel data. Nonparametric analysis showed that the hazard rate declines monotonically with the age of firms, which suggests that a Gompertz specification better fits the data than any of the alternatives (Carroll et al. 1996; Klepper 2002; Argyres and Bigelow 2007). Specifying the model as such allows for the incorporation of time-varying covariates. The model can be formalized as follows:

$$h(\tau) = \exp(\beta_0 + \beta' c) \exp[(\gamma_0 + \gamma' x)\tau],$$

where $h(\tau)$ is the hazard of a firm at age τ, vector *c* contains the covariates that affect the hazard proportionally at all values of duration, vector *x* contains the covariates that condition how age affects the hazard of a firm, β_0 and γ_0 are scalar coefficients, and β' and γ' are vectors of coefficients. In order to control for the robustness of the coefficients and standard errors, I also estimated the models using a logit specification and a Poisson specification with clustered standard errors. Both additional specifications yielded results statistically similar to the Gompertz model.

The data on firm failure and the characteristics that are hypothesized to affect firm failure are all updated annually. The dataset does therefore take a panel structure making the firm year the unit of analysis. The 1,301 developers have a minimum of 1 firm year and a maximum of 28 firm years, which adds up to 7,864 observations. The dependent variable is lagged by one year. The data that are used in the empirical analyses are complete for all firms and for all years, which implies that no missing values are generated.

DEPENDENT VARIABLE

The dependent variable $h(\tau)$ represents the probability that the event of hazard will occur, given that it had not occurred in any prior year, and does therefore indicate whether a firm failed to exist during a given year. To construct the variable, dummies are created for each firm year, which take the value of 0 if the firm was still alive at the end of the year and 1 otherwise. In addition to exits as a result of bankruptcy, a total of 151 firms exited the industry due to the fact that they were acquired by another firm. These acquired firms are treated as right censored exits (Klepper 2002).

62 Recent implies that the firm i and its partner j have at least collaborated once in year t to year t-4.

INDEPENDENT VARIABLES

The variables *Weak Tie Failure* and *Strong Tie Failure* are both variables that count the number of bankrupt firms that firm *i* has co-produced a game with in the last five years. In particular, *Weak Tie Failure* counts the number of recent[62] partners to which focal firm *i* is weakly tied and have gone out of business in the last 5 years. Similarly, *Strong Tie Failure* counts the number of recent partners to which focal firm i is strongly tied and have gone out of business in the last five years. I calculated the strength of a tie between focal firm i and network partner j by observing the five years prior to the last co-production. If firm i and network partner j co-produced more than one video game in the five years prior to the last co-production, the partner was marked as a strong tie. Other partners were coded as weak ties. So, *Weak Tie Failure* is defined as:

$$Weak\ Tie\ Failure_{it} = \sum_{w=1}^{N} X_{iw,t}$$

where w represents a failed partner to which firm i has a weak tie X. Similarly, *Strong Tie Failure* is defined as:

$$Strong\ Tie\ Failure_{it} = \sum_{s=1}^{N} X_{is,t}$$

where s represents a failed partner to which firm i has a strong tie X. To illustrate this measure; LucasArts, a company that released its first game in 1989, collaborated with 21 partners from 1991 until 1995. A total of 10 partners exited the industry and 6 of them were weak ties while 4 of them were strong ties. Therefore, in 1995 LucasArts has a *Partner Failure Weak* score of 6 and a *Partner Failure Strong* score of 4.

The *Network Diversity* variable measures the diversity of firm i's ego network with respect to the stylistic elements covered by firm i's partners $a, \ldots N$. Stylistic elements such as genres, perspectives, and age ratings represent the production skills held by a firm. In other words, a firm that has experience in producing 3rd person perspective action games that are suitable for person's over 16 is expected to have different competences than a firm that has experience in producing top-down perspective puzzle games for children. In calculating the values of the variable I follow Stirling (2007), who recently theorized about the measurement of diversity. He argues that diversity is a system level property and that the level of diversity depends on the *variety, balance* and *disparity* of all elements in a system. In line with this definition and all else being equal, i) the greater the variety, the greater the diversity; ii) the more even is the balance, the greater the diversity; and iii) the more disparate the represented elements, the greater the diversity (Stirling 2007). Following this definition I first calculated the disparity between pairs of firms in terms of their product portfolio's using Jaffe's (1986) similarity index. I measured the distribution of a firm's games across all stylistic elements by adopting a five-year moving window. This distribution located each firm in a multidimensional product space, captured by a K-dimensional vector. By doing so, I assume that the distribution of a firm's games over the set of stylistic elements reflects the distribution of the firm's operational knowledge. The disparity between firm i and j is given as:

$$d_{ijt} = 1 - \left[\sum_{k=1}^{K} f_{ikt}\, f_{jkt} \Big/ \left(\sum_{k=1}^{K} {f_{ikt}}^2 \right)^{1/2} \left(\sum_{k=1}^{K} {f_{jkt}}^2 \right)^{1/2} \right]$$

in which d_{ijt} is the disparity between the portfolio of firm i and firm j in time period t and f_{ikt} is the fraction of stylistic element k in the vector of all stylistic elements K covered by firm i in time period t. Hence, d_{ijt} ranges between 1 and 0, with 1 indicating maximum dissimilarity and 0 indicating maximum similarity. In order to measure the variety and the balance, I constructed valued adjacency matrices for each time period using a moving window. Based on these matrices I was able to identify the number of partners in *i*'s ego network – variety – and the distribution of the number of interactions between *i* and each of its partners *a, …, N – balance.* By doing so, I was able to calculate the *Network Diversity* variable:

$$Div_{it} = \sum_{a=1}^{N} d_{ant} * p_{at} * p_{nt}$$

Where *a, …, N* is the range of all *i*'s partners in time period *t,* d_{ant} is a's disparity from *n* and p_{at} is the strength of partner *a*'s presence in *i*'s network – which is given by the number of interactions between *i* and its partner *a*. This measure takes into account all three elements that contribute to the diversity of a firm's set of network partners.

Console Turbulence needs to reflect the unoccupied area in the exploration space imposed on video game developers following the introduction of a new technology. Each new generation of consoles provides an exploration space that can be occupied by firms in the industry. The amount of available area in this space is a function of the number of consoles in the market in year *t,* the 'newness' of the consoles and its technological disparity. A good measure of turbulence should therefore include these three elements. Indeed, the larger the number of consoles in the video game industry, the wider the technological boundaries that video game developers can explore. Also, the longer a console is present in the market, the more these technological limits are yet explored of the console. And finally, the higher the technological disparity of the consoles in the market, the larger the exploration space available for video game developers. Following this line of reasoning, the variable *Console Turbulence* is defined as follows:

$$Turb_t = \sum_{k=1}^{K} \frac{1}{(t+1) - k_r}$$

where k_r represents the release year *r* of console *k* and *t* represents the current year. Thus, by summing the number of consoles, discounting for their age and taking into account the lifespan of a console, the variable *Console Turbulence* captures the unoccupied area in the exploration space and the subsequent uncertainty faced by video game developers.

CONTROL VARIABLES

The variable *Spinoff* is a 1-0 dummy equal to 1 for firms that were founded by former employees of incumbent firms in the video game industry. In some cases, the spinoff was formed as a result of conflict between the employee and the management of the firm that employee worked for. In other cases, the employee simply pursued a potentially more profitable career path or needed to generate income after the bankruptcy of its former employer. *Experienced Firm* is also a 1-0 dummy equal to 1 for firms that diversified from industries other than the video game industry and for firms that were founded by entrepreneurs that previously headed or owned a firm in another industry. These entrepreneurs were typically former CEOs, CFOs or other types of leading managers. The reference group here comprises all other startups. This group of firms includes recently graduated entrepreneurs that had no former business affiliation and lower level employees of firms outside the industry, who decided to start a venture in the video game industry. The theoretical justification for making this three firm-type division stems from the idea that spinoffs and experienced firms profited from the experience that the founder gained either as an employee in another video game firm or as a leading manager in another industry (Klepper and Simons 2000; Klepper 2002). Also, this variable controls for possible endogeneity problems associated with the selection of network partners. The variable *Incumbent* is a dummy variable equal to 1 if firms entering a new generation of video games have experience in the production of video games for the prior generation. *Subsidiaries* is a count variable counting the number of subsidiaries that firm *i* has in year *t. Number of Games* is a count variable that measures the number of games produced per year per firm. *Firm Diversity* measures firm *i*'s diversity in year *t* using a modified Herfindahl index[63] (Hall 2002; Phelps 2010).

$$Firm\ Diversity_i = \left[1 - \sum_{s=1}^{S} \left(\frac{N_{si}}{N_i}\right)^2\right] * \frac{N_i}{N_i - 1},$$

where N_i is the number of stylistic elements covered by firm *i* in the past five years and N_{si} is the number of times that stylistic element *s* is covered by firm *i*'s in the past five years. This variable ranges from 0 to 1 in which 1 represents maximum diversity. *Firm Degree* measures the degree of firm *i* in a five year moving window. *Full Developer* is a 1-0 dummy variable equal to 1 if firm *i* only develops video games. Firms that also published video games were coded 0. Variables *G1, G2, G3, G4* and *G5* are annually updated dummy variables equal to 1 if firm *i* produces games for generation 1, generation 2, generation 3, generation 4 and generation 5 respectively. Generation 6 is the reference group and each of the dummies is mutually exclusive. *Population* is an industry level variable that measures the total number of firms that are active in any given year. *Games Total* is a yearly measure of the total number of games produced in the video game industry. The three variables *USA, Japan,* and *UK* are dummy variables taking the value of 1 if the main office of the firm is located in any of these three countries and 0 otherwise. The choice of selecting these three countries is based on the fact that these are by far the largest countries both in terms of number of firms and number of games produced. These firm level variables also control for the fact that qualitatively different firms show different positioning patterns in the network.

[63] I also calculated firm diversity as an entropy measure. The entropy measure and the adjusted Herfindahl showed a high level of correlation (0.94) and both measures had similar effects on the dependent variable.

RESULTS

Table 5.1 provides descriptive statistics and correlations for all variables used in the analysis. *Network Diversity, Firm Degree and Number of Games* show fairly high levels of correlation. This high correlation suggests that firms with diverse networks produce many games and are in general connected to many firms which. To ensure that these high levels of correlation did not alter the results, I calculated the variance inflation factors for all variable showing correlations that exceed 0.5. These factors indicated that it is unlikely that the estimations will be affected by any serious problems of multicollinearity.

The results of the Gompertz regression model estimations are presented in table 5.2. The model specified in the first column only includes the control variables. Both the spinoff dummy and the experienced firm dummy are negative and significant showing that spinoffs and experienced firms are less likely to fail than other entrants. This result is in line with previous findings (see for example Klepper 2002). The incumbent dummy is negative and significant which indicates that firms that had already experienced a shift from one generation to the other showed significantly lower hazards than firms that did not have any prior experience with technology shifts. Age – represented by the τ – has a positive impact on the likelihood of failure, indicating that as firms grow older they are more likely to leave the industry. The relation between the incumbent variable and the age variable may reflect a non-linear bell-shaped relation between firm age and firm failure; young firms, as well as old firms are likely to fail. Firms of medium age are among the best performers[64]. The number of subsidiaries that a firm has is negatively related to the likelihood of failure. There are various explanations for this finding. First, if the number of subsidiaries is indeed a good proxy for firm size, it provides organizational slack that enables large firms to survive while smaller firms fail (Pfeffer and Salancik 1978). Second, multiple locations can serve as observation units to identify and attract skilled workers. Third, multiple locations can serve as laboratories to explore best practices which can subsequently be implemented in the other locations.

64 Note that age enters the model through the x vector. It measures the number of years elapsed since the firm entered the video game industry. This variable controls for possible learning and selection effects in the network variables.

The variable Number of Games is positive but not significant indicating that producing many games, ceteris paribus does not allow firms to survive while firms producing just a few games fail. Firm Degree has a clear negative effect on the likelihood of failure. This implies that developers that are connected to many publishers are more likely to survive than developers that are connected to only few publishers. The reason for this finding may be that publishers are the more powerful nodes in the dyad and can easily cut ties with one developer and initiate ties with another. Therefore, developers that are well connected can redistribute their interests after being cut off by a publisher. Firm Diversity has a positive effect on firm failure. In other words, firms that are more diverse in terms of the stylistic elements that they cover are more likely to fail. There are at least two different interpretations of this finding. First, developers covering a wide range of stylistic elements may be difficult to assess for publishers seeking ties with new developers. This argument is in line with Zuckerman (1999) who argued that ambiguous reputation can decrease performance. Second, the coverage of one stylistic element competes with the coverage of other stylistic elements and the extent to which a developer can fully master the skills associated with a stylistic element may be lowered by the coverage of many other elements. The variable Full Developer is positive and significant. This finding can be interpreted as a clear advantage for developers that also publish games. Not only do they spread their risks over multiple activities, such firms can also use their experience acquired through the publishing activities into their development activities and vice versa. The generation dummies *G1, G2, G3, G4* and *G5* are all positive but only *G1, G3* and *G4* are significant at the 1% level, 5% level and 5% level respectively. Since generation 6 represents the reference category, this implies that firms were more likely to fail in generation 1, 3 and 4 than in generation 6. The size of the population is weakly, but positively related to the likelihood of failure. An increase in the number of firms competing in the industry negatively affects the life chances of any firm in the industry. The effect of the USA country dummy positive and significant, indicating that firms in the USA experienced a higher likelihood of failure than firms in other countries. The other two country dummies, UK and Japan, show a negative effect, but only Japan is significant at the 5% level. Thus, firms from the US show higher hazards than firms from other countries in the rest of the world, while this is not the case for firms from the UK or Japan.

In model 2 I add the partner failure variables, the network diversity variable and the console turbulence variable. Both Weak Tie Failure and Strong Tie Failure are positively related to the likelihood of failure and both variables are statistically significant. This result indicates that in general the failure of partners harms the

TABLE 5.1
Descriptive statistics and correlations

Variables	Mean	SD	Min	Max	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
1 Network diversity	150.58	1262.53	0.00	29457	1.00																				
2 Strong tie failure	0.15	0.71	0	15	0.64	1.00																			
3 Weak tie failure	0.44	1.30	0	23	0.49	0.62	1.00																		
4 Console turbulence	3.30	1.21	0	6	-0.04	-0.05	-0.04	1.00																	
5 Spinoff	0.32	0.46	0	1	-0.05	-0.08	-0.08	-0.11	1.00																
6 Experienced firm	0.25	0.43	0	1	0.15	0.19	0.18	0.00	-0.39	1.00															
7 Incumbent	0.43	0.50	0	1	0.13	0.20	0.26	-0.05	-0.04	0.12	1.00														
8 No. of subsidiaries	0.72	2.68	0	34	0.68	0.58	0.57	-0.04	-0.10	0.25	0.22	1.00													
9 No. of games	3.92	11.99	0	228	0.78	0.59	0.52	-0.05	-0.07	0.23	0.23	0.78	1.00												
10 Firm degree	3.52	6.91	0	90	0.73	0.75	0.79	-0.01	-0.08	0.24	0.36	0.75	0.77	1.00											
11 Firm diversity	0.75	0.38	0	1	0.06	0.10	0.16	-0.03	-0.01	0.07	0.34	0.11	0.15	0.24	1.00										
12 Full developer	0.54	0.50	0	1	-0.12	-0.17	-0.25	-0.07	0.25	-0.33	-0.25	-0.25	-0.20	-0.27	-0.11	1.00									
13 Generation 1	0.02	0.14	0	1	-0.02	-0.02	-0.03	-0.05	-0.08	0.10	-0.12	-0.03	-0.01	-0.06	-0.09	-0.08	1.00								
14 Generation 2	0.12	0.33	0	1	-0.04	-0.04	-0.07	0.01	-0.11	0.14	-0.22	-0.05	-0.06	-0.10	-0.06	-0.15	-0.05	1.00							
15 Generation 3	0.20	0.40	0	1	-0.04	-0.05	-0.04	0.51	-0.11	-0.01	-0.03	-0.05	-0.05	-0.03	0.00	-0.07	-0.07	-0.19	1.00						
16 Generation 4	0.32	0.47	0	1	-0.02	0.00	0.00	0.04	-0.02	-0.04	0.02	-0.04	-0.06	0.00	0.02	0.03	-0.10	-0.25	-0.35	1.00					
17 Generation 5	0.29	0.46	0	1	0.05	0.06	0.06	-0.45	0.20	-0.08	0.14	0.06	0.09	0.07	0.06	0.18	-0.09	-0.24	-0.32	-0.44	1.00				
18 Firm population	355.43	95.81	1	427	0.04	0.04	0.08	0.11	0.15	-0.20	0.19	0.05	0.03	0.10	0.12	0.23	-0.46	-0.65	-0.01	0.33	0.26	1.00			
19 USA	0.30	0.46	0	1	0.03	0.02	0.02	0.01	0.13	-0.01	-0.09	0.04	0.03	0.01	-0.06	0.07	0.16	0.04	-0.04	-0.04	-0.01	-0.11	1.00		
20 Japan	0.40	0.49	0	1	0.01	0.02	0.00	0.02	-0.15	0.11	0.16	-0.02	0.01	0.02	0.09	-0.28	-0.09	0.08	0.09	-0.01	-0.09	-0.05	-0.54	1.00	
21 UK	0.15	0.36	0	1	-0.03	-0.04	-0.02	0.02	0.09	-0.14	0.01	-0.03	-0.02	-0.01	0.00	0.14	-0.06	-0.09	-0.03	0.09	0.03	0.12	-0.27	-0.35	1.00

focal firm. Moreover, the coefficient of Strong Tie Failure is more than two times the size of Weak Tie Failure which means that the failure of strongly tied partners is more detrimental than the failure of weakly tied partners. The Network Diversity variable is negative but not significant. Thus, being connected to a set of diverse network partners does not alter the survival of firms. Console turbulence has a negative effect on the firm hazard, but the effect is not statistically significant.

In model 3 and 4, the interaction effects between Weak Tie Failure and Console Turbulence and Strong Tie Failure and Console Turbulence are added. The statistically significant and negative interaction between console turbulence and Strong Tie Failure indicates that failure of strongly tied network partners harms developers in stable periods while it actually benefits firms in turbulent time frames. As expected, this finding is in line with hypotheses 1 and 2. The interaction effect between Weak Tie Failure and Console Turbulence is statistically not significant while the main effect remains unaltered. Hence, the failure of weakly tied partners is detrimental for firm survival irrespective of the technological turbulence in the video game industry.

In model 5 an interaction effect between Network Diversity and Console Turbulence is added to the model. While the interaction effect is negative and significant, the main effect of Network Diversity is positive but not significant. An F-test for the interaction and the two main effects shows that the coefficients are jointly significant at the 5% level. The direction of the interaction effect and the main effects may be interpreted as follows: firms that have diverse network partners clearly benefit from these partners in eras of technological turbulence. However, in eras of technological stability, being connected to a set of diverse partners does not alter the survival chances of the focal firm. This finding is partly in line with the expectations laid out in hypotheses 3 and 4.

DISCUSSION AND CONCLUSION

DISCUSSION

The findings of this study highlight the importance of technological turbulence in analyzing the effects of network composition on firm survival. In contrast to the vast majority of studies that focus on interfirm networks, the current paper deals with an industry that is characterized by periods of technological stability and periods of high levels of technological change. Therefore, this study helps to increase our understanding of the role of network linkages in a highly competitive, rapidly changing industry: the global video game industry. Similar to other creative industries, the video game industry is characterized by high levels of project-based collaboration and the strong reliance of the industry on changing technologies makes these project-based collaborations critical for the survival of the developers of video games. By studying six consecutive generations of products in which the old hardware technology was replaced by new dominant hardware technology, the paper answers questions on how firm networks affect firm survival in changing technological settings in which these firms face changing challenges and opportunities.

One of the main findings of the study holds that the effect of exit of a developer's publishing partners from the industry is moderated by the technological turbulence in the industry. During periods of low technological turbulence, the failure of strongly tied publishers negatively affects the survival of developers. This finding is in line with prior studies in management science and economic sociology literature which have shown that durable and intensive relationships allow for smoother transfer of information and that such strong ties do therefore function well as

TABLE 5.2
Coefficient estimates of the Gompertz hazard model, Robust standard errors: **≤ 0.01, *≤ 0.05

VARIABLES	1	2	3	4	5
NETWORK DIVERSITY * CONSOLE TURBULENCE					-0.001 *
					0.000
STRONG TIE FAILURE * CONSOLE TURBULENCE				-0.196 **	
				0.074	
WEAK TIE FAILURE * CONSOLE TURBULENCE			-0.039		
			0.031		
NETWORK DIVERSITY		-0.001	-0.001	-0.001	0.001
		0.000	0.000	0.000	0.001
STRONG TIE FAILURE		0.321 **	0.323 **	0.879 **	0.323 **
		0.078	0.078	0.217	0.078
WEAK TIE FAILURE		0.125 **	0.246 **	0.143 **	0.133 **
		0.045	0.104	0.047	0.046
CONSOLE TURBULENCE		-0.072	-0.058	-0.053	-0.060
		0.037	0.039	0.038	0.038
SPINOFF	-0.440 **	-0.432 **	-0.431 **	-0.433 **	-0.429 **
	0.077	0.077	0.077	0.077	0.077
EXPERIENCED FIRM	-0.298 **	-0.302 **	-0.302 **	-0.304 **	-0.296 **
	0.091	0.091	0.091	0.091	0.091
INCUMBENT	-0.775 **	-0.716 **	-0.716 **	-0.713 **	-0.718 **
	0.094	0.095	0.095	0.095	0.095
NUMBER OF SUBSIDIARIES	-0.084 **	-0.079 **	-0.081 **	-0.082 **	-0.077 **
	0.038	0.041	0.041	0.041	0.041
NUMBER OF GAMES	-0.012	0.005	0.005	0.005	0.006
	0.010	0.010	0.010	0.010	0.010
FIRM DEGREE	-0.013	-0.063 **	-0.064 **	-0.065 **	-0.054 **
	0.013	0.019	0.019	0.019	0.019
FIRM DIVERSITY	1.733 **	1.782 **	1.769 **	1.771 **	1.770 **
	0.304	0.301	0.301	0.301	0.303
FULL DEVELOPER	0.527 **	0.535 **	0.534 **	0.533 **	0.537 **
	0.082	0.083	0.083	0.083	0.083
GENERATION 1	1.707 **	1.746 **	1.734 **	1.725 **	1.715 **
	0.368	0.379	0.379	0.379	0.379
GENERATION 2	0.348	0.452	0.448	0.439	0.416
	0.277	0.287	0.287	0.287	0.287
GENERATION 3	0.490 *	0.571 *	0.567 *	0.553 *	0.544 *
	0.239	0.246	0.246	0.246	0.246
GENERATION 4	0.516 *	0.475 *	0.474 *	0.469 *	0.458 *
	0.232	0.232	0.232	0.232	0.232
GENERATION 5	0.298	0.214	0.213	0.208	0.192
	0.230	0.231	0.231	0.231	0.231
FIRM POPULATION	0.002 *	0.002 *	0.002 *	0.002 *	0.002 *
	0.001	0.001	0.001	0.001	0.001
USA	0.312 **	0.340 **	0.336 **	0.335 **	0.338 **
	0.096	0.096	0.096	0.096	0.096
JAPAN	-0.227 *	-0.195	-0.198	-0.200	-0.197
	0.103	0.103	0.103	0.103	0.103
UK	-0.001	0.042	0.039	0.035	0.040
	0.113	0.114	0.114	0.114	0.114
CONSTANT	-4.555 **	-4.602 **	-4.623 **	-4.649 **	-4.600 **
	0.486	0.485	0.485	0.485	0.486
T	0.075 **	0.067 **	0.067 **	0.066 **	0.066 **
	0.011	0.012	0.012	0.012	0.012
NUMBER OF OBSERVATIONS	6,495	6,495	6,495	6,495	6,495
NUMBER OF FIRMS	1,301	1,301	1,301	1,301	1,301
LOG-LIKELIHOOD	-1684.008	-1666.788	-1665.967	-1663.114	-1663.875

mechanisms to improve upon existing ideas (Ruef 2002). Indeed, in periods of low technological turbulence, the ideas that have been explored in the past, can be improved upon and commercially exploited. This exploitation of ideas requires actors involved in the project to 'speak the same language'. Then, in line with the findings, if a developer loses its partners that allow the developer to exploit ideas, this is likely to have a negative impact on the survival chances of the developer.

In contrast to periods of stable technological regimes, I find that during periods of technological transitions developers benefit from the failure of their strongly tied publishing partners. In order to be able to explore newly formed technology spaces and produce novel and innovative products, firms do not benefit from familiar collaborations and smooth interactions; rather, creative and innovative new products result from friction and an unbiased exploration processes with unfamiliar partners (Vedres and Stark 2010). In a similar vein, March (1991, p. 71) stressed that *"exploration includes things captured by terms such as search, variation, risk taking, experimentation, play, flexibility, discovery, innovation"*. As partnerships between developers and publishers become stronger, the level of routinization of the processes that coordinate and control the partnership will increase. Evolutionary economists have argued that such routinization of collaboration practices (Nelson and Winter 1982; Heiner 1983) functions well in efficiently dealing with recurrently observed situations, but that these stable routines are not per se beneficial in technologically turbulent periods (Eisenhardt and Martin 2000). Thus, developers do not benefit from strong ties to publishers in turbulent periods, because the high level of routinization makes them unable to identify and explore the opportunities offered by a new generation of consoles. Moreover, the failure of strongly tied publishing partners induces developers to seek new partners or turn to existing partners that they have less familiar ties to.

In periods of technological stability the failure of a weakly tied publishing partner negatively affects the survival chances of a developer. The fact that the effect is not as strong as the effect of failure of strongly tied firms confirms the idea that strong ties can truly benefit firms in stable periods. The level of routinization in projects between two weakly tied network partners is rather low and is therefore less appropriate to function as a vehicle to incrementally improve upon existing ideas and concepts. In technologically turbulent eras, the failure of weakly tied publishing partners has a somewhat different effect on the survival of firms than the failure of strongly tied partners. In contrast to strong tie partnerships, weak tie partnerships between a developer and a publishing partner do not impose a high probability of developing routines and becoming locked-in into the partnership. This is caused by the lack of longevity of the partnership. The findings clearly show that the failure of weakly tied publishing firms always negatively affects the survival of developers.

A second dimension of the composition of the network of a developer and its publishers concerns the diversity of publishing partners. By integrating theoretical arguments provided by March (1991) and research on collaborative innovation, this paper studies the role of cognitive diversity in a developer's network and findings indicate that exposure to diverse ideas is mainly beneficial if new technologies need to be explored. In particular, in line with prior studies that investigate the role of diversity – as stemming from network structure – on the likelihood of firms to innovate, this paper shows that being connected to a diverse set of publishing partners allows developers to survive in periods in which innovation is critical. Conversely, if exploitation of existing ideas is sufficient to be a successful competitor, the importance of variety of inputs decreases. The question of when firms need to explore future opportunities and when to exploit existing competences is highly relevant for all firms in industries with high levels of rapid technological progress and highlighting the role of interfirm networks in this process sheds light on how firms gain from their interfirm network during different stages of the ILC.

By distinguishing between the effects of diversity of partners and the failure of differently tied partners this paper sheds light on the distinction between resources and routines (Amit and Schoemaker 1993). Routines are often used to describe the indivisible coordination and control mechanisms that guide the allocation of resources at the firm level. Although routines are often described as firm level characteristics, collaborations that take the form of projects can also become routinized (Dyer and Hatch 2006; Engwall 2003). Moreover, the routinization of projects is likely to be related to the duration and intensity of the collaboration between two firms and the collaboration between weakly tied partners is less interwoven with routinized practices than the collaboration between strongly tied partners. In contrast to tie strength, the diversity among network partners is does not provide information on the level of routinization of a collaborative setting, but rather on the variety of available resources. From this point of view, a set of network partners is seen as repositories of resources – in particular specialized knowledge. Such resources are not per se specific to a collaborative pair of firms involved in a project, but rather reflect the aggregate of skills possessed by individual employees within firms.

CONCLUSION

In this paper, I have sought to combine network theory with theories of the ILC to investigate whether and how embeddedness of network relations of firms matters for survival, across stages of the ILC. By analyzing the complete history of firms in the video game industry this paper has provided a fine-grained analysis of the network strategies pursued by firms and its effect on their survival chances. The analysis of the video game industry suggests that the effect of failure of network partners is moderated by the technological turbulence in the industry and that the effect differs between weakly and strongly tied network partners. It also shows how developers benefit from diverse publishing partners in times of change, while this does not benefit them in stable periods.

In contrast to the vast majority of research on interfirm networks this study provides a rare case of interfirm networks other than strategic alliances. While research on firm alliances has been growing rapidly in the past decades, few studies have investigated other types of interfirm networks. In contrast to the typical study on alliances, the network of firms analyzed in this paper includes all types of firms – large, medium, small, young and old. As a result, the outcomes of this study pertain to a wider range of businesses. Also, the analysis of the developer – publisher network in this paper draws attention to the asymmetry in interfirm networks. The underlying principles that guide the formation of any interfirm network – aimed at facilitating the exchange and generation of knowledge – are based on asymmetry in the knowledge and competence endowments of firms. This asymmetry is likely to play an important role in the emergence of network structures, and micro-structures such as structural holes may well be reflecting the cognitive needs and wants of those in less favorable positions, rather than an informational power structure. In other words, structural holes such as the obvious missing link between two developers linked to the same publisher may get a different interpretation because the unconnectedness of two actors inherently results from their functional task. Thus, by highlighting the fact that developers and publishers are heterogeneously endowed with competences, this paper acknowledges the fact that interfirm networks are inherently asymmetric. This paper is also an attempt to extend the boundaries of the analysis of social networks. Rather than relying on often tested effects of network centrality of the position of firms in micro-structures, I have studied the embeddedness of firms in a history of weaker and stronger relations and I have investigated the level of similarity or diversity present in the portfolio of publishing partners of video game developers.

One limitation of this study is that it cannot empirically test whether the introduction of new video game consoles indeed forced firms to produce innovative video games. I have relied on the insights of industry insiders and scientific evidence from other cases of technological change. Ideally, one would like to characterize each video game in the data set based on its novelty value. This limitation also stresses the fact that future research could explore the position of separate video game projects within firms and the relation between these projects. Such a multi-level perspective could increase our understanding of projects organized within firms. Another limitation is that the hit-driven and unpredictable nature of video game success may have its effect on the outcomes of the study. For example, because even within firms hits are likely to be followed by flops, the premium for larger firms may be higher than in other industries. Indeed, larger firms may be better able to absorb the negative effects associated with flops.

The findings presented in this paper provide important implications for students and practitioners of business strategy. First, the loss of network partners as such has a negative effect on survival. During periods of low technological turbulence, failure of strongly tied network partners is more likely to affect firm survival than the failure of weakly tied network partners. However, during technological transitions firms can benefit from the failure of strongly tied network partners. This safeguards these firms from becoming locked-in into relational partnerships. This complex relation requires managers actively evaluate a portfolio of partners and relate it not only to firm internal characteristics but more importantly to the changing technological conditions imposed upon the firm. Second, since technological change provides opportunities for firms within the video game industry, being connected to partners with diverse knowledge allows these firms to successfully cope with the changed competitive context. Such diversity allows firms to quickly identify new opportunities, to stay flexible in adapting to new contexts and to exploit these relationships whenever necessary. This is not per se the case in eras that are rather stable, since the locus of profit making in these eras is found in exploitation of competences, rather than exploration.

The findings in this study can be generalized towards other industries in which technological change is rapid and collaboration is important. Industries such as the biotech industry and the software industry are structured in a similar fashion and the production processes heavily involve external partners. The results may also be important for other, much older industries such as the automobile industry. While this industry has seen a rather stable set of firms over the last decades (Klepper 2002), the introduction of electric cars provides opportunities for learning through network ties. The ability to signal opportunities will be dependent on the composition of each firm's ego network of car part suppliers and automobile manufacturers. In sum, the continuous stream of technological change across industries and the growing role of networks in a large range of different industries increase the importance of collaborative choices made by firms.

References chapter 5

Abernathy, W.J., Clark. K.B (1985). Innovation: Mapping the winds of creative destruction. Research Policy 14: 3 – 22.

Ahuja, G. (2000). Collaboration networks, structural holes and innovation: A longitudinal study. Administrative Science Quarterly 45 (3): 425 – 453

Amit, R., Schoemaker, P.J. (1993). Strategic assets and organisational rent. Strategic Management Journal 14: 33 – 46.

Argyres, N., Bigelow, L. (2007). Does transaction misalignment matter for firm survival at all stages of the industry lifecycle? Management Science 53: 1332 – 1345.

Baldwin, C.Y., Clark, K.B. (2000). Design rules: The power of modularity. MIT Press: Cambridge, MA

Baum, J.A.C, Calabrese, T., Silverman, B.S. (2000). Don't go it alone: alliance network composition and startups' performance in Canadian biotechnology. Strategic Management Journal 21: 267 – 294.

Beckman, C.M., Haunschild, P.R., Phillips, D.J. (2004). Friends or strangers? Firm-specific uncertainty, market uncertainty, and network partner selection. Organization Science 15 (3): 259 – 275.

Bian, Y.J. (1997). Bringing strong ties back in: Indirect ties, network bridges, and job searches in China. American Sociological Review 62: 266 – 285.

Bidwell, M., Fernandez-Mateo, I. (2010). Relationship duration and returns to brokerage in the staffing sector. Organization Science 21 (6): 1141 – 1158.

Boltanski, L., Thevenot, L. (2006). On justification: Economies of worth. Princeton, New Jersey: Princeton University Press.

Bonacich, P. (1972). Factoring and weighting approaches to clique identification. Journal of Mathematical Sociology 2: 113 – 120.

Bonacich, P. (2007). Some unique properties of eigenvector centrality. Social Networks 29: 555 – 564.

Burt, R.S. (1992). Structural holes: The structure of competition. New York, New York: Academic Press.

Burt, R.S. (2005). Brokerage and closure: An introduction to social capital. New York, New York: Oxford University Press.

Butts, C.T. (2009). Revisiting the foundations of network analysis. Science 325: 414 – 416.

Carroll, G.R., Bigelow, L.S., Seidel, M.D., Tsai, L. (1996). The fates of de novo and de alio producers in the American automobile industry 1885-1981. Strategic Management Journal 17: 117 – 137.

Caves, R. (2000). Creative industries: Contracts between arts and commerce. Cambridge, Massachusetts: Harvard University Press.

Christensen, C.M. (1997). The innovator's dilemma. Boston, Massachusetts: Harvard Business School Press.

Coleman, J.S. (1988). Social capital in the creation of human capital. American Journal of Sociology 94: 95 – 120

Coleman, J.S. (1990). Foundations of social theory. Cambridge, Massachusetts: Harvard University Press.

Constant, D., Kiesler, S., Sproull, L. (1996). The kindness of strangers: On the usefulness of weak ties for technical advice. Organization Science 7: 119 – 135.

DeVany, A., Walls, W.D. (1999). Uncertainty in the movie industry: Does star power reduce the terror of the box office? Journal of Cultural Economics 23: 285 – 318.

Durkheim, E. (1915). The elementary forms of the religious life. New York, New York: The Free Press.

Dyer, J. (1996). Specialized supplier networks as a source of competitive advantage: Evidence from the auto industry. Strategic Management Journal 17 (4): 271 – 292.

Dyer, J.H., Hatch, N.W. (2006). Relation-specific capabilities and barriers to knowledge transfers: creating advantage through network relationships. Strategic Management Journal 27: 701 – 719.

Dyer, J.H., Nobeoka, K. (2000). Creating and Managing a High Performance Knowledge-Sharing Network: The Toyota Case. Strategic Management Journal 21: 345 – 367.

Eisenhardt, K.M., Martin, J. (2000). Dynamic capabilities: what are they? Strategic Management Journal 21 (10-11): 1105 – 1121.

Engwall, M. (2003). No project is an island - linking projects to history and context. Research Policy 32 (5): 789 – 808.

Fleming, L., Mingo, S., Chen, D. (2007). Brokerage and collaborative creativity. Administrative Science Quarterly 52: 443 – 475.

Forster, W. (2005). The encyclopedia of game machines. Consoles, handhelds & home computers 1972 - 2005. New York, New York: Game Plan.

Gaudiosi, J. (2005). Next generation game concepts: Developers chime in on the role of licensed properties vs. original themes. Businessweek, 1 December.

Glasmeier, A. (1991). Technological discontinuities and flexible production networks: the case of Switzerland and the world watch industry. Research Policy 20 (5): 469 – 485.

Gort, M., Klepper, S. (1982). Time paths in the diffusion of product innovations. Economic Journal 92: 630 – 653.

Granovetter, M.S. (1973). The strength of weak ties. American Journal of Sociology 78: 1360 – 1380.

Gulati, R., Garguilo, M. (1999). Where do interorganizational networks come from? American Journal of Sociology 104 (5): 1439 – 1493.

Hall, B.H. (2002). A note on the bias in the Herfindahl based on count data. In A. Jaffe and M. Trajtenberg, eds., Patents, citations, and innovation. Cambridge, Massachusetts: MIT Press.

Hansen, M.T. (1999). The search-transfer problem: The role of weak ties in sharing knowledge across organization subunits. Administrative Science Quarterly 44: 82 – 111.

Heiner, R. (1983). The origin of predictable behavior. American Economic Review 73: 560 – 595.

Henderson, R., Clark, K. (1990). Architectural innovation: the reconfiguration of existing product technologies and the failure of established firms. Administrative Science Quarterly 35: 9 – 31.

Hill, C.W.L., Rothaermel, F.T. (2003). The performance of incumbent firms in the face of radical technology innovation. Academy of Management Review 28 (2): 257 – 274.

Hosmer, D., Lemeshow, S. (1999). Applied survival analysis: regression modeling of time to event data. New York, New York: John Wiley and Sons.

Jaffe, A. (1986). Technological opportunity and spilloversof R&D: Evidence from firms' patents, profits and market value. American Economic Review 76: 984 – 1001.

Johns, J. (2005). Video games production networks: value capture, power relations and embeddedness. Journal of Economic Geography 6 (2): 151 – 180.

Kent, S.L. (2001). The ultimate history of video games: From Pong to Pokemon - The story behind the craze that touched our lives and changed the corld. New York: Prima Publishing.

King, A.A., Tucci, C.L. (2002). Incumbent entry into new market niches: The role of experience and managerial choice in the creation of dynamic capabilities. Management Science 48 (2): 171 – 186.

Klepper, S. (1996). Entry, exit, growth, and innovation over the product life cycle. The American Economic Review 86: 562 – 583.

Klepper, S. (2002). The capabilities of new firms and the evolution of the US automobile industry. Industial and Corporate Change 11 (4): 645 – 666.

Klepper, S., Simons, K.L. (2000). Dominance by birthright: entry of prior radio producers and competitive ramifications in the U.S. television receiver industry. Strategic Management Journal 21 (10/11): 997 – 1016.

Krackhardt, D. (1992). The strength of strong ties: The importance of philos in organizations. In N. Nohria and R. Eccles (eds.), Networks and organizations: Structure, form, and action, Boston, Massachusetts: Harvard Business School Press.

Kogut, B. (1988). Joint ventures: Theoretical and empirical perspectives. Strategic Management Journal 9: 319 – 332.

Lampel, J., Lant, T., Shamsie, J. (2000). Balancing act: Learning from organizing practices in cultural industries. Organization Science 11 (3): 263 – 269.

Larson, A. (1992). Network dyads in entrepreneurial settings: A study of the governance of exchange relationships. Administrative Science Quarterly 37: 76 – 104.

Levin, D., Cross, R. (2004). The strength of weak ties you can trust: The mediating role of trust in effective knowledge transfer. Management Science 50 (11): 1477 – 1490.

MacEachren, A.M. (1995). How maps work: representation, visualization and design. New York, New York: Guilford Press.

Madhavan, R., Koka, B.R., Prescott, J.E. (1998). Networks in transition: how industry events (re)shape interfirm relationships. Strategic Management Journal 19 (5): 439 – 459.

March, J.G. (1991). Exploration and exploitation in organizational learning. Organization Science 2: 71 – 87.

McEvily, B., Zaheer, A. (1999). Bridging ties: A source of firm heterogeneity in competitive capabilities. Strategic Management Journal 20: 1133 – 1156.

Mitchell, W. (1991). Dual clocks: Entry order influences on incumbent and newcomer market share and survival when specialized assets retain their value. Strategic Management Journal 12 (2): 85 – 100.

Moran, P. (2005). Structural vs. relational embeddedness: Social capital and managerial performance. Strategic Management Journal 26 (12): 1129 – 1151.

Nelson, R., Winter, S. (1982). An evolutionary theory of economic change. Cambridge, UK: Belknap.

Nonaka, I. (1994). A dynamic theory of organizational knowledge. Organization Science 5: 14 – 37.

Pfeffer, J., Salancik, J. (1978). The external control of organizations. New York, New York: Harper and Row.

Phelps, C.C. (2010). A longitudinal study of the influence of alliance network structure and composition on firm exploratory innovation. Academy of Management Journal 53 (4): 890 – 913.

Podolny, J.M. (1994). Market uncertainty and the social character of economic exchange. Administrative Science Quarterly 39: 458 – 483.

Polanyi, M. (1966). The tacit dimension. London, UK: Routledge and Kegan Paul.

Powell, W.W., Koput, K.W., Smith-Doerr, L. (1996). Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology. Administrative Science Quarterly 41: 116 – 145.

Rodan, S., Galunic, C. (2004). More than network structure: How knowledge heterogeneity influences managerial performance and innovativeness. Strategic Management Journal 25: 541 – 562.

Rosenkopf, L., Tushman, M. (1998). The coevolution of community networks and technology: Lessons from the flight simulation industry. Industrial and Corporate Change 7 (2): 311 – 346.

Rothaermel, F.T. (2001). Incumbent's advantage through exploiting complementary assets via interfirm cooperation. Strategic Management Journal 22 (6-7): 687 – 699.

References chapter 5

Rothaermel, F.T., Deeds, D.L. (2004). Exploration and exploitation alliances in biotechnology: a system of new product development. Strategic Management Journal 25: 201 – 221.

Ruef, M. (2002). Strong ties, weak ties, and islands: Structural and cultural predictors of organizational innovation. Industrial and Corporate Change 11 (3): 427 – 449.

Salganik, M.J., Dodds, P.S., Watts, D.J. (2006). Experimental study of inequality and unpredictability in an artificial cultural market. Science 311: 854 – 856.

Schumpeter, J.A. (1975) (original pub. 1942). Creative destruction. From capitalism, socialism and democracy. New York, New York: Harper.

Shannon, C.E. (1948). A mathematical theory of communication. Bell Systems Technological Journal 27: 379 – 423, 623 – 656.

Sorenson, O., Waguespack, D.M. (2006). Social structure and exchange: Self-confirming dynamics in Hollywood. Administrative Science Quarterly 51 (4): 560 – 589.

Stark, D. (1996). Recombinant property in East European capitalism. American Journal of Sociology 101 (4): 993 – 1027.

Stark, D. (2009). The sense of dissonance: Accounts of worth in economic life. Princeton, New Jersey: Princeton University Press.

Stirling, A. (2007). A general framework for analyzing diversity in science, technology and society. Journal of the Royal Society Interface 4 (15): 707 – 719.

Tripsas, M. (1997). Unraveling the process of creative destruction: complementary assets and incumbent survival in the typesetter industry. Strategic Management Journal 18: 119 – 142.

Tschang, F.T. (2007). Balancing the tensions between rationalization and creativity in the video games industry. Organization Science 18 (6): 989 – 1005.

Tushman, M.L, Anderson, P. (1986). Technological discontinuities and organizational environments. Administrative Science Quarterly 31: 439 – 465.

Tushman, M., Rosenkopf, L. (1992). Organisational determinants of technological change. In Research in organizational behavior, L. L. Cummings and B. M. Staw., eds. 311 – 347.

Utterback, J., Abernathy, W. (1975). A dynamic model of process and product innovation. Omega 3 (6): 639 – 656.

Uzzi, B., Lancaster, R. (2003). Relational embeddedness and learning: The case of bank loan managers and their clients. Management Science 49 (4): 383 – 399.

Uzzi, B. (1997). Social structure and competition in interfirm networks: The paradox of embeddedness. Administrative Science Quarterly 42: 35 – 67.

Uzzi, B. (1996). Embeddedness and economic performance: The network effect. American Sociological Review 61: 674 – 698.

Vedres, B., Stark, D. (2010). Structural folds: Generative disruption in overlapping groups. American Journal of Sociology 15 (4): 1150 – 1190.

Zajonc, R.B. (1968). Attitudinal effects of mere exposure. Journal of Personality and Social Psychology 9, Monograph supplement 2, part 2.

Zuckerman, E.W. (1999). The categorical imperative: Securities analysts and the illegitimacy discount. American Journal of Sociology 104: 1398 – 1438.

Alternative explanations and robustness checks

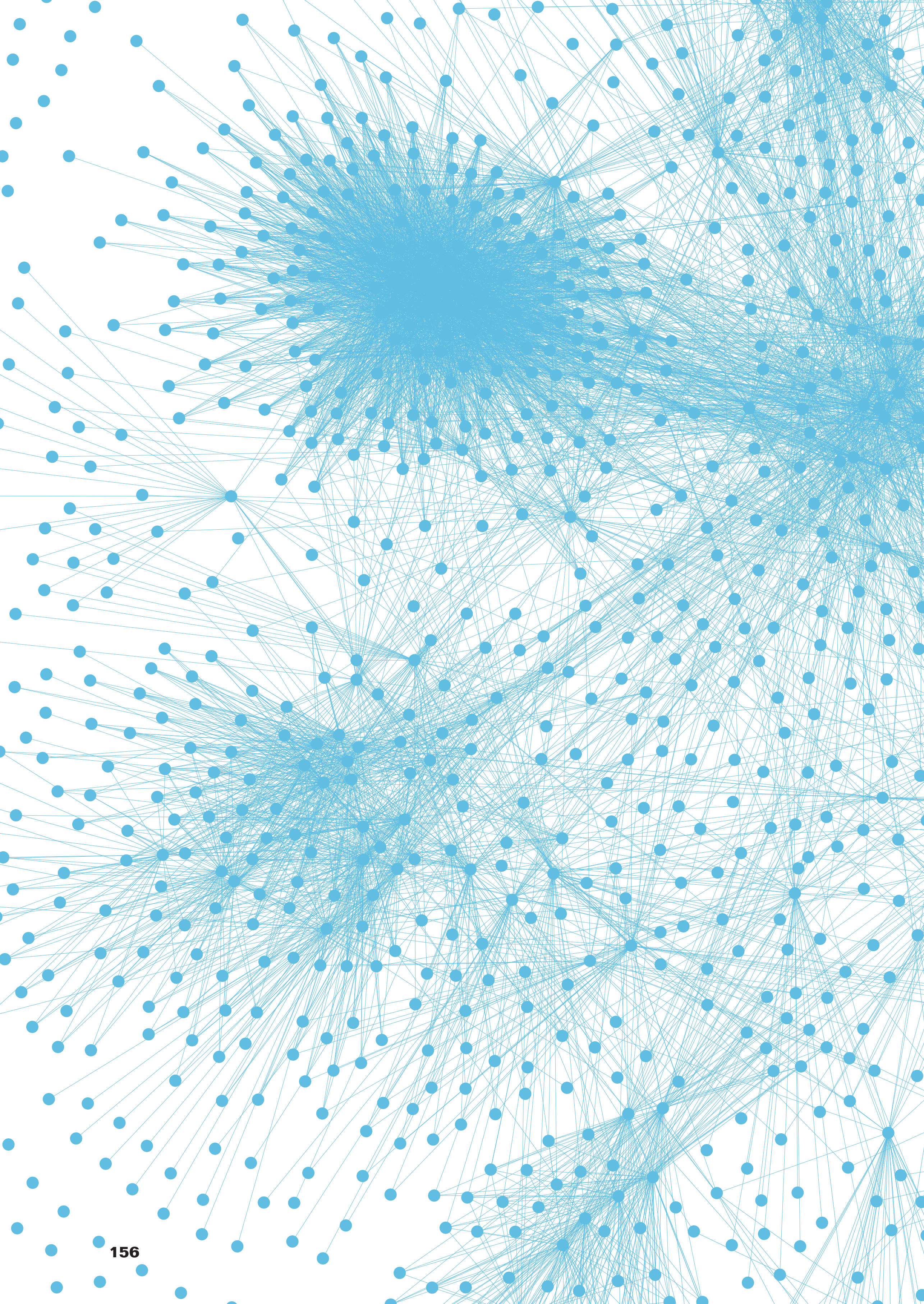
I considered several alternative explanations and assessed the robustness of the results. First, with regards to the stability measure, one might argue that the level of stability in a firm's network is the result of an endogenous network formation process. More in particular, tie formation might be driven by forces of homophily resulting in firms teaming up with similar other firms. Similarity may be found in the age, size, stylistic portfolio and degree of each firm and its partner firms. The introduction of new consoles may pose bigger challenges for firms with certain characteristics and, as a result, firm failure may be caused by being connected to firms with characteristics sensitive to the changing environmental conditions, rather than failure of network partners. In order to test the validity of this alternative explanation, I divided all firms in two groups: firms with stability levels lower than the population average and firms with stability levels higher than the population average. For each of these firms I calculated the difference between focal firm characteristics and average network partner characteristics. These characteristics included age, number of games in the prior year, stylistic portfolio and number of ties. I then ran a Mann-Whitney U test to test whether the null hypothesis that the two samples are drawn from the same population. In other words, I tested whether the mean characteristics differences in the group with low failure levels differed from the mean characteristics differences in the group with high failure levels. The outcomes show that the hypothesis that both samples are drawn from the same population cannot be rejected, indicating that the similarity of firms and partner firms did not bias the outcomes of the failure variable used in the regression model.

Second, in addition to the random effects model I ran a fixed effects model by removing the time-invariant variables from the specification. Then, I subjected the original random effects specifications and the new fixed effects specifications to Hausman tests. This test compares the fixed effects specification and the random effects specification under the H0 that the individual effects are not correlated with the other covariates in the model. The H0 was not rejected, which indicates that the random effects specification produces unbiased estimators (Hausman 1978).

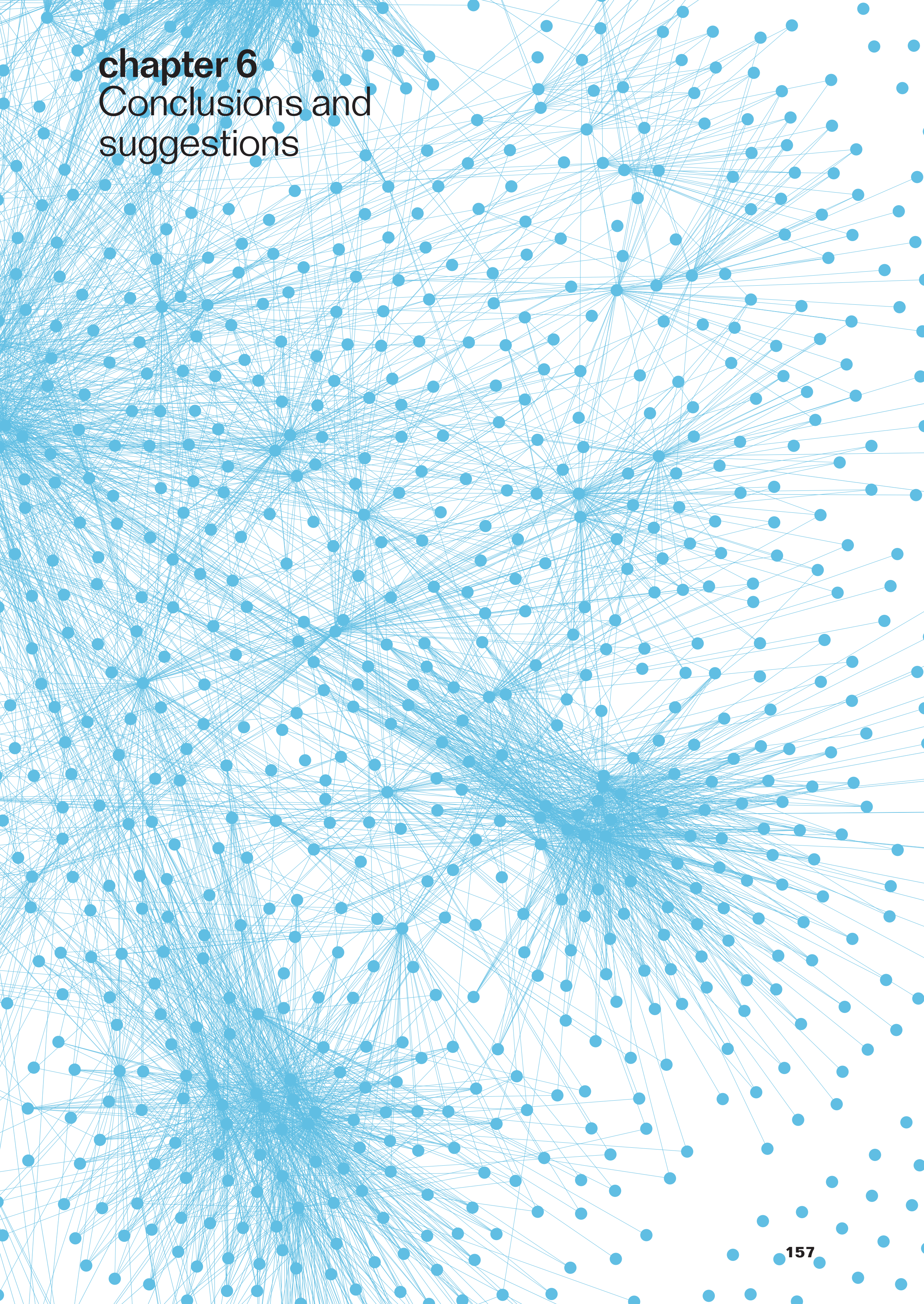
TABLE 5.3
Consoles and console characteristics

	CONSOLE	MANUFACTURER	LOCATION	SPECIFICATIONS			LAUNCH DATE[1]
				CPU BITS	MHZ	RAM	
GEN 1	Odyssey	Magnavox	Napa, California	X	X	X	May-72
	Channel F	Fairchild Semiconductor	Mountain View, California	8	1.8	64	Aug-76
	Atari 2600	Atari	Sunnyvale, California	8	1.2	128	Oct-77
	Odyssey 2	Magnavox[2]	Napa, California	8	1.8	64	Dec-87
	Intellivision	Mattel Electronics	Fresno, California	16	0.5	2K	Nov-82
GEN 2	Atari 5200	Atari	Sunnyvale, California	8	1.8	2K	Nov-82
	ColecoVision	Coleco	Hartford, Connecticut	8	3.6	1K	Jul-82
	Vectrex	Western Technologies	San Francisco, California	8	1.6	512	Nov-82
	NES	Nintendo	Kyoto, Japan	8	1.8	2K	Jul-83
	Master System	Sega	Tokyo, Japan	8	3.6	8K	Oct-85
	Atari 7800	Atari	Sunnyvale, California	8	1.8	4K	May-84
GEN 3	TurboGrafx-16	NEC	Tokyo, Japan	16	7.2	8K	Oct-87
	Genesis	Sega	Tokyo, Japan	16	7.6	64K	Oct-88
	TurboGrafx CD	NEC	Tokyo, Japan	16	7.2	8K	Nov-90
	Neo Geo	SNK	Osaka, Japan	16	12	8K	Oct-90
	SNES	Nintendo	Kyoto, Japan	16	3.58	128K	Nov-90
	CD-i	Phillips	Eindhoven, Netherlands	16	15.5	1M	Nov-91
GEN 4	3DO	3DO	Redwood City, California	32	12.5	2M	Sep-93
	Amiga CD32	Commodore	Santa Clara, California	32	14.3	2M	Sep-93
	Jaguar	Atari	Sunnyvale, California	16	13.3	2M	Nov-93
	Neo Geo CD	SNK	Osaka, Japan	16	12	2M	Nov-94
	PC-FX	NEC	Tokyo, Japan	32	21.5	2M	Dec-94
	Saturn	Sega	Tokyo, Japan	32	28.6	2M	Nov-94
	Sega 32X	Sega	Tokyo, Japan	32	23	2M	Nov-94
	PlayStation	Sony	Tokyo, Japan	32	33.8	2M	Dec-94
	Nintendo 64	Nintendo	Kyoto, Japan	64	93.75	4.5M	Jun-96
GEN 5	Dreamcast	Sega	Tokyo, Japan	128	200	26M	Nov-98
	GameCube	Nintendo	Kyoto, Japan	128	485	40M	Sep-01
	PlayStation 2	Sony	Tokyo, Japan	128	295	36M	Mar-00
	Xbox	Microsoft	Redmond, Washington	128	733	64M	Nov-01
GEN 6	Xbox 360	Microsoft	Redmond, Washington	256	3200	512M	Nov-05
	PlayStation 3	Sony	Tokyo, Japan	256	3200	256M	Nov-06
	Wii	Nintendo	Kyoto, Japan	256	729	24M	Nov-06

[1] The launch dates refer to the first launch dates. In nearly all cases a console was first released in one country and followed by other countries. So, Japanese manufacturers tend to release their consoles first in Japan and then in the US, while US manufacturers tend to do the opposite.
[2] Magnavox was acquired by Philips before the launch of the Magnavox Odyssey 2.



chapter 6
Conclusions and suggestions



Introduction

This research project has sought to unravel the historical process responsible for the spatial organization of the video game industry. We have done so by studying the subtleties of this creative and project-based industry and by explicitly integrating theories from network science and the literature on ILCs. These two strands of literature feature two distinct but related meso-levels of analysis: firms as a network of connected and collaborating entities and firms as a competing population. These two levels have been identified in the literature on Evolutionary Economic Geography as the two main units of analysis, but have previously only been analyzed in isolation (Boschma and Frenken 2006; Frenken and Boschma 2007). By integrating these two levels of analysis, we have highlighted the fact that spatial concentration of economic activity is a *historical process* that features *changes in the nature of competition and collaboration*. Moreover, this dissertation positions itself in more prominently the field of Evolutionary Economic Geography by stressing the importance of context specific subtleties and by quantifying economic actions from a dynamic perspective. This concluding chapter summarizes the main findings of our research effort, points out the main contributions and proposes directions for future academic research on the spatial concentration of industries.

The central argument laid out in this dissertation is that the spatial organization of the video game industry is related to the changes in the nature of competition and collaboration. Competition on the one hand is about the differences between firms and the extent to which these differences are favored by the selection environment. Networks on the other hand are about how the continuous diffusion of resources and routines generates the heterogeneity among firms. In particular, heterogeneity is the fuel of a competition process between firms and it is through the embeddedness of firms in webs of social relations that the spatial organization of the video game industry is as it currently is. In the preceding four chapters, we have empirically investigated how the founding and failure of new firms depends on access to inputs that can be used in the production process and we analyzed the determinants of how firms seek connections to other firms. The answers provided in these chapters have worked towards answering the main research question:

How do social networks affect the industrial dynamics and spatial concentration of the video game industry along its industry life cycle?

Throughout the four empirical investigations we have offered a historical account of the spatial industrial organization of the video game industry. We have highlighted, in chronological order, how firms rely on external sources of competitive advantage and how these sources are accessed. We start from the moment of entry into the industry and examine the spatial characteristics that drive the formation of new firms in a region. We then analyzed how spatial characteristics influence the survival chances of firms. In the last two chapters we go from the relatively implicit notion of networks at the spatial level to the more explicit level of the interfirm networks and analyze how the formation patterns change along the ILC and how firm survival is dependent on network relations in different temporal settings. The following section sums up the most important contributions of the dissertation and discusses its implications. The final section addresses the limitations of this dissertation and we build on these limitations to suggest improvements that can be implemented in future research.

SUMMARY AND DISCUSSION OF THE MAIN FINDINGS

FIRMS IN THEIR REGIONAL CONTEXT

The first two empirical studies presented in chapter 2 and chapter 3 implicitly investigated the regional dimension of networks along the ILC. That is, rather than observing and measuring every single interaction between firms and other economic actors involved in the production of video games we studied the social characteristics of the region in which firms were located. Moreover, we linked these regional social characteristics to the various stages of the ILC. In particular, chapter 2 deals with the spatial and temporal entry patterns of firms in the United States' video game industry. In line with other studies in the field of organizational ecology the empirical analysis builds on the notion of density dependence. Density dependence describes a process in which the entry of new firms is initially fostered by growth in the firm population and later curtailed through the increase of crowding and competition. The empirical analysis shows that a similar process describes the regional entry of firms in the US video game industry. Organizational ecologists have attributed this finding to an initial effect of legitimation of the industry, which is offset by a subsequent competition effect.

In response to the findings presented by organizational ecologists, Aldrich and Fiol (1994) argued that the legitimation effect as a result of increasing populations should be seen as a form of cognitive legitimation because industry stakeholders become more familiar with the activities undertaken by firms in the industry and develop a level of "taken-for-grantedness". They argue that cognitive legitimation alone cannot explain the full process of institutionalization of an industry. In particular, socio-political legitimacy, which can be described as the process *"by which the general public, key opinion leaders, or government officials accept a venture as appropriate and right, given existing norms and laws"* (Aldrich and Fiol 1994, p. 648) should also be taken into account. Although the study of Aldrich and Fiol is highly cited and celebrated, very few studies have been able to translate the ideas put forward by their paper into an empirical context. Chapter 2 provides a clear attempt to do so. The main argument made in the chapter is that the level of regional social capital in relation to the regional firm population is responsible for variation in the number of regional entrants. Social capital is defined as a regional community concept that describes the level of cohesion among all inhabitants in a region. Regions with high levels of social capital are endowed with a stock of densely connected inhabitants and these dense connections are responsible for the homogenization of ideas.

Every new industry is build upon new principles, new values and new ideas that are not yet known by the general public. The more these new principles, new values and new ideas deviate from the yet existing ones, the more contested an industry becomes. This is especially so when businesses in new industries want to enter a geographical market that is rich in social capital. In a web of densely connected inhabitants, deviant behavior – showing support for a contested practice – is likely not to be tolerated. However, in line with the hypothesis of chapter 3, this contestedness can be alleviated if firm representatives can organize themselves and create socio-political legitimacy for the new industry. The extent to which firm representatives can organize themselves depends on the number of firms present in the regional industry, while the likelihood that they can create socio-political legitimacy depends on the level of social capital. As soon as industry representatives have been able to generate understanding for their activities, they are more likely to receive support from the regional community. Hence, the main finding in this chapter is that the legitimacy of the video game industry is a function of the number of firms in the population, the level of social capital and an interaction between the two. In particular, as the number of new firms increases, industry representatives will organize themselves to be able to benefit from the available regional social capital.

Whereas chapter 2 investigated the regional conditions that favor the entry of firms, chapter 3 investigates whether firms located in regions with many other firms benefitted from this co-location or that this benefit was limited to spinoff firms. The motivation for this research is the recently emerged debate on the ability of firms to benefit from co-location. Economic geographers, following Marshall's (1920) account, have referred to the benefits that co-locating firms can reap as a result of exploiting the access to specialized suppliers and buyers, a large and specialized labor pool, and local knowledge spillovers. In the field of economic geography this idea has reached an almost paradigmatic status. However, a wide range of studies in other fields showed that firms are actually harmed by co-locating with other firms. Recently, Klepper (2007) refined this argument by showing that in the US automobile industry the benefits of being co-located only accrued to spinoff firms, rather than to the entire population of firms (Klepper 2007).

The empirical analysis presented in chapter 3 shows that in line with Klepper's argument spinoff firms do indeed outperform non-spinoffs. However, the benefits of co-locating do not solely accrue to spinoffs. All firms in the industry benefit from being co-located with many other firms too, but only after a certain threshold. This bell-shaped relation between the number of firms in a region and the likelihood of failure experienced by firms indicates the fact that this relation is more complex than often portrayed. Both negative externalities and positive externalities are likely to play a role here and the stage of development of the regional firm population is decisive in determining which of the two externalities prevails over the other. We explain this finding from a linear increase of negative localization economies on the one hand and the exponential increase of network externalities that arise as a result of the project-based nature of the video game industry on the other. Each new firm in the industry results in one additional unit of competition, while the relation between the number of firms and the number of possible team configurations is positively exponential. The recombination potential grows more than proportional with the size of a cluster (cf. Weitzman 1998) and in line with Grabher (2002, p. 255) *"(t)he practice of project-based collaboration (…) maximizes recombinatory options between a diverse range of skill sets, biographical backgrounds and cultural orientations"*.

Chapter 3 also scrutinizes the concept of firm failure. The vast majority of prior studies on the failure of firms has remained virtually silent about the differences between firms exiting the industry because of bankruptcy and firms exiting the industry as a result of being acquired. While bankruptcy is likely to constitute an organizational failure, being acquired may actually be a positive event in the life course of a firm. Chapter 3 shows that similar to survival, the acquisition of a firm in the video game industry represents a success event for the acquired firm. Not only are spinoffs frequently acquired, also firms that produce video games that are valued by video game critics tend to be acquired. These two findings – firms benefit from co-locating and acquisitions represent success events – are attributed to the nature of the industry. The video game industry is a creative project-based industry that is driven by competition for creative and valuable human capital. Being located in regions with many other firms provides firms with access to large pools of skilled labor. Also, firms that want access to skilled labor use acquisitions to strengthen their resource stock. In sum, chapter 3 clearly shows that the project-based nature of the industry and its atypical acquisition patterns are industry subtleties worth addressing, because of its contribution to the spatial concentration process of video game firms.

In sum, chapter 2 and chapter 3 have shed new light on regional heterogeneity and its role played in the change in the distribution of firms across space. Prior research has described how regions or other spatial entities differ in terms of its social organization and institutions by introducing concepts such as "industrial districts" (Becattini 1979; 1990), "innovative milieux" (Camagni 1991; 2002), "new industrial spaces" (Scott 1988), and "learning regions" (Florida 1995; Maskell et al. 1998). Storper (1997) referred to these concepts as untraded interdependencies and argued that they are responsible for generating spatial heterogeneity in economic competitiveness. One of the shortcomings in this literature is that it often fails to explain how regional differences come into place, and under what circumstances economic actors can benefit from them. The first two empirical chapters of this dissertation clearly constitute a step forward in addressing these shortcomings by analyzing regional differences from a more dynamic perspective.

Social capital, which is presented in this dissertation both as a regional blessing and a regional curse, has been found to have a clear impact on both the initial and the later distribution of firms in the video game industry. The definition of social capital provided by Putnam (1995) shows strong similarities to Storper's (1997) definition of untraded interdependencies and, interestingly, the analysis in chapter 2 showed that the level of social capital should not be seen as a one-dimensional "good" or "bad". Rather, by organizing themselves entrepreneurs are able to twist the initial negative effect of regional social capital into something positive. This is not to say that entrepreneurs are able alter the structure of the regional social organization; rather, entrepreneurs can influence what flows through this structure. By collectively diffusing knowledge about the activities of the new industry, entrepreneurs can motivate stakeholders to provide them with the resources and routines needed in their new ventures. In doing so, their environment "opens up" and turns the threat of high levels of social capital into an opportunity thereby creating a window of locational opportunity (Storper and Walker 1989). This finding also clearly relates to findings about the initial stages of the ILC. Initially very few firms enter the industry and once the activities of the industry become socially accepted, more and more firms start entering.

The other main implication of this study pertains to the relevance of regional heterogeneity for the survival of firms. We show that firms initially experience a negative effect following an increase in the number of firms in a region. However, after a region has reached a certain threshold in terms of the number of firms, the effect of a further increase in the number of firm becomes positive. Thus, being located in such regions significantly increases the likelihood of survival of firms in the video game industry. Similar to the effect of social capital, the relation between a regional population of firms and the success of these firms is dependent on the stage in which an industry finds itself. This finding refines the results from previous studies that show that – in manufacturing industries – firms do not benefit from co-location and are even harmed by an increase in concentration. The question becomes whether manufacturing firms indeed do not benefit from being co-located or that this relations simply has not been examined yet. If manufacturing firms benefit from being co-located with many others, it is interesting to study the factors that cause these benefits. In the case of the video game industry, we attributed our findings to the linear increase in negative localization economies and the exponential increase in positive localization economies. Since manufacturing industries do not dominantly rely on creative ideas of skilled labor, a beneficial effect of high levels of co-location would have to be the result of other factors. Another important implication from our results relates to the literature of spatial clusters. Our study indicates that the benefits that firms may experience from being co-located with others is preceded by competition effects and that therefore firm survival is not affected by stable regional institutions, but by industry related dynamics. In particular, we find no evidence for the fact that some regions are intrinsically endowed with a set of resources that benefit the survival of firms per se. These beneficial resources come in place through the increase of the firm population.

FIRMS IN A NETWORK CONTEXT

The second pair of studies, presented in chapter 4 and chapter 5, explicitly addresses the role of networks along the ILC. In chapter 4 the formation of the interfirm network is analyzed. While in chapter 2 and chapter 3 regional characteristics were used as the most direct form to describe firm connectedness, this chapter explicitly investigates the drivers of actual relations between firms. In particular, the collaboration patterns between publishers and developers are investigated with a clear focus on explaining the stability or instability of these patterns in dyad formation. Very few studies have quantitatively tested what drives to formation of interfirm networks and the analysis of these drivers in a dynamic setting have been virtually nonexistent. In the modeling of the research question at hand, we identified three main drivers of network formation. First, individual firm characteristics are added to the model because such characteristics are expected to influence the ability to exploit external knowledge. Second, the model includes former relational structures because network endogeneity causes structures to reproduce themselves. And finally, attribute similarity such as cognitive or geographical proximity are included because they tend to reduce transaction costs (Nooteboom 1992; Boschma 2005).

Broadly speaking, the results of the study indicate that the formation of a collaborative pair is increasingly influenced by geographical proximity, cognitive proximity and being experienced; and to a lesser extent by organizational and institutional proximity. The increasing importance of geographical proximity is attributed to the creative and project-based nature of the video game industry in which social networks and “staying in the loop” are crucial. Additionally, one may argue that the increasing technological complexity of video game development requires more interfirm collaboration at shorter geographical distances. Shorter distances allow an interaction to be more intense and more efficient which is important when dealing with technologically complex problems. The increasing importance of cognitive proximity may also be attributed to the fact that developing new video games became more technologically complex. The development of such games requires cognitively proximate partners because this proximity will increase their mutual understanding. Note that this explanation deviates from the traditional dominant design thesis which predicts that in later stages of the industry, products become more homogeneous and better codified. One may also argue that as a result of the stronger boundaries between video large pools of skilled labor. Also, firms that want access to skilled labor use acquisitions to strengthen their resource stock. In sum, chapter 3 clearly shows that the project-based nature of the industry and its atypical acquisition patterns are industry subtleties worth addressing, because of its contribution to the spatial concentration process of video game firms.

In sum, chapter 2 and chapter 3 have shed new light on regional heterogeneity and its role played in the change in the distribution of firms across space. Prior research has described how regions or other spatial entities differ in terms of its social organization and institutions by introducing concepts such as “industrial districts” (Becattini 1979; 1990), “innovative milieux” (Camagni 1991; 2002), “new industrial spaces” (Scott 1988), and “learning regions” (Florida 1995; Maskell et al. 1998). Storper (1997) referred to these concepts as untraded interdependencies and argued that they are responsible for generating spatial heterogeneity in economic competitiveness. One of the shortcomings in this literature is that it often fails to explain how regional differences come into place, and under what circumstances economic actors can benefit from them. The first two empirical chapters of this dissertation clearly constitute a step forward in addressing these shortcomings by analyzing regional differences from a more dynamic perspective.

Social capital, which is presented in this dissertation both as a regional blessing and a regional curse, has been found to have a clear impact on both the initial and the later distribution of firms in the video game industry. The definition of social capital provided by Putnam (1995) shows strong similarities to Storper’s (1997) definition of untraded interdependencies and, interestingly, the analysis in chapter 2 showed that the level of social capital should not be seen as a one-dimensional “good” or “bad”. Rather, by organizing themselves entrepreneurs are able to twist the initial negative effect of regional social capital into something positive. This is not to say that entrepreneurs are able alter the structure of the regional social organization; rather, entrepreneurs can influence what flows through this structure. By collectively diffusing knowledge about the activities of the new industry, entrepreneurs can motivate stakeholders to provide them with the resources and routines needed in their new ventures. In doing so, their environment “opens up” and turns the threat of high levels of social capital into an opportunity thereby creating a window of locational opportunity (Storper and Walker 1989). This finding also clearly relates to findings about the initial stages of the ILC. Initially very few firms enter the industry and once the activities of the industry become socially accepted, more and more firms start entering.

The other main implication of this study pertains to the relevance of regional heterogeneity for the survival of firms. We show that firms initially experience a negative effect following an increase in the number of firms in a region. However, after a region has reached a certain threshold in terms of the number of firms, the effect of a further increase in the number of firm becomes positive. Thus, being located in such regions significantly increases the likelihood of survival of firms in the video game industry. Similar to the effect of social capital, the relation between a regional population of firms and the success of these firms is dependent on the stage in which an industry finds itself. This finding refines the results from previous studies that show that – in manufacturing industries – firms do not benefit from co-location and are even harmed by an increase in concentration. The question becomes whether manufacturing firms indeed do not benefit from being co-located or that this relations simply has not been examined yet. If manufacturing firms benefit from being co-located with many others, it is interesting to study the factors that cause these benefits. In the case of the video game industry, we attributed our findings to the linear increase in negative localization economies and the exponential increase in positive localization economies. Since manufacturing industries do not dominantly rely on creative ideas of skilled labor, a beneficial effect of high levels of co-location would have to be the result of other factors. Another important implication from our results relates to the literature of spatial clusters. Our study indicates that the benefits that firms may experience from being co-located with others is preceded by competition effects and that therefore firm survival is not affected by stable regional institutions, but by industry related dynamics. In particular, we find no evidence for the fact that some regions are intrinsically endowed with a set of resources that benefit the survival of firms per se. These beneficial resources come in place through the increase of the firm population.

FIRMS IN A NETWORK CONTEXT

The second pair of studies, presented in chapter 4 and chapter 5, explicitly addresses the role of networks along the ILC. In chapter 4 the formation of the interfirm network is analyzed. While in chapter 2 and chapter 3 regional characteristics were used as the most direct form to describe firm connectedness, this chapter explicitly investigates the drivers of actual relations between firms. In particular, the collaboration patterns between publishers and developers are investigated with a clear focus on explaining the stability or instability of these patterns in dyad formation. Very few studies have quantitatively tested what drives to formation of interfirm networks and the analysis of these drivers in a dynamic setting have been virtually nonexistent. In the modeling of the research question at hand, we identified three main drivers of network formation. First, individual firm characteristics are added to the model because such characteristics are expected to influence the ability to exploit external knowledge. Second, the model includes former relational structures because network endogeneity causes structures to reproduce themselves. And finally, attribute similarity such as cognitive or geographical proximity are included because they tend to reduce transaction costs (Nooteboom 1992; Boschma 2005).

Broadly speaking, the results of the study indicate that the formation of a collaborative pair is increasingly influenced by geographical proximity, cognitive proximity and being experienced; and to a lesser extent by organizational and institutional proximity. The increasing importance of geographical proximity is attributed to the creative and project-based nature of the video game industry in which social networks and “staying in the loop” are crucial. Additionally, one may argue that the increasing technological complexity of video game development requires more interfirm collaboration at shorter geographical distances. Shorter distances allow an interaction to be more intense and more efficient which is important when dealing with technologically complex problems. The increasing importance of cognitive proximity may also be attributed to the fact that developing new video games became more technologically complex. The development of such games requires cognitively proximate partners because this proximity will increase their mutual understanding. Note that this explanation deviates from the traditional dominant design thesis which predicts that in later stages of the industry, products become more homogeneous and better codified. One may also argue that as a result of the stronger boundaries between video game genres – which show some analogy to dominant designs – firms are likely to specialize and are therefore drawn to more cognitively similar firms.

The findings in this chapter somewhat contradict the outcomes in a study on German co-inventor networks in biotech, which showed a deceasing importance of geographical proximity as time passed by (Ter Wal 2011). This paper refers to Audretsch and Feldman (1996) who argue that during the initial stages of a new industry, when knowledge tends to be highly tacit, geographical proximity is likely to foster performance, while this is not per se the case in later stages. They argue that these changing benefits stem from the fact that knowledge is initially tacit and becomes codified in later stages. Since tacit knowledge is better communicated over shorter distances, geographical proximity is expected to be more important in the first stages of industrial development. We argue that our findings deviate from the ideas proposed by Audretsch and Feldman (1996) because creative, project-based industries such as the video game industry do not follow typical ILC based on the process of product homogenization. Although game codes are inherently codified, the value of these codes is largely dependent on fads and fashions and the knowledge on what is valuable is largely tacit.

Chapter 5 further builds on the ideas laid out in chapter 4. Specifically, it addresses the relation between interfirm networks and firm performance and extends the current line of research by explicitly integrating insights from network analytic research with theoretical arguments found in research on the technological evolution of industries. It shows how new technologies prompt firms to shift their focus from exploitation to exploration. Each new generation of video game consoles creates challenges and opportunities for the developers of video games by introducing new technological standards and thereby allowing firms to explore the boundaries of the new standards. The improvements in technology of next-generation game consoles allow game developers to create video games that are significantly different from the games produced for the prior-generation consoles. As a result, the production of video games – around the release of a new generation of consoles – is characterized by the exploration of the creative boundaries of the new technology

The findings show that the failure of a firm's network partners affects the life chances of these firms and its effect varies with the strength of network ties. The loss of network partners as such has a negative effect on survival. During periods of low technological turbulence, failure of strongly tied network partners is more likely to affect firm survival than the failure of weakly tied network partners. However, during technological transitions firms can benefit from the failure of strongly tied network partners. This safeguards these firms from becoming locked-in into relational partnerships. Also, the benefits that arise from diversity among a firm's network partners are moderated by the changes in technological settings in an industry. Such diversity allows firms to quickly identify new opportunities, to stay flexible in adapting to new contexts and to exploit these relationships whenever necessary. This is not per se the case in eras that are rather stable, since the locus of profit making in these eras is found in exploitation of competences, rather than exploration.

These findings shine a new light on network analytic studies trying to model the relation between the embeddedness of firms in webs of relations and the performance of these firms. Prior research has been mainly concerned with analyzing which structure surrounding ego in the network yields the highest benefits for ego. While these studies partially rely on structure as reflecting a power hierarchy, another factor that is mentioned to stem from network structure is the level of similarity of information flowing through a network. We argue that this is mainly an assumption and that directly measuring how firms differ in terms of the knowledge that they have acquired throughout their lifespan may disentangle the power and information arguments. Such an approach forces network studies to also pay clear attention to content in relations, rather than network structure only.

In sum, the main implications from chapter 4 and chapter 5 relate to the role of formal networks and its dependence on changes along the ILC. Scholars of social networks have dominantly studied networks from a static perspective. Such a perspective does not fully address issues related to the extent to which the observed network structures come into being and how they affect the survival of firms in different stages of the ILC. Chapter 4 and chapter 5 explicitly analyze networks with a dynamic focus and the analyses reveal that the structure of the networks and the benefits that stem from these structures are subject to change over time. The evolutionary approach and the focus on networks as a diffusion mechanism position these studies at the core of the research program of Evolutionary Economic Geography as outlined by Boschma and Frenken (2006).

LIMITATIONS AND FUTURE RESEARCH

Thus far, we have described the contribution of this dissertation to the literature on the spatial concentration of economic activity. Our analysis of the video game industry has offered some new insights on the processes of the spatial evolution of a project-based industry, but in addition to the questions that are left unanswered the new insights also raised new questions that can be regarded as a stimulus for future research. Below we will discuss some of the avenues open for future research.

First, we identified formal collaboration networks and co-location as mechanisms responsible for the diffusion of resources and routines. However, there are other mechanisms too that, similar to collaboration networks and co-location, are expected to rely on changes in the ILC and have a spatial dimension. For example, the acquisition of firms has been argued to be a fast solution to fill a gap between the resources currently present in a firm and the resources needed to remain successful. A question then becomes whether acquisition activity is linked to the ILC and whether the pattern of acquisitions is affected by spatial factors? A wide range of studies in the acquisition literature has found that acquisitions tend to be associated with problems of aligning and integrating the routinized practices of the acquirer and the target firm (Ranft and Lord 2002). This finding may be attributed to the stage of the industry. In the initial stages of the industry firms do not yet have a clear focus and are rather flexible, while firms in later stages of the industry have a clear orientation and are much less flexible. For an acquiring firm, this may be an important issue to address when planning to acquire a new target. The finding that acquisitions are associated with problems of aligning and integrating the routinized practices of the acquirer and the target may also relate to the spatial backgrounds of firms. For example, Chapman (2003) describes how cross-border acquisitions have replaced greenfield investments as the dominant mode of entering a new country. This tendency exposes some of the issues related to the recombination of companies with back grounds in different corporate geographies.

Another example of a diffusion mechanism is labor mobility. While there is some variation across countries, labor is not particularly mobile in space and various studies have shown that an increase in local tenure decreases the probability of employees changing either workplace or, in particular, region of residence (Gordon and Molho 1995; Eriksson et al. 2008; Boschma et al. 2008). Also, Agrawal et al. (2006) found that, based on patent data, *"knowledge flows to an inventor's prior location are approximately 50% greater than if they had never lived there, suggesting that social relationships, not just physical proximity, are important for determining flow patterns"* (Agrawal et al. 2006, p. 571). Based on these insights the question arises of how labor mobility patterns shift along the ILC and how the stability or instability of these patterns affects the process of spatial concentration? Especially in industries that rely heavily on labor such as the video game industry, these patterns are likely to have a great impact on the geographical clustering. Something to take into consideration is the homogenization of a local labor force. If labor mobility tends to occur over small distances and as employees within the same spatial area show high levels of institutional and cognitive similarity, regions may become homogeneous in terms of its labor force (DiMaggio and Powell 1983). Such homogeneity can provide a threat as soon as new technologies emerge (Tushman and Anderson 1986).

It may also be that different diffusion mechanisms are related to one another. We already found that geographically proximate firms are more likely to team up for the production of a video game. A subsequent result from such a formal collaboration can be that the mobility of labor between the two network partners increases or that firms that have previously worked together show a greater likelihood of acquiring one another. An increase of linkages between two firms will also have its effect on the similarity of firms in terms of the resources and routines that these firms rely upon. For example, while the transfer of employees from one company to the other implies a movement of skills rather than the diffusion of routines a combination between labor mobility and formal collaboration may cause the routines of the two firms to diverge. Indeed, the mere effect of labor mobility will not relate to changes in routines because firms that receive new labor are incumbents that have already established routines and the tacitness of routines inhibits single employees from fully articulating them in the new setting.

A second suggestion is to study the role of policy in the process of spatial concentration. In this dissertation, we have been virtually silent about the role of policy and its implications on the outcomes presented in this dissertation. However, the increasing tendency of local policy makers to develop policies to attract video game firms and other related types of firms (Scott 2006) and the abundant interest of young entrepreneurs to set up video game businesses raises the importance of studying the role of such policies in processes of spatial concentration. One of the challenges for researchers taking up this task is the herculean effort needed to collect data on local policy making in a systematic way. Regional policies differ by and large and mapping the spatial heterogeneity in these policies will require access to data from a large variety of organizations – even within the region. One of the interesting questions to be answered is how regional or national policies can be aligned with the different temporal stages that industries go through. Is policy flexible enough to support local economic activity during a transitioning period in which industrial conditions and structures are subject to change? And how do regional policy makers compete with other regional policy makers? In particular, are policies in different regions within countries supportive of one another or do regions compete at the national level? Answering such questions about the spatial and temporal dimension of economic stimulation policies would provide useful insights both for academic research and local policy makers.

A third suggestion for future research is to more precisely analyze the content and the context of what is actually diffused through networks and among spatially proximate firms. Current research on the connectedness of firms mostly observes whether there is a connection between firms and how firms change behavior or increase performance as a result from such a connection. However, little is known about what it is in relations with other firms or stakeholders that makes firms to behave and perform differently. As already mentioned in chapter 5, a large share of network analytic research investigates the influence of network structures on firm performance without paying attention to the fact that firms and other stakeholders have histories, diverse experiences, heterogeneous knowledge bases and different skill sets that they bring into their collaborations (Fleming et al. 2007). By analyzing this qualitative heterogeneity in network relations researchers will be better able to understand the mechanisms that underlie the social behavior of firms.

Analyzing the content and the context of relations will also greatly enhance the our understanding of the mechanism that underlies the succes of spinoff firms. Spinoffs are often argued to outperform other entrants as a result of routine replication. However, spinoffs may also outperform other firms because of other reasons. For example, Buenstorf and Fornahl (2009) showed that the inheritance of network relations from their parent firm may also play an important role in the success of spinoffs. In addition to the inheritance of networks, spinoffs may also benefit from the reputation that they have established through their affiliation with the parent firm. This reputation can help them getting access to financial resources because providers of financial inputs a better able to make estimations of the financial behavior of the new organizational unit. It also may explain their improved access to skilled pools of employees and desirable real estate locations.

This suggestion requires a more thorough "social network analysis" of collaboration networks and of spinoff lineages. Indeed, while social network analysis provides a powerful framework to study the relationships between people or firms as expressed as binary or weighted adjacency matrices, it is limited in the sense that it often fails to capture the context of an interaction. Thus, rather than answering the question of whether there is a diffusion of resources and routines, one should answer questions about how much and what is actually diffused. In the final empirical chapter we provided a first attempt to move beyond a dichotomous representation of a relation by stressing the qualitative nature of a relationship. Future research could further develop this avenue, for example by directly studying the content of relationships. The increasing quality of large online databases may allow researchers to do so.

A last suggestion is to collect data and to start working on analyzing the spatial concentration processes of industries in relation to the spatial distribution of other industries. Klepper (2002a) and Buenstorf and Klepper (2010) show how entry levels and survival levels of firms are related to the presence of related industries and Neffke (2009) and Neffke et al. (2011) argue that related industries exhibit high levels of labor mobility. For example, industries can be related based on their cognitive distance from one another (Nooteboom 1992). Low cognitive distance refers to the fact that knowledge and skills of the workers in two different industries exhibit high levels of similarity. Such low cognitive distance between two industries decreases the costs of applying knowledge acquired in one industry in the other. Another mechanism through which the co-presence of related industries may affect the spatial organization of an industry is the creation of legitimacy. Different industries that share some common features can clear the roads in terms of generating understanding for a new activity. For example, it may be that the presence of toy or cartoon producers in a region allowed video game producers to get access to resources that would have been otherwise unavailable. Based on these ideas one could argue that industries are likely to show high levels of entry and high levels of survival if related industries are present in the region.

Examples of the spatial co-location of cognitively proximate industries are abundant. For example, in addition to the high concentration of video game firms in the San Francisco region, this region is also characterized by its abundance of software producers and hardware manufacturers. Following Klepper (2002a) and Buenstorf and Klepper (2010) one could argue that these industries form breeding grounds for entrepreneurs with the ambition of setting up a video game firm. The experiences that entrepreneurs gain in these industries make them more likely and more suitable to enter the video game industry than other entrepreneurs. Following Neffke (2009) and Neffke et al. (2011), one could argue that the co-presence of video game production one the one hand and software production and hardware manufacturing on the other reinforces its mutual dominance in the respective industries. Indeed, the potential of large flows of labor mobility between the industries is likely to create opportunities to create new and innovative new products.

We hope that this research will provide a useful reference for scholars aiming to study spatial concentration processes from a dynamic perspective. Our attempt was to study both firm founding and firm failure events and to relate to sources of such events to the different stages of the ILC. This dissertation pointed out that by studying the historical process of the embeddedness of firms in webs of social relations offers an important foundation to explain the founding and failure of firms in a spatial setting.

References chapter 6

Abernathy, W.J., Utterback J.M. (1978). Patterns of innovation in industry. Technology Review 80 (7): 40 – 47.

Aldrich, H.E., Fiol, C.M. (1994). Fools rush in? The institutional context of industry creation. Academy of Management Review 19 (4): 645 – 670.

Almeida, P., Kogut, B. (1997). The exploration of technological diversity and the geographic localization of innovation. Small Business Economics 9: 21 – 31.

Amit, R., Schoemaker, P.J. (1993). Strategic assets and organisational rent. Strategic Management Journal 14: 33 – 46.

Audretsch, D., Feldman, M. (1996) Innovative clusters and the industry life cycle. Review of Industrial Organization 11: 253 – 273.

Balland, P.A. (2011). Proximity and the evolution of collaboration networks: Evidence from research and development projects within the Global Navigation Satellite System (GNSS) industry. Regional Studies, in print.

Banerjee, A.V. (1992). A simple model of herd behavior. Quarterly Journal of Economics 107 (3): 797 – 817.

Barney, J. (1991). Firm resources and sustained competitive advantage. Journal of Management 17: 99 – 120.

Baum, J.A.C., Mezias, S.J. (1992). Localized competition and organizational failure in the Manhattan hotel ndustry, 1898 – 1990. Administrative Science Quarterly 37 (4): 580 – 604.

Becker, M.C. (2004). Organizational routines. A review of the literature. Industrial and Corporate Change 13: 643 – 677.

Bikhchandani, S., Hirschleifer, D., Welch, I. (1992). A theory of fads, fashion, custom, and cultural change as informational cascades. Journal of Political Economy 100: 992 – 1026.

Boggs, J., Rantisi, N. (2003). The ‘relational’ turn in economic geography. Journal of Economic Geography 3: 109 – 116.

Boschma, R. (2005). Proximity and innovation: a critical assessment. Regional Studies 39: 61 – 74.

Boschma, R.A., Frenken, K. (2006). Why is economic geography not an evolutionary science? Towards an evolutionary economic geography. Journal of Economic Geography 6: 273 – 302.

Boschma, R.A., Frenken, K. (2003). Evolutionary economics and industry location. Review for Regional Research 23: 183 – 200.

Boschma, R., Frenken, K. (2010). The spatial evolution of innovation networks: a proximity perspective. In R. Boschma and R. Martin (eds.), The Handbook on Evolutionary Economic Geography. Cheltenham, UK: Edward Elgar, pp. 120 – 135.

Boschma, R.A., Wenting, R. (2007). The spatial evolution of the British automobile industry: Does location matter? Industrial and Corporate Change 16 (2): 213 – 223.

Braunerhjelm, P., Feldman, M. (eds.) (2006). Cluster genesis. Technology–based industrial development. Oxford: Oxford University Press.

Breschi S., Lissoni, F. (2001). Knowledge spillovers and local innovation systems: A critical survey. Industrial and Corporate Change 10 (4): 975 – 1005.

Bresnahan, T., Gambardella, A. (eds.) (2004). Building High-Tech Clusters: Silicon Valley and Beyond. Cambridge: Cambridge University Press.

Brown, J.S., Duguid, P. (1991). Organizational learning and communities of practice: a unified View of Working, Learning and Innovation. Organization Science 2 (1): 40 – 56.

Buenstorf, G., Klepper, S. (2009). Heritage and agglomeration: the Akron tyre cluster revisited. The Economic Journal 119: 705 – 733.

Buenstorf, G., Fornahl, D. (2009). B2C - Bubble to cluster: The dot.com boom, spin-off entrepreneurship, and regional agglomeration. Journal of Evolutionary Economics 19: 349 – 378.

Burt, R.S. (2005). Brokerage and Closure: An introduction to social capital. New York, New York: Oxford University Press.

Caves, R.E. (2000). Creative industries: Contracts between art and commerce. Cambridge, Massachusetts: Harvard University Press.

Caves, R.E. (2002). Creative industries: Contracts between art and commerce. Journal of Cultural Economics 26 (1): 82 – 84.

Cefis, E., Marsili, O. (2007). Going, going, gone. Innovation and exit in manufacturing firms. ERIM Report Series. Reference No. ERS-2007-015-ORG

Christensen, C.M., Bower, J.L. (1996). Customer power, strategic investment, and the failure of leading firms. Strategic Management Journal 17: 197 – 218.

Cohen, W.M., Levinthal, D.A. (1990). Absorptive capacity: A new perspective on learning and innovation. Administrative Science Quarterly 35: 128 – 152.

Cooke, P., Lazzeretti, L. (eds.) (2008). Creative cities, cultural clusters and local economic development. Cheltenham, UK: Edward Elgar.

Cox W.E. (1967). Product life cycles as marketing models. Journal of Business 40 (4): 375 – 384.

Delmestri, G., Montanari, F., Usai, A. (2005). Reputation and strength of ties in predicting commercial success and artistic merit of independents in the italian film industry. Journal of Management Studies 42: 975 – 1002.

DeVany, A., Walls., W.D. (1999). Uncertainty in the movie industry: Does star power reduce the terror of the box office? Journal of Cultural Economics 23: 285 – 318.

DiMaggio, P. (1997). Culture and cognition. Annual Review of Sociology 23: 263 – 287.

DiMaggio, P.J., Powell, W.W. (1983). The iron cage revisited: Institutional isomorphism and collective rationality in organizational fields. American Sociological Review 48: 147 – 160.

Fleming, L., Mingo, S., Chen, D. (2007). Brokerage and collaborative creativity. Administrative Science Quarterly 52: 443 – 475.

Frenken, K., Boschma, R.A. (2007). A theoretical framework for evolutionary economic geography: industrial dynamics and urban growth as a branching process. Journal of Economic Geography 7: 635 – 649.

Friedman, T. (2005). The world is flat. New York, New York: Farrar, Straus and Giroux.

Ghemawat, P. (2007). Redefining global strategy: Crossing borders in a world where differences still matter. Boston, Massachusetts: Harvard Business School Press.

Gilbert, C.G. (2005). Unbundling the structure of inertia: Resource versus routine rigidity. The Academy of Management Journal 48 (5): 741 – 763.

Giuliani, E. (2007). The selective nature of knowledge networks in clusters: evidence from the wine industry. Journal of Economic Geography 7: 139 – 168.

Glückler, J. (2007). Economic geography and the evolution of networks. Journal of Economic Geography 7: 619 – 634.

Gort, M., Klepper, S. (1982). Time paths in the diffusion of product innovations. Economic Journal 92: 630 – 653.

Grabher, G. (2002). The Project Ecology of Advertising: Tasks, Talents, and Teams. Regional Studies, 36 (5): 245 – 262.

Grabher, G. (2004). Learning in projects, remembering in networks? Communality, sociality, and connectivity in project ecologies. European Urban and Regional Studies 11 (2): 99 – 119.

Grabher, G. (2006). Trading routes, bypasses, and risky intersections: Mapping the travels of 'networks' between economic sociology and economic geography. Progress in Human Geography 30 (2): 163 – 189.

Granovetter, M.S. (1973). The strength of weak ties. American Journal of Sociology 78: 1360 – 1380.

Gulati, R. (1999). Network location and learning: The influence of network resources and firm capabilities on alliance formation. Strategic Management Journal 20 (5): 397 – 420.

Hannan, M.T., Freeman, J.H. (1977). The population ecology of organizations. American Journal of Sociology 82: 929 – 964.

Hannan, M.T., Freeman, J.H. (1989). Organizational ecology. Cambridge, Massachusetts: Harvard University Press.

Heebels, B., Boschma, R. (2011). Performing in Dutch book publishing 1880-2008. The importance of entrepreneurial experience and the Amsterdam cluster. Journal of Economic Geography, in print.

Heiner, R. (1983). The origin of predictable behavior. American Economic Review 73: 560 – 595.

Heiner, R. (1988). Imperfect decisions and routinized production: Implications for evolutionary modeling and inertial technical change. In G. Dosi, C. Freeman, R. Nelson, G. Silverberg and L. Soete (eds.) Technical Change and Economic Theory. London, UK: Pinter Publishers, pp. 148 – 169.

Henderson, R., Clark. K. (1990). Architectural innovation: The reconfiguration of existing product technologies and the failure of established firms. Administrative Science Quarterly 35: 9 – 31.

Hirsch, P.M. (1972). Processing fads and fashions: An organization-set analysis of cultural industry systems. American Journal of Sociology 77: 639 – 659.

Hirsch, S. (1967). Location of industry and international competitiveness. Oxford, UK: Oxford University Press.

Hite, J.M., Hesterly, W.S. (2001). The evolution of firm networks. Strategic Management Journal 22 (3): 275 – 286.

Hunt, S.D., Morgan, R.M. (1995). The comparative advantage theory of competition. The Journal of Marketing 59 (2): 1 – 15.

Jaffe A.B., Trajtenberg, M., Henderson R. (1993). Geographic localization of knowledge spillovers as evidenced by patent citations. Quarterly Journal of Economics 108 (3): 577 – 598.

Jovanovic B., MacDonald, G.M. (1994). The life cycle of a competitive industry. Journal of Political Economy 102 (2): 322 – 347.

Kent, S.L. (2001). The ultimate history of video games: From Pong to Pokemon - The story behind the craze that touched our lives and changed the world. New York, New York: Prima Publishing.

Klepper, S. (1996). Entry, exit, growth, and innovation over the product life cycle. American Economic Review 86: 562 – 583.

Klepper, S. (1997). Industry life-cycles. Industrial and Corporate Change 6: 145 – 182.

Klepper, S. (2002a). The capabilities of new firms and the evolution of the US automobile industry. Industrial and Corporate Change 11: 645 – 666.

Klepper, S. (2002b). Firm survival and the evolution of oligopoly. RAND Journal of Economics 33 (1): 37 – 61.

Klepper, S. (2007). Disagreements, spinoffs, and the evolution of Detroit as the capital of the U.S. automobile industry. Management Science 53 (4): 616 – 631.

Klepper, S. (2010). The origin and growth of industry clusters: The making of Silicon Valley and Detroit. Journal of Urban Economics 67: 15 – 32.

Klepper, S., Sleeper, S. (2005). Entry by spinoffs. Management Science 51: 1291 – 1306.

Kogut, B., Zander, U. (1992). Knowledge of the firm, combinative capabilities, and the replication of technology. Organization Science 3: 383 – 397.

Kor, Y.Y., Mahoney, J.T. (2004). Edith Penrose's (1959) contributions to the resource-based view of strategic management. Journal of Management Studies 41 (1): 183 – 191.

Krugman, P. (1991). Geography and trade. Leuven, Belgium: Leuven University Press.

Lazzeretti, L., Boix, R., Capone, F. (2008). Do creative industries cluster? Mapping creative local production systems in Italy and Spain, Working Paper 08.05, Departament d'Economia Aplicada, Universitat Autònoma de Barcelona.

Lippman, S.A., Rumelt, R.P. (1982). Uncertain imitability: An analysis of interfirm differences in efficiency under competition. Bell Journal of Economics 13: 418 – 438.

Lorenzen, M., Frederiksen, L. (2007). Why do cultural industries cluster? Localization, urbanization, products and projects. In P. Cooke and R. Lazzeretti (eds.), Creative cities, cultural clusters, and local economic development, Cheltenham, UK: Edward Elgar, pp. 155 – 179.

Malmberg, A., Maskell, P. (2006). Localized learning revisited. Growth and Change 37: 1 – 18.

Marshall, A. (1920) (original pub. 1890). Principles of political economy, 8th edition. London, UK: Macmillan.

Martin, R., Sunley, P. (2003). Deconstructing clusters: Chaotic concept or policy panacea? Journal of Economic Geography 3: 5 – 35

McPherson, M., Smith-Lovin, L., Cook, J.M. (2001). Birds of a feather: Homophily in social networks. Annual Review of Sociology 27: 415 – 444.

Mezias, J., Mezias, S. (2000). Resource partitioning, the founding of specialist firms, and innovation: The American feature film industry, 1912–1929. Organization Science 11: 306 – 322.

Montgomery, C.A., Wernerfelt, B. (1988). Diversification, Ricardian rents, and Tobin's q. The RAND Journal of Economics 19 (4): 623 – 632.

Morrison, A. (2008). Gatekeepers of knowledge within industrial districts: Who they are, how they interact. Regional Studies 42: 817 – 835.

Murmann, J.P. (2003). Knowledge and competitive advantage: The coevolution of firms, technology, and national institutions. Cambridge, UK: Cambridge University Press.

Murmann, J.P., Frenken, K. (2006). Towards a systematic framework for research on dominant designs, technological innovations, and industrial change. Research Policy 35: 925 – 952.

Neffke, F.M.H. (2009, July 10). Productive places: The influence of technological change and relatedness on agglomeration externalities. Utrecht University.

Neffke, F.M.H., Henning, M., Boschma, R.A. (2011). How do regions diversify over time? Industry relatedness and the development of new growth paths in regions. Economic Geography, in print.

Nelson, R., S. Winter. (1982). An evolutionary theory of economic change. Cambridge, UK: Belknap.

Nooteboom, B. (1992). Towards a dynamic theory of transactions. Journal of Evolutionary Economics 2: 281 – 299.

Penrose, E.T. (1959). The theory of the growth of the firm. Oxford, UK: Basil Blackwell.

Phelps, C.C. (2010). A longitudinal study of the influence of alliance network structure and composition on firm exploratory innovation. Academy of Management Journal 53 (4): 890 – 913.

Podolny, J.M. (2001). Networks as the pipes and prisms of the market. American Journal of Sociology 107 (1): 33 – 60.

Porter, M. (1990). The competitive advantage of nations. New York, New York: Free Press.

Powell, W.W., Koput, K.W., Smith-Doerr, L. (1996). Interorganizational collaboration and the locus of innovation: Networks of learning in biotechnology. Administrative Science Quarterly 41: 116 – 145.

Pratt, A.C. (1997). The cultural industries production system: a case study of employment change in Britain, 1984–1991. Environment and Planning A 29 (11): 1953 – 1974.

Putnam, R. D. (1995). Bowling alone: America's declining social capital. The Journal of Democracy 6 (1): 65 – 78.

Rantisi, N.M. (2004). The ascendance of New York fashion. International Journal of Urban and Regional Research 28: 86 – 106.

Rivera, M., Soderstrom, S., Uzzi, B. (2010). Dynamics of dyads in social networks: Assortative, relational, and proximity Mechanisms. Annual Review of Sociology 36: 91 – 115.

Rogers, D.L. (2004). The end game: How top developers sold their studio. Gamasutra Features, http://www.gamasutra.com/features/20040303/rogers_01.shtml.

Salen, K., Zimmerman, E. (2004). Rules of play: Game design fundamentals. Cambridge, Massachusetts: MIT Press.

Salganik, M.J., Dodds, P.S., Watts, D.J. (2006). Experimental study of inequality and unpredictability in an artificial cultural market. Science 311: 854 – 856.

Schoales, J. (2006). Alpha clusters: Creative innovation in local economies. Economic Development Quarterly 20: 162 – 177

Schumpeter, J.A. (1975) (original pub. 1942). Creative destruction. From capitalism, socialism and democracy. New York, New York: Harper.

Scott, A.J. (1997). The cultural economy of cities. International Journal of Urban and Regional Research 21 (2): 323 – 339.

Scott, A.J. (2000). The cultural economy of cities: Essays on the geography of image-producing industries. London, UK: Sage.

Scott, A.J. (2004). Hollywood and the world: The geography of motion-picture distribution and marketing. Review of International Political Economy 11: 33 – 36.

Scott, A.J. (2006). Creative cities: Conceptual issues and policy questions. Journal of Urban Affairs, 28: 1 – 17.

Selznick, P. (1957). Leadership in administration. New York, New York: Harper and Row.

Sorenson, O., Waguespack, D.M. (2006). Social structure and exchange: Self-confirming dynamics in Hollywood. Administrative Science Quarterly 51 (4): 560 – 589.

Sorenson, O. (2003). Social networks and industrial geography. Journal of Evolutionary Economics 13 (5): 513 – 527.

Stark, D. (2009). The sense of dissonance. Accounts of worth in economic life. Princeton and Oxford: Princeton University Press.

Sorenson, O., Rivkin, J., Fleming, L. (2006). Complexity, networks and knowledge flow. Research Policy 35: 994 – 1017.

Storper, M. (1995). The resurgence of regional economies, ten years later: The region as a nexus of untraded interdependencies. European Urban and Regional Studies 2 (3): 191 – 221.

Storper, M. (1997). The regional world: Territorial development in a global economy. New York, New York: Guilford Press.

Storper, M., Venables, A. (2004). Buzz: face-to-face contact and the urban economy. Journal of Economic Geography 4: 351 – 370.

Storper, M., Walker, R. (1989). The capitalist imperative: territory, technology and industrial growth. Oxford, UK: Blackwell Publishing.

Teece D.J., Pisano G., Shuen A. (1997). Dynamic capabilities and strategic management. Strategic Management Journal 18 (7): 509 – 533.

Ter Wal, A. (2009, November 19). The structure and dynamics of knowledge networks. Utrecht University.

Ter Wal, A., Boschma, R. (2009). Applying social network analysis in economic geography: theoretical and methodological issues. The Annals of Regional Science 43: 739 – 756.

Ter Wal, A. (2011). The spatial dynamics of the inventor network in German biotechnology: Geographical proximity versus triadic closure. Papers in Evolutionary Economic Geography 11.02, Section of Economic Geography, Utrecht University.

Tschang, F.T. (2007). Balancing the tensions between rationalization and creativity in the video game industry. Organization Science 18: 989 – 1005.

Tushman, M.L, Anderson, P. (1986). Technological discontinuities and organizational environments. Administrative Science Quarterly 31: 439 – 465.

Utterback, J.M. (1994). Mastering the dynamics of innovation. Boston, Massachusetts: Harvard Business School Press.

Utterback, J.M., Abernathy, W.J. (1975). A dynamic model of product and process innovation. Omega 3: 639 – 656.

Uzzi, B. (1997). Social structure and competition in interfirm networks: The paradox of embeddedness. Administrative Science Quarterly 42: 35 – 67.

Vedres, B., Stark, D. (2010). Structural folds: Generative disruption in overlapping groups. American Journal of Sociology 15 (4): 1150 – 1190.

Vernon R. (1966). International investment and international trade in the product cycle. Quarterly Journal of Economics 80 (2): 190 – 207.

Wenting, R. (2008, September 11). The evolution of a creative industry. The industrial dynamics and spatial evolution of the global fashion design industry. Utrecht University.

Weitzman, M.L. (1998). Recombinant growth. The Quarterly Journal of Economics 113 (2): 331 – 360.

Wernerfelt, B. (1984). A resource-based view of the firm. Strategic Management Journal 5: 171 – 180.

Zaheer, A., Bell, G.G. (2005). Benefiting from network position: Firm capabilities, structural holes, and performance. Strategic Management Journal 26: 809 – 825.

Zollo, M., Winter, S.G. (2002). Deliberate learning and the evolution of dynamic capabilities. Organization Science 13 (3): 339 – 353.

Summary in Dutch
Samenvatting in het Nederlands

INLEIDING

Er zijn veel voorbeelden van bedrijfssectoren waarin het merendeel van alle bedrijven zich in één of slechts enkele regio's hebben gevestigd. Veel producenten van computers en halfgeleiders hebben zich bijvoorbeeld gevestigd in Silicon Valley, terwijl automobielproductie in de Verenigde Staten zich voornamelijk afspeelt in en rondom Detroit. Deze ongelijke ruimtelijke spreiding van economische activiteit heeft zowel geografen als economen aangezet tot het bestuderen van de totstandkoming van deze patronen.

Doorgaans hebben economen getracht om dergelijke spreidingspatronen te verklaren vanuit abstracte modellen die uiteindelijk convergeren naar een evenwichtssituatie. Deze modellen zijn veelal gebaseerd op vergaande aannames zoals toegang tot volledige informatie voor actoren en een grote mate van homogeniteit tussen actoren. Geografen daarentegen hebben getracht de ruimtelijke spreidingspatronen te verklaren door heel gedetailleerd naar de verschillen en overeenkomsten tussen unieke regio's te kijken en vanuit deze verschillen en overeenkomsten een patroon te identificeren. Hierbij wordt voornamelijk gebruik gemaakt van narratieven en anekdotisch bewijs.

De uitkomsten die binnen de twee disciplines worden gepresenteerd zijn uiteenlopend. Waar economen hameren op de rol van toenemende meeropbrengsten, benadrukken geografen voornamelijk de institutionele verschillen tussen regio's. Door de grote verschillen in verklaringen en de uiteenlopende methodologieën vindt er weinig fundamentele discussie plaats tussen de twee disciplines. Recentelijk is er een derde benadering ontstaan, Evolutionaire Economische Geografie genaamd, die ten doel heeft de sterke punten uit beide disciplines verder uit te werken en uit te breiden om zo een historische verklaring te geven voor de ongelijke ruimtelijke spreiding van economische activiteit. Eén van de belangrijkste argumenten binnen deze benadering is dat bedrijven gedurende de levenscyclus van een industrie continue verwikkeld zijn in een proces waarin kennis, ideeën en routines worden uitgewisseld en worden hergebruikt. Dit diffusieproces heeft een duidelijke ruimtelijke inslag, omdat de uitwisseling van kennis, ideeën en routines vaak over een kleine afstand plaatsvindt.

Deze dissertatie belicht de twee belangrijkste factoren die zo'n diffusieproces kenmerken. Allereerst belichten we het feit dat diffusieprocessen sterk tijdsafhankelijk zijn. Met andere woorden, het karakter van het diffusieproces verandert naarmate een industrie zich verder ontwikkelt. De ontwikkeling van een industrie kan worden geanalyseerd met behulp van het industrielevenscyclus concept. Dit concept beschrijft de patronen van toetreding en uittreding van bedrijven en de basis waarop bedrijven concurreren. Vaak maken industrieën een transitie door van een beginsituatie met weinig toetreders naar een situatie met veel toetreders en veel verschillende producten, gevolgd door een sterke daling in het aantal bedrijven en een homogenisering van producten. Uiteindelijk neemt de industrie een oligopolistische vorm aan. Klepper (2007) verklaart dit patroon vanuit twee karakteristieken die de bedrijven in een industrie verschillend maken: de tijd van toetreding en de ervaringen van ondernemers vóór toetreding. Bedrijven die eerder toetreden en meer ervaring hebben vóór toetreding zijn groter en productiever, waardoor ze opbrengsten van onderzoek en ontwikkeling voor meerproducten kunnen gebruiken en waardoor de uitvoer van onderzoek en ontwikkelingproductiever is. Een belangrijke les in deze verklaring is, dat de ervaringen van ondernemers die ze hebben opgedaan bij andere bedrijven – en wat dus kan worden gezien als diffusie – van cruciaal belang zijn voor de ontwikkeling van een industrie. De tweede factor die een belangrijke rol speelt in het diffusieproces is het mechanisme dat verantwoordelijk is voor de verspreiding van kennis, ideeën en routines nadat bedrijven reeds zijn toegetreden. Immers, bedrijven doen het niet alleen beter of slechter als gevolg van een aantal initiële condities: bedrijven leren, veranderen en passen zich aan. Deze leerprocessen kunnen worden geanalyseerd aan de hand van een netwerkbenadering. Een netwerk kan worden gezien als een web van relaties waarin bedrijven zijn verwikkeld. Het idee is dat bedrijven voornamelijk leren van hun omgeving en niet als geïsoleerde eenheden slechts vertrouwen op zelfreflectie. In deze dissertatie behandelen we twee vormen van netwerken. De eerste vorm is zeer expliciet en gaat over de formele relaties die bedrijven aangaan met andere bedrijven om samen producten te produceren. Tijdens dergelijke productieprocessen wisselen bedrijven ideeën uit en leren ze van elkaar. De tweede vorm is meer impliciet en gaat over alle informele relaties die bedrijven aangaan met andere bedrijven, personen, overheidsinstellingen en andere organisaties. Dit soort relaties berusten niet op contracten, zijn weinig formeel, maar kunnen een belangrijke rol spelen in het toegang krijgen tot waardevolle productiemiddelen. Voorbeelden van dit soort relaties zijn sociale netwerken tussen werknemers en familierelaties. Dergelijke relaties spelen zich vaak af over kortere afstanden (Grabher 2002).

Samengevat gaat het onderzoek over de ruimtelijke dimensie van diffusiepatronen van kennis, ideeën en routines tussen bedrijven in relatie tot de industrielevenscyclus. We baseren ons onderzoek op gegevens over de videogame industrie. Deze industrie is sterk geconcentreerd in enkele regio's wereldwijd en draagt in toenemende mate bij aan de welvaart in westerse economieën. Daarnaast is de videogame industrie grotendeels gebaseerd op samenwerking tussen bedrijven, omdat net als in andere project georiënteerde industrieën een product wordt geproduceerd door een team van mensen dat afkomstig is van meerdere bedrijven (Caves 2003). Op basis van deze data geven we antwoord op de belangrijkste vraag binnen deze dissertatie:

ONDERZOEKSVRAAG

HOE KAN DE RUIMTELIJKE CONCENTRATIE VAN DE VIDEOGAME INDUSTRIE WORDEN BEGREPEN ALS EEN UITKOMST VAN DE SOCIALE, ECONOMISCHE AND INSTITUTIONELE VERBONDENHEID VAN BEDRIJVEN GEDURENDE DE INDUSTRIELEVENSCYCLUS?

BEVINDINGEN

Om antwoord te geven op de onderzoeksvraag hebben we vier deelonderzoeken uitgevoerd. In deze deelonderzoeken bestuderen we hoe bedrijven in verschillende fasen van de industrielevenscyclus beïnvloed worden door netwerkrelaties met andere bedrijven en overige organisaties, die deze bedrijven van waardevolle productiemiddelen kunnen voorzien.

DEELVRAAG 1

HOE BEÏNVLOEDT HET SOCIAAL KAPITAAL IN EEN REGIO HET VESTIGINGSGEDRAG VAN BEDRIJVEN IN DE AMERIKAANSE VIDEOGAME INDUSTRIE?

Bedrijven in traditionele maakindustrieën zoals automobielproductie of kledingproductie staan onder zware druk van concurrentie uit lage lonen landen. Nationale en regionale overheden besteden daarom veel aandacht aan het stimuleren en aantrekken van nieuwe industrieën om economische groei veilig te stellen. Dit heeft wetenschappers gemotiveerd om te onderzoeken hoe en waar industrieën zoals ICT, biotechnologie, nanotechnologie and groene technologie, maar ook culturele industrieën zoals film, muziek, media and ontwerp ontstaan (Bresnahanand Gambardella 2004; Braunerhjelm and Feldman 2006; Cooke and Lazzeretti 2008). Ondanks dat een groot aantal van dit soort studies aangeeft dat de factoren die bijdragen aan de succesvolle groei van nieuwe industrieën erg context specifiek zijn, geven deze studies ook aan dat de groei van nieuwe industrieën over het algemeen sterk wordt gestimuleerd door de netwerken tussen de partijen die zijn betrokken bij het ontstaan van de nieuwe industrie.

Potentiële ondernemers hebben middelen nodig zoals kennis, financiering en werknemers om een bedrijf succesvol op te starten. In eerste instantie worden dit soort middelen vaak verstrekt door personen en instanties die in de buurt van de ondernemer zijn gevestigd zoals lokale banken, familie, sociale netwerken en lokale overheden (Sorenson 2003; Hite and Hesterly 2001). In dit deelonderzoek bestuderen we de relatie tussen de kans dat ondernemers daadwerkelijk toegang krijgen tot de benodigde middelen en de mate van sociaal kapitaal in een regio. Sociaal kapitaal is gedefinieerd als de “karakteristieken van sociale organisatie zoals netwerken, normen en sociaal vertrouwen die coördinatie en samenwerking voor wederzijds gewin faciliteren (Putnam 1995, p. 67).” Door sociaal kapitaal te definiëren als een collectieve eigenschap, gekarakteriseerd door sterke en betrouwbare relaties, kan sociaal kapitaal worden gezien als een stimulans voor de regionale ontwikkeling van ondernemerschap. Immers sociaal kapitaal faciliteert samenwerking en creëert een ondersteunende regionale structuur.

Echter, sociaal kapitaal kan ook verantwoordelijk zijn voor het tegenhouden van nieuwe industrieën. Nieuwe industrieën zijn vaak controversieel van aard, omdat ze niet goed passen bij de bestaande normen and waarden en omdat ze gevestigde belangen in andere industrieën bedreigen. Aangezien sociaal kapitaal is gebaseerd op vertrouwen en het in stand houden van bestaande normen en waarden, kan een hoge mate van sociaal kapitaal ook tot gevolg hebben dat een nieuwe, en dus controversiële, industrie niet wordt geaccepteerd en gesteund. Daarom kunnen lokale netwerken met veel sociaal kapitaal als een muur fungeren die ondernemers in nieuwe industrieën niet toelaat en onthoudt van steun. Als er ondernemers zijn die ondanks een dergelijk struikelblok toch toe weten te treden in regio’s met veel sociaal kapitaal, kunnen zij zich inzetten om de bestaande normen en waarden aan te passen en acceptatie te creëren voor de nieuwe industrie. Als er acceptatie gecreeerd kan worden zal de hoge mate van sociaal kapitaal in plaats van een struikelblok, een stimulans voor ondernemerschap betekenen. Dit zal echter alleen mogelijk zijn als er voldoende massa is in termen van het aantal ondernemers. Dus, een hoge mate van sociaal kapitaal remt ondernemerschap in nieuwe en controversiële industrieën af, maar zodra er acceptatie voor de nieuwe industrie is gecreëerd, kan het juist een positieve invloed op ondernemerschap hebben.

Dit deelonderzoek wijst uit dat regio's in de Verenigde Staten met veel sociaal kapitaal in eerste instantie weinig ondernemerschap in de videogame industrie kende, maar dat de hoeveelheid sociaal kapitaal, nadat er meer bedrijven toetraden tot deze regio's, uiteindelijk een positief effect had op het aantal ondernemers in de regionale videogame industrie.

DEELVRAAG 2
IN HOEVERRE KUNNEN BEDRIJVEN IN DE GLOBALE VIDEOGAME INDUSTRIE PROFITEREN VAN RUIMTELIJKE CO-LOCATIE MET ANDERE BEDRIJVEN?

Economisch geografen hebben van oudsher de ruimtelijke concentratie van bedrijven verklaard als een gevolg van agglomeratievoordelen. Agglomeratievoordelen bestaan uit een betere toegang tot geschoolde werknemers, meer aanbod van toeleveranciers en kennisuitwisseling tussen bedrijven en zorgen ervoor dat bedrijven langer kunnen overleven. Een alternatieve verklaring is recentelijk geopperd door Klepper (2007). Hij geeft aan dat geconcentreerde regio's kunnen ontstaan zonder de aanwezigheid van agglomeratievoordelen. Volgens hem is vooral de ervaring van ondernemers van belang. Ondernemers die ervaring hebben in de huidige industrie of ondernemers die ervaring hebben in gerelateerde industrieën hebben een grotere kans om betere bedrijven op te richten dan ondernemers zonder deze ervaring. Ook vindt Klepper (2007) dat ondernemers met ervaring zich vaak vestigen in nabijheid van het moederbedrijf en dat deze moederbedrijven vaak ook succesvol zijn. Hieruit volgt dat het ontstaan van clusters kan worden verklaard als een cumulatief proces waarin een aantal succesvolle moederbedrijven veel succesvolle ondernemers genereren, die vervolgens zelf ook weer succesvolle bedrijven genereren. De conclusie dat co-locatie niet per se voordelen met zich meebrengt, komt ook naar voren in eerdere studies die vaststellen dat co-locatie zelfs negatieve effecten heeft op de overlevingskansen van bedrijven in de metaalbewerkingsindustrie (Appold 1995), de schoenindustrie (Sorenson en Audia 2000), de textielindustrie (Staber 2001) en de biotechnologie-industrie (Stuart en Sorenson 2003).

Gegeven de resultaten in deze studies, is het niet onaannemelijk om te concluderen dat agglomeratievoordelen inderdaad geen rol spelen in het ontstaan van clusters. Echter, het bewijs voor deze these is voornamelijk gebaseerd op resultaten uit maakindustrieën, waardoor het onmogelijk is om de resultaten te generaliseren voor andere typen industrieën. Industrieën die zijn georganiseerd in projecten zoals de videogame industrie zijn in tegenstelling tot veel maakindustrieën afhankelijk van sociale netwerken tussen bedrijven en de werknemers van die bedrijven (Breschi en Lissoni, 2009; Grabher, 2002). Hierdoor is het waarschijnlijk dat de ruimtelijke organisatie van dit soort industrieën een ander patroon kent dan maakindustrieën. De hypothese die we toetsen in deze deelstudie behelst dat negatieve agglomeratie externaliteiten lineair groeien met het aantal bedrijven dat aanwezig is in de regio, terwijl de positieve externaliteiten exponentieel groeien als gevolg van een toename van het aantal bedrijven in een regio. Immers, een extra bedrijf in een cluster genereert de mogelijkheid om het aantal sociale contacten van de reeds aanwezige werknemers exponentieel te doen groeien terwijl het aantal bedrijven waarmee de reeds aanwezige bedrijven concurreren slechts groeit met één.

De resultaten van de studie wijzen uit dat bedrijven inderdaad voordeel hebben van de aanwezigheid van veel andere bedrijven, maar alleen als het aantal andere bedrijven meer dan 55 is. Het komt er op neer dat voornamelijk in de grote steden zoals Parijs, San Francisco, Los Angeles en Londen bedrijven kunnen profiteren van de aanwezigheid van andere bedrijven.

DEELVRAAG 3
WAT ZIJN DE DETERMINANTEN VAN NETWERK FORMATIE TUSSEN BEDRIJVEN IN DE GLOBALE VIDEOGAME INDUSTRIE?

Het analyseren van bedrijfsnetwerken wordt in toenemende mate gebruikt om te onderzoeken hoe regio meer welvarend kunnen worden (Ter Wal and Boschma 2009; Morrison 2008), hoe bedrijven worden ondersteund door andere bedrijven (Uzzi1997; Boggs and Rantisi 2003), hoe bedrijven baat hebben bij een bepaalde positie in het netwerk (Gulati 1999; Zaheer and Bell 2005), hoe innovatie tot stand komt (Powell, Koput and Smith-Doerr 1996; Vedres and Stark 2010) en hoe het ruimtelijke kennisuitwisselingspatroon tussen bedrijven er uit ziet (Giuliani 2007). De interesse in bedrijfsnetwerken komt voort uit het feit dat deze netwerken de creatie van innovatieve producten kan stimuleren, en het mogelijk maakt om risico's te delen en marktmacht te vergroten. Echter, waar onderzoek naar de uitkomsten van structuren in bedrijfsnetwerken zeer prominent aanwezig is in de sociale wetenschap, is er weinig aandacht voor de totstandkoming van bedrijfsnetwerken. Daarnaast is er weinig bekend over hoe dit proces verandert door de tijd en wat het ruimtelijk patroon er van is.

Theoretische benaderingen hebben reeds drie mechanismen geïdentificeerd die de formatie van bedrijfsnetwerken zouden kunnen beïnvloeden: heterogeniteit in bedrijfskarakteristieken (Boschma and Frenken 2010), relationele structuren die zichzelf herproduceren (Rivera et al. 2010) en de mate van gelijkheid van bedrijfskarakteristieken (McPherson et al. 2001; Boschma 2005). In dit deelonderzoek bestuderen we hoe deze mechanismen de formatie van het bedrijfsnetwerk beïnvloeden in verschillende fasen van de industrielevenscyclus (Klepper 1996; Audretsch and Feldman 1996).

De uitkomsten van het deelonderzoek wijzen erop dat de patronen die de formatie van het bedrijfsnetwerk in de eerste fasen van de industrielevenscyclus beïnvloeden zich herhalen in latere fasen. Echter, de sterkte van de patronen verandert enigszins. Zo zijn bedrijven naar het einde van de industrielevenscyclus meer geneigd om samen te werken met bedrijven die op korte afstand zijn gevestigd. Ook werken bedrijven steeds meer samen met bedrijven die erg gelijkend zijn in termen van het type videogames dat ze maken.

DEELVRAAG 4

HOE BEÏNVLOEDT BEDRIJFS-SAMENWERKING DE PRESTATIE VAN VIDEOGAME BEDRIJVEN TEN TIJDE VAN TECHNOLOGISCHE STABILITEIT EN TURBULENTIE?

Onderzoek naar de invloed van bedrijfsnetwerken op bedrijfsprestaties heeft aan populariteit gewonnen, maar er is nog weinig onderzoek gedaan naar hoe het functioneren van bedrijfsnetwerken verandert in verschillende fasen van de industrielevenscyclus. Door expliciet de literatuur over bedrijfsnetwerken en industrielevenscycli te combineren, presenteert deze studie een eerste exercitie van hoe de relatie tussen bedrijfsnetwerken en bedrijfsprestaties wordt beïnvloed door veranderingen in de technologische condities in een industrie.

De videogame industrie wordt gekenmerkt door zes perioden waarin een generatie van consoles werd vervangen door een nieuwe generatie van videogame consoles. Elke nieuwe generatie was vernieuwend in termen van technologie ten opzichte van de voorgaande generatie waardoor de ontwikkelaars van videogames creatief konden omgaan met de mogelijkheden geboden door de nieuwe generatie (Kent 2001). Op het moment dat de grenzen van de nieuwe technologie door de videogame ontwikkelaars waren bereikt, vond er een verandering plaats waarin de ontwikkeling van videogames steeds meer bouwde op voorgaande games (March 1991; Klepper 1996).

Het onderzoek spitst zich voornamelijk toe op twee kenmerken van bedrijfsnetwerken in veranderende markten. Allereerst bekijken we het effect van netwerkpartners die failliet gaan op de prestaties van een bedrijf. Daarin maken we onderscheid tussen partners waarmee het bedrijf een sterke band had en partners waarmee het bedrijf een minder sterke band had. De resultaten wijzen uit dat wanneer de videogame industrie aan sterke verandering onderhevig is, het goed is als partners waarmee een bedrijf een sterke band heeft failliet gaan. We verklaren dit vanuit het idee dat partners waarmee je een sterke band hebt minder snel geneigd zijn om compleet anders te gaan produceren: iets dat wel nodig is als een markt onderhevig is aan sterke verandering. Het tweede aspect dat we bestuderen is de diversiteit van de netwerkpartners van een bedrijf. De resultaten geven aan dat bedrijven in stabiele periodes niet profiteren van diverse netwerkpartners, terwijl dit wel het geval is in turbulente periodes. Door het samenbrengen van inzichten uit de literatuur over netwerkanalyse en inzichten uit de literatuur over technologische verandering beschrijft deze studie gedetailleerd hoe bedrijven afhankelijk zijn van hun netwerkpartners als er technologische veranderingen in de markt optreden.

BIJDRAGEN AAN DE LITERATUUR

Deze dissertatie biedt een eerste evolutionaire analyse van ruimtelijke industriële dynamiek gecombineerd met inzichten van netwerkanalytische studies. Netwerkanalytische methoden zijn pas relatief recent voor het eerst gebruikt in de economisch geografische literatuur. Door het maken van de combinatie van industrielevenscycli, netwerkanalyse en ruimtelijke dynamiek hebben we meer duidelijkheid gecreëerd over hoe het locatiegedrag van bedrijven en de voor- en nadelen die daarmee gepaard gaan, samenhangen met veranderingen in de mate van concurrentie en samenwerking. We hebben aangetoond dat netwerkdynamiek en cluster-dynamiek sterk aan elkaar zijn gerelateerd. De externaliteiten die gepaard gaan met co-locatie zijn voor wetenschappelijk onderzoek een onderwerp van debat gebleken, maar we hebben met deze studie aangetoond dat – ten minste in de videogame industrie casus – agglomeratie-externaliteiten in de vorm van netwerk-externaliteiten een grote bijdrage leveren aan de dynamiek van ruimtelijke concentratie van economische activiteit.

In de eerste twee studies hebben we impliciet gekeken naar de regionale dimensie van netwerken binnen een industrielevenscyclus. Allereerst zijn ondernemers sterk afhankelijk van het aanwezige sociaal kapitaal in een regio. Als de nieuwe industrie regionaal nog niet is gelegitimeerd, is het lastig voor een ondernemer om toegang te krijgen tot de benodigde productiemiddelen, zeker wanneer er een hoge mate van sociaal kapitaal in de regio aanwezig is. De niet-gelegitimeerde industrie is controversieel en voor individuen en organisaties die de ondernemer willen voorzien van productiemiddelen zullen de sancties hoger zijn naarmate er meer sociaal kapitaal is. Als er, om uiteenlopende redenen toch nieuwe bedrijven toetreden, kunnen de daaropvolgende toetreders echter profijt hebben van hoge niveaus van sociaal kapitaal. Deze bevinding plaatst het proces van toetreding in een dynamisch perspectief en leidt tot duidelijke implicaties voor regionaal beleid. De tweede studie heeft aangetoond dat in tegenstelling tot veel maakindustrieën, de bedrijven in de videogame industrie wel profiteren van co-locatie met andere bedrijven. We verklaren deze bevinding vanuit het idee dat in projectgeoriënteerde industrieën, de voordelen van agglomeratie exponentieel stijgen, omdat de vestiging van één extra bedrijf veel extra netwerkrelaties kan opleveren, terwijl de nadelen slechts proportioneel toenemen. Door het benadrukken van de karakteristieken van projectgeoriënteerde industrieën en door onderscheid te maken tussen agglomeratievoordelen en agglomeratienadelen heeft deze studie een meer gedetailleerd beeld geschetst van de dynamiek van co-locatie.

In het tweede paar studies hebben we expliciet gekeken naar de regionale dimensie van netwerken binnen een industrielevenscyclus. De derde studie is een eerste poging om de verschillende mechanismen die verantwoordelijk zijn voor deformatie van het bedrijfsnetwerk uit elkaar te halen en in een dynamisch perspectief te plaatsen. Hierdoor verbinden we heel duidelijk netwerktheoretische inzichten uit de sociologie en statistische natuurkunde en de ruimtelijke dimensie van samenwerking zoals die is ontwikkeld in de evolutionaire economische geografie (Boschma 2005; Frenken and Boschma 2007). We laten zien dat de mechanismen die verantwoordelijk zijn voor de formatie van het bedrijfsnetwerk vrij stabiel zijn, maar dat bedrijven in latere fasen van de industrie vooral geneigd zijn om samen te werken over kortere afstanden met partners die hetzelfde type videogame maken. De vierde studie kijkt hoe de manier waarop bedrijven samenwerkingsrelaties aangaan samenhangt met hoe ze presteren als er technologische veranderingen in de markt optreden. De uitkomsten wijzen erop dat het goed is om onderscheid te maken tussen turbulente en stabiele periodes omdat het effect van verschillende soorten netwerkrelaties daar sterk mee samenhangt. Dit kan een verklaring zijn voor het verschil in uitkomsten gepresenteerd door eerdere studies waarin het effect van netwerkrelaties op prestaties slechts in een stabiele situatie werden onderzocht.

SUGGESTIES VOOR VERDER ONDERZOEK

Alhoewel dit onderzoek naar de relatie tussen ruimtelijke industriële dynamiek en de dynamiek in netwerkvormen in de videogame industrie nieuw inzicht geeft in de evolutie van deze industrie, leidt zij ook tot nieuwe onderzoeksvragen.

Allereerst rijst de vraag of de toetreding in andere typen industrieën hetzelfde patroon volgt als in de videogame industrie. Is toetreding in maakindustrieën net zo afhankelijk van het sociaal kapitaal dat aanwezig is in een regio? En hoe hangt de toetreding van nieuwe bedrijven samen met de aanwezigheid van bedrijven in gerelateerde industrieën. Klepper (2002) liet al zien dat nieuwe industrieën vaak uit bestaande industrieën worden geboren en als de gerelateerdheid tussen de twee hoog genoeg is, is het mogelijk dat de nieuwe industrie als minder controversieel wordt gezien.

Ten tweede zien we in ons onderzoek dat een creatief productieproces zoals het ontwerpen van videogames duidelijk baat heeft bij nabijheid tot andere videogameontwerpers. In grote steden zoals Los Angeles, San Francisco, Londen en Parijs doen bedrijven het significant beter dan in andere, kleinere steden. Waar wordt dit precies door veroorzaakt? Is het zoals wij in deze dissertatie aangeven een gevolg van netwerk-externaliteiten of zijn er andere factoren die meespelen? Eén van de redenen zou kunnen zijn dat in deze steden ook veel gerelateerde industrieën zijn gevestigd en wellicht is arbeidsmobiliteit binnen de videogame industrie (Kloosterman 2008) en tussen de videogame industrie en gerelateerde industrieën een bron van inspiratie.

Een derde suggestie voor toekomstig onderzoek is meer van methodologische aard. Het potentieel dat traditionele netwerkanalytische methoden biedt is nog verre van uitgeput in de economische geografie en nieuwe, minder structurele manieren om netwerken te benaderen kunnen van grote waarde zijn om dynamische processen te analyseren (Rodan en Galunic 2004). In de vierde studie hebben we een eerste aanzet gedaan tot een meer flexibele benadering van netwerken, maar een meer historische inslag zou ons een nog rijker inzicht geven in de relaties tussen bedrijven. Hoe werkt bijvoorbeeld het “geheugen” van netwerken? Hoe ver kijken bedrijven terug en hoe gaan ze om met goede en slechte netwerkervaringen? Op deze manier is het ook mogelijk om de inhoud van netwerkrelaties in beschouwing te nemen.

Curriculum vitae

Mathijs de Vaan was born on 9 Februari 1983 in Nijmegen, the Netherlands. He studied economics with a minor in geography at the Utrecht School of Economics and received his M.Sc. in 2006. During his studies, he spent semesters abroad as an exchange student at the University of Wyoming in the United States and at Simon Fraser University in Canada. After graduation in 2006 he travelled the United States during a three month journey from San Diego to Anchorage. In 2007 he started in the PhD program at the Department of Geosciences at Utrecht University with a focus on economic geography. His interdisciplinary approach led him to spend a semester as a visiting scholar at the Department of Sociology at Columbia University, NY, USA. Currently, Mathijs studies and works at the Department of Sociology at Columbia University.