THE DIFFUSION OF UNIVERSITY SPINOFFS:

INSTITUTIONAL AND ECOLOGICAL PERSPECTIVES

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In memory of my father

Abstract

Spinoffs are companies based on university intellectual property established to commercialize university technology to the marketplace. The objective of this study was to examine the reasons for the rapid diffusion of spinoffs in the UK, as well as the potential effects of these companies on university resource acquisition. The study used two broad theoretical perspectives from the sociology of organizations: institutional theory and organizational ecology. It blended elements from other related perspectives such as organizational evolution and social exchange theory.

Driven by the need to establish a full database of spinoffs for the first time, quantitative data collection and analysis techniques were predominantly employed. The emerging database comprised of nearly 9 million datapoints capturing the full population of university spinoffs (and their demographics) by all English and Scottish universities over a period of 15 years (1993-2007). Qualitative exploratory data collection methods were also used to supplement the design and structure of the study, including hypothesis formation. In total, 6 in-depth interviews with Technology Transfer Managers were conducted at a representative number of universities across England and Scotland.

The study identified the role of certain environmental, institutional factors in shaping the decision by universities to adopt spinoff formation as a standard practice. Such factors were the role of networking, social compliance, industry associations, and media information providers. It also demonstrated that spinoff formation gradually but significantly enhanced university financial resources over time. The study finally discussed the process of coevolution of universities and spinoffs as distinct populations of organizations within the community of academic entrepreneurship. Specifically, the discussion moved towards building a new theory of "reciprocal legitimacy".

Abbreviations

AURIL	Association for university research and industry links
AUTM	Association of university technology managers
BBSRC	Biotechnology and biological sciences research council
BVCA	British venture capital association
EKTA	European knowledge transfer association
EPSRC	Engineering and physical sciences council
ESRC	Economic and social research council
HEBCI	Higher education business and community interaction
HEFCE	Higher education funding council for England
HEIF	Higher education innovation fund
HESA	Higher education statistics agency
FAME	Financial analysis made easy
IP	Intellectual property
IPO	Initial public offering
IT	Institutional theory
KTPs	Knowledge transfer partnerships
MRC	Medical research council
PE	Population ecology
SFC	Scottish funding council
SME	Small-medium enterprise
TTO	Technology transfer office
UNICO	University companies association

1. INTRODUCTION

In the last two decades, the importance of university technology commercialization has attracted the interest of numerous researchers. In the United Kingdom, university commercial activities accelerated in the 1990's, a period when many educational institutions established Technology Transfer Offices (Wright, Vohora and Lockett, 2002). In this context, a principal route for university technology transfer to the marketplace has been the establishment of spinoff firms. Spinoffs are organizations founded to exploit a piece of intellectual property created in an academic institution. Early rough estimates reported that British universities generated 338 spinoff firms between 1996-2000 with 175 spinoffs incorporated in 2001 alone (Charles and Conway, 2001). This enthusiasm for spinoff generation has recently been matched by academia, resulting in a significant increase in the amount of research devoted to the phenomenon.

Despite the above estimates, so far there had been no unified database of UK spinoffs and various industry- and government-sponsored reports have lamented its absence. This has been a core motivation for my study: lack of data makes research on spinoffs harder and hampers policy initiatives aimed at improving university technology transfer. Second, extant research on university spinoffs has been rather unidirectional. It has mainly focused on why spinoffs are necessary for the local or national economy (Shane, 2004a) or on methods to enhance spinoff formation among universities. Yet, we know little about the exact conditions under which they spread. The first research question of this study is therefore "*how did spinoffs spread?"*. It is well known that in the early 1990's there was certainly some opposition to these companies, as active community members considered them risky and dangerous for the mission of contemporary universities. There was also lack of expertise in

establishing spinoffs. How did universities overcome environmental uncertainty and practical obstacles such as these to engage in spinoff formation? Was it a purely rational decision or not? Extant research has also omitted to consider whether universities benefited from commercial activities. The second research question of this study is obviously *"how did spinoffs affect university resource acquisition?"*.

As mentioned, a core challenge in this work has been the construction of a full university spinoff database. I consulted numerous public sources and contacted virtually every single UK university to collect information on spinoffs. I also spoke with Technology Transfer Officers at a number of educational institutions in order to understand the spinoff phenomenon prior to forming testable hypotheses. The breadth of information collected allowed me to look at spinoffs over time, as my database spanned over 15 years. It also helped me study spinoffs and theorize at multiple levels of analysis: the individual spinoff, the population of spinoffs, and the academic entrepreneurship community that includes spinoffs and universities alike.

My research hypotheses are grounded in the sociology of organizations and, in particular, institutional theory, and organizational ecology and evolution. Instead of looking at static explanations of the spinoff diffusion process or the spinoff-related benefits on universities, these perspectives have allowed me to look at the wider environmental context of university spinoff formation. For example, I examine the impact of environmental pressures from the government and other institutions upon the decisions of universities to form spinoffs over time. I also examine the coevolution of spinoffs and universities as communities of organizations over time, drawing parallels with symbiotic relationships of biological species. Because of the complexity of the spinoff phenomenon, I have used various other theoretical

perspectives closely linked to the ones mentioned above, such as diffusion and management fashion theories as appropriate.

This documents is structured as follows. First, I present an overview of the literature on the university spinoffs phenomenon identifying recent trends and gaps that need to be filled. In chapter 3, I review the main tenets of institutional theory and organizational legitimacy as well as ecological theories of organizational change that will be used throughout the next chapters. Chapter 4 presents my first empirical study that examines the first research question on the diffusion of UK spinoffs. The next chapter deals with the second research question, looking at potential financial benefits of spinoff formation to universities. Finally, drawing parallels from biology, chapter 6 presents a novel conceptualization on the coevolution of spinoffs and universities as two different species in an ecological community. In the last chapter, I provide an overview of the findings and conclusions of this study, suggesting directions for future research.

A final note on the format of this thesis: A lot of the information presented in chapters 2 and 3, including theoretical and phenomenological definitions as well as methodological approaches are repeated or supplemented in chapters 5-7 where the empirical research and findings are presented. The reason for this is that, chapters 5, 6 and 7 follow the template of research papers published in academic journals. Thus, to give a precise overview of each of these independent research projects, I included there information that may have been presented at earlier chapters. For the same reasons, chapters 5-7 are written in first plural to reflect the fact that they represent joint work with my main advisor during my studies.

2. SPINOFF PHENOMENON

University spinoffs and, more generally, academic entrepreneurship have attracted the attention of an ever higher number of scholars internationally. According to Rothaermel, Agung and Jiang (2007), there have been 173 journal papers on academic entrepreneurship and, according to Djokovic and Souitaris (2008), 103 papers specifically dedicated to academic spinoffs only in the past few decades. Shane (2004a) was one of the leading authors in providing a comprehensive review of the literature on the spinoff phenomenon. His seminal book on academic entrepreneurship describes the major developments in the field of spinoff formation and technology transfer. His work starts by answering the questions of why and how university spinoffs emerged in a historical context, and provides evidence on the establishment process, outcomes, performance determinants and problems of university spinoffs.

Rothaermel *et al*. (2008) distinguish four major research areas in the field: a) the entrepreneurial research university, b) productivity of the Technology Transfer Office, c) new firm creation and d) environmental context and networks of innovation. Each of these domains answers specific questions – for instance, domain (a) looks at university cooperation agreements, licensing, marketing activities and the role of science/incubation parks. Domain (b) examines the varying degree of autonomy of the TTO, its policy on equity stakes, and its performance in terms of spinoffs formation and licensing deals. The third research stream, which is most relevant to my work, focuses specifically on spinoffs looking at issues such as venture capital availability, IPOs, and the growth and performance of spinoffs. The final domain emphasizes the role of the larger environment within which universities are embedded and identifies four factors that define academic entrepreneurship, i.e.

networks with other universities, science parks, business incubators and university geographic location (Rothaermel *et al.*, 2008).

Djokovic and Souitaris (2008) distinguish among macro-, meso- and micro-level research studies. At the macro level, they argue that government and industry support mechanisms and incentives, as well as the role of the technology and market conditions are important determinants of inventions commercialization. At the meso level, the authors argue that spinoff formation is determined by university support mechanisms and individual strategies. Finally, at the micro level of analysis, their attention shifts to the imprinting effects of the founding conditions including the composition and characteristics of the founding team and their networking with the university and the industry, as well as the actual performance of the spinoffs themselves (Djokovic and Souitaris, 2008).

My purpose in this chapter is not to provide an exhaustive literature review of the phenomenon beyond those of Rothaermel *et al.* (2008), Djokovic and Souitaris (2008), and Shane (2004a). Instead, I will use these reviews to reveal several research gaps in the literature that will help situate my own research in this large body of scholarly work. In particular, I wish to focus on four major issues that I examine theoretically and empirically in the next chapters and that are important for methodological, analytical and theoretical reasons. These are:

- definitions and length of databases used
- levels of analysis used
- explanations for spinoff diffusion, and
- outcomes of spinoff activity

2.1. Definitions and length of databases used

Although there is no objection to using survey research methods to examine spinoffs, I consider it as astonishing that after 25 years of work in the field, we still have no unified longitudinal database of spinoffs in any country. But I first need to clarify what I mean by spinoffs. Shane defines academic spinoffs as "new companies founded to exploit a piece of intellectual property created in an academic institution" (2004a: 4). Pirnay, Surlemont and Nlemvo (2003) define university spinoffs as "new firms created to exploit commercially some knowledge, technology or research results developed within a university" and Lockett and Wright (2005) and Nicolaou and Birley (2003) provide similar descriptions. A major source of confusion, which could potentially hamper efforts to quantify the spinoff activity in a certain country, is the use of start-up firms established by former university employees as alternatives to spinoffs. Shane argues that "Companies established by current or former members of a university, which do not commercialize intellectual property created in academic institutions are not included in the spinoff definition. Thus, university spinoffs are a subset of all start-up companies created by the students and employees of academic institutions" (2004a: 4). He rejects other authors' definitions, such as Roberts (1991) who consider as spinoffs companies founded by anyone who has studied or worked at a university.

When I mention university spinoffs, I therefore refer to a definition that existing databases or scientific papers often confuse with ordinary startups. As I argue in my methodology chapter, the first contribution of this study is the construction of a single, unified, complete database of all UK spinoffs. This has important implications for how we understand and interpret the spinoff industry. In their reviews, Rothaermel *et al.* (2008) and Djokovic and Souitaris (2008) provide examples of

papers where the authors have made no or limited efforts to validate that firms in their samples fully match Shane's definition. For example, Grandi and Grimaldi (2005) refer to "university startups" instead of spinoffs and Mansfield (1991, 1998) assesses industry startups based on university inventions – something quite different from academic spinoffs (cf. Nerkar and Shane, 2003). Similarly, Lockett and Wright (2005) use a survey methodology that does not guarantee whether firms in their sample are actually spinoffs.

The second issue with the datasets used in the literature is their length. Sampling can be biased compared to population or census data due to responding/selection bias, time/historical effects and other contextual factors. For instance, Lockett and Wright (2005) use university data over only two years to examine the determinants of spinoff formation. Their sample of spinoff "birth" events consists of only 62 responding universities capturing spinoffs formed during that limited timeframe[1]. Grandi and Grimaldi (2005) use a similarly limited sample (42) of university "startups". Perhaps due to these restrictions in data availability, in the academic entrepreneurship literature there is disproportionate representation of university licensing and patenting activity (where data is available) relative to spinoff activity (e.g. Owen-Smith and Powell, 2003; Sampat, 2006; Sine, Shane and DiGregorio, 2003; Shane, 2004b).

2.2. Levels of analysis used

Consequently, a relevant methodological issue has to do with the level of analysis employed by scholars. Researchers have routinely used the individual university or spinoff as the unit of analysis, as data limitations restrict higher level analyses. In my third conceptual paper, I am able to examine the interdependence of

[1] Contrast this with my own panel database of all 1,404 spinoffs by 113 universities over 15 years

spinoffs and universities as two distinct industries/communities that coevolve (Astley, 1985). This chapter attempts to develop theory without the use of actual data – but having an overview of the field through my database has been instrumental in doing so. Current methodological approaches have made it impossible to also look at demographic (Carroll and Hannan, 2000) or population (Hannan and Freeman, 1977) effects on the birth and death rates of spinoffs within specific geographic locations or other established criteria. Finally, the breadth of the datasets used has made researchers unable to examine the long-term effects of environmental or institutional factors on the emergence, growth and taken-for-grandedness of the spinoff industry over time (DiMaggio and Powell, 1983).

2.3. Explanations for spinoff diffusion

A key theme regarding the spinoff phenomenon is the question of why did it actually emerge against other, traditional methods of university technology transfer such as technology licensing. There is ample evidence on this central question and I here wish to provide a short summary of the theoretical perspectives and findings presented in the literature. A stream of research in academic entrepreneurship has examined environmental factors that predict a smooth transfer of technology to the market. Prominent among these factors are the existence of a venture capital industry willing to invest in early-stage technologies or a well functioning financial market such as NASDAQ or the Alternative Market in London (Shane, 2004a). Another environmental effect has to do with government legislation: the Bayh-Dole act that was introduced in the United States in 1980 is largely seen as a key policy intervention that enabled academics to seek alternative routes for the commercialization of their inventions rather than rely on licensing of patents and IP (Shane, 2004b). Drawing on transaction cost economics, Shane (2002a) has shown

that patents deriving from universities are more likely to be exploited through a spinoff firm when these patents are ineffective in a line of business. This argument further supports the link between the nature of the technology and its receptivity by the market in determining the decision of universities to finally form spinoffs. Other researchers have shown that efforts by universities to secure revenues from equity positions in new firms are often seen as less risky compared to licensing intellectual property to outside partners (cf. Bray and Lee, 2000; Feldman, Feller, Bercovitz and Burton, 2002), which further incentivizes university spinoff generation.

At the micro- or meso- levels (Djokovic and Souitaris, 2008), a stream of research has emphasized the role of academics and researchers in university laboratories as central to the creation of spinoff companies. For instance, the extent to which academic founders are market-oriented influences directly the attractiveness of business ideas coming out of universities (Grandi and Grimaldi, 2005). Also, the entrepreneurial orientation and networking capabilities of individual inventors improve the chances for spinoff formation and success (Walter, Auer and Ritter, 2006). In this context, Nicolaou and Birley (2003a) have used network theory to propose a trichotomous categorization of university spinoffs: An orthodox spinoff refers to the process where both the academic and the technology are spun out of the university, a hybrid spinoff involves the technology spinning out of the school but the academics partly retaining their university positions, while a technology spinoff involves technology spinning out but the academic maintaining no links with the newly established firm. The role of differential networking dynamics can therefore explain some of the core dynamics in the evolution of the industry.

Apart from the individual inventors, universities are seen as playing a critical role in the spinoff process by embracing entrepreneurial efforts through Technology

Transfer Offices (TTO). A number of researchers have explored the different types of these offices (cf. Markman, Phan, Balkin and Gianiodis, 2005) suggesting that the age, experience or structure of a TTO (Bray and Lee, 2000; Powers and McDougall, 2005; Shane, 2004a) are directly related to their productivity in spinoff generation. University policies towards the restriction of inventors' involvement to consulting or contracting roles may also discourage them from starting their own companies (Tornatzky, Waugaman and Gray, 1999) thus reducing chances for spinoff formation. DiGregorio and Shane (2003) have shown that the overall quality and prestige of a research institution can boost the rate of spinoff formation, because well known institutions have more resources at their disposal to push technology commercialization. The quality of a university's faculty is also found to be a strong predictor of the number of startup companies formed (Powers and McDougall, 2005) because their expertise and talent are highly appreciated by private investors who entrust their funds on spinoff firms.

Evidently, this short review shows that what is missing in this body of work is the inclusion of non-efficiency explanations to the spinoffs' diffusion. As I argue in my papers, one of the key problems with spinoffs is their liability of newness (Stinchcombe, 1965a). The same liability applies to universities that engaged in spinoff entrepreneurial activities for the first time. In the following chapters, I therefore place particular emphasis on the role of environmental, institutional pressures on universities and I include non-efficiency or non-rational explanations to the spread of spinoffs. Such forces are those of compliance to state regulation, mimetic behaviors (DiMaggio and Powell, 1983), and fashion processes (Abrahamson, 1991; 1996) that are largely dictated by the universities' and spinoffs' need to acquire legitimacy (Suchman, 1995).

2.4. Outcomes of spinoff activity

Despite the increasing volume of publications on academic entrepreneurship, there is also a clear tendency to observe the phenomenon from the scope of what universities can do for spinoffs, rather than what spinoff firms can do for universities. As I showed earlier, there has been extensive research conducted on the role of TTOs and the role of university strategic decisions on the rate of spinoff formation and the success/performance of these firms (Roatharmel *et al*., 2007; Shane, 2004a). We also know that universities attempt to foster an entrepreneurial spirit among their staff by offering special courses, seminars and mentoring (Birley, 2002) or by organizing networking events (Mustar, 1997). However, we do not know whether such investments on behalf of universities are paying off and to what extent they contribute to the schools' success.

From the universities' point of view, Louis, Jones, Anderson, Blumenthal and Campbell (2001) examined the activity of life scientists and found that engaging in entrepreneurial activities such as holding equity in a spinoff company enhanced faculty research productivity. Doutriaux and Barker (1995) studied Canadian researchers who started spinoff companies and found that their research funding increased by an average of 57% from two to three years before founding the company to two to three years after the event (see also Blair and Hitchens, 1998). It has also been suggested that many scientists perceive spinoffs as more desirable places to work compared to established institutions because they believe that the former undertake more interesting and challenging projects that the latter (Kenney, 1986).

Yet, these findings are limited and often atheoretical. Universities operate in the highly competitive industry of education, where the acquisition of resources and human capital are critical for their success. Universities compete for government and

private funds to expand their research facilities; they advertise themselves in order to attract PhD candidates and often charge fees for their services due to increasing costs of production. It is therefore surprising that so little work has focused on the impact of spinoff generation on the universities that create them. In line with my previous arguments, I believe that the main reason for this bias is the lack of systematic data collection efforts and the assumption among researchers that innovations that diffuse are, in fact, always enhancing the productivity of the innovator/adopter (Abrahamson, 1996; Rogers, 2003).

In his seminal work, Shane (2004a) summarized this and the other points I raised above eloquently. He lamented the lack of knowledge that still permeates the spinoff literature with regards to the origins, evolution and impact of spinoffs: "To date, we have no comprehensive study of university spinoffs. We lack systematic explanations for and evidence of the importance of spinoff companies, the historical evolution of spinoff activity, the factors that explain the formation of spinoffs… or the effect of spinoffs on the universities that create them" (2004a: 3). Despite progress since then, I aim to contribute to this broad debate not only with my database but by bringing in the theoretical perspectives of neo-institutionalism and population and community ecology from the field of organization studies (Baum, 2006).

3. THEORETICAL PERSPECTIVES

3.1. Introduction

In the following paragraphs, I provide an introduction to the two main theoretical approaches, institutional theory and legitimacy (Meyer and Rowan, 1977; DiMaggio and Powell, 1983) and organizational ecology (Hannan and Freeman, 1977; Astley, 1985), which form the basis for my research. The purpose of this section is to familiarize the reader with the main constructs that will later appear in the three papers (ch. 5-7) and to provide the origins, purposes and applications of the institutional and ecological perspectives in the existing literature. Where possible, I also give examples of these theories as to their application in the higher education market that constitutes my phenomenological context. Further, the following introductory paragraphs provide core recent developments in these theoretical streams that help situate my own studies in contemporary organization studies literature. For further reading, detailed literature reviews for both the institutional and ecological theories are reported in the Appendix (1, 2) of the study.

3.2. Institutional theory

The institutional perspective of organizations seeks to explain the nature and origins of social order that prevents variations among organizational forms, structures and behaviors. Central to institutional theorists' work is the question of "why is there such a startling homogeneity of organizational forms and practices?" (DiMaggio and Powell, 1983) To answer this question, institutional theory draws from the strictly Weberian tradition of bureaucracy that describes the relationship between organizations and their environment (Weber, 1978) as well as the Darwinian model of adaptation, whereby firms formulate strategies by adapting to environmental changes.

A major contribution of institutional theory is related to the weakness in existing theory concerning an inattention to the audiences responsible for conferring legitimacy on actors and objects. The structure of an organizational field that defines the behavior of its members is formulated and enforced upon firms by different members of its environment. For example, fields are defined by public opinion, by the views of important constituencies, by knowledge legitimated through the educational system, by social prestige, by the laws and definitions of the courts, or by governments (Meyer and Rowan, 1977). Social control on organizations can be imposed either directly with the threat of negative sanctions or indirectly through incentives (Zucker, 1977). Often, these elements of formal structure function as highly rationalized myths and firms are driven to incorporate the practices and procedures defined by them in order to increase their legitimacy and their survival prospects. Firms that abide by these societal rules can therefore avoid inspection and negative judgments by their environments with regard to their actions.

Importantly, these environmental norms tend to eliminate behavioral differentiation among organizations, in favor of isomorphism and a question arises as to whether conformity with institutionalized rules conflicts with criteria of efficiency. Institutional theorists suggest that once disparate organizations in the same line of business are structured into an actual field, powerful forces emerge that lead them to become more similar to one another (DiMaggio and Powell, 1983). Organizations may change their goals or develop new practices and new firms may enter a field driven by a desire to improve performance so that a certain degree of innovation is secured for a short period of time. However, in the long run, a threshold is reached beyond which adoption of these practices provides legitimacy rather than improves performance. This happens because organizations tend to model themselves after

similar organizations in their field that they perceive to be more legitimate or successful, so that mimetic behaviors among competitors eliminate the advantage of early adopters. Consequently, failure to conform to the widely established rules results in claims of illegitimacy and inability to adapt (Zuckerman, 1999).

To understand how institutionalism exercises power upon organizations, a comparison is often made with resource dependence theories (Oliver, 1991). Resource dependence stresses the organizational necessity of adapting to environmental uncertainty, coping with problematic interdependencies and actively managing or controlling resource flows (Pfeffer and Salancik, 1978). In contrast, institutional theory emphasizes the self-serving advantages of compliance with institutional requirements, even when resource scarcity is not existent and market forces are not influential. Firms tend or pretend to comply with norms deriving by historical or cultural pressures because, in the long run, illegitimacy is a more imminent threat to their existence.

3.2.1. Institutional isomorphism in higher education

The above broad definition of institutional theory has often been applied to national systems of education. For example, it has been argued that, in modern societies, certain ideologies define the functions appropriate to a university such as instruction or research methods in various scientific fields (Meyer and Rowan, 1977). These ideologies represent rationalized and impersonal prescriptions that identify various social purposes and specify in a rule-like way the appropriate means to pursue technical goals.

Several social control agencies hold certain authorities to preserve these ideologies, e.g. federal legislatures and their constituencies, the state education agency, the state-level professional associations and the teaching-training institutions

of a country (Rowan, 1982). In educational organizations, institutionalized norms and values created by these constituencies play an extremely important role in innovation. Thus, expanding educational organizations looking for new domains or new structures are forced by pressures of conformity to adapt those structures that have the support and endorsement of key agencies in the institutional environment (Rowan, 1982).

This sensitivity for compliance by universities is explained by high levels of uncertainty regarding the potential value of changes in their structure. Educational innovations can seldom be justified on the basis of solid technical evidence and they usually gain legitimacy and acceptance on the basis of social evaluations such as the endorsement of legislatures or professional agencies (Baldridge and Burnham, 1975). For example, school administrators who create new curricula or training programs must attempt to validate them as legitimate innovations in educational theory and governmental requirements. If they are successful, the new procedures can be perpetuated as authoritatively required or as satisfactory (Meyer and Rowan, 1977) and they may then diffuse over time to other local schools. The case of university commercial activities and spinoffs that I examine here is a case of such successful educational innovations.

In contrast, when negative evaluations emerge even from only a portion of the institutional environment, local school systems hesitate to adopt the new practices, and those that have adopted them may have to drop them. For instance, a number of research-oriented institutions seriously consider adapting to declining enrollments by eliminating the teaching function (Hannan and Freeman, 1977). To entertain this option would be to challenge central organizational norms and to violate legitimacy claims, thereby incurring considerable costs for the focal institutions.

Despite the uniformity of external pressures on educational organizations, the institutional environment may be partly differentiated for certain subgroups. This does not mean that some organizations are constrained by the institutional environment while others are not, but rather, that there are different expectations for different types of organizations in the same population. Many of the commonplace distinctions that are drawn between public and private universities reflect such differentiated expectations (Tolbert, 1985). The two types of institutions have a long-standing tradition of drawing on different sources of financial support. Public institutions have typically relied heavily on governmental sources of support, especially support from state legislature through subsidies, contracts and research grants (Rankin, 1956). Private schools, on the other hand, have received their income primarily from tuition, endowments and gifts or grants from private donors. These patterns derive historically from legal decisions addressing the issue of state control over institutions and, over time, differences in dependency relations for public and private colleges have become institutionalized (Tolbert, 1985). Accordingly, public universities that charge fees are deemed unacceptable, and private schools that receive state subsidies are perceived as illegitimate. For example, Covaleski and Dirsmith (1988) have shown that institutional forces may incur severe consequences to public universities by determining budgetary practices for schools that appropriate federal funds.

Apart from external pressures on universities, institutional theory suggests that internal reorganization is often undertaken in an attempt to make the organization isomorphic with the changing institutional environment (Meyer and Rowan, 1977; DiMaggio and Powell, 1983; Zucker, 1987). In this respect, strategic decisions by university administrators legitimize their organizations by aligning them to practices

and formalities expected by similar players. Pfeffer and Moore (1980), for example, have shown that the level of paradigm development characterizing a department's scientific field and its priorities may predict the level of grants and contract funds obtained as well as explain internal budget allocations. In my empirical study (ch. 6), I find similar effects of spinoff formation on the appropriation of funds by public universities in the UK.

3.2.2. Organizational legitimacy

Originating from institutional theory as described above, organizational legitimacy lies at the core of industry construction, in the sense that only legitimate organizations can survive and proliferate to form a field (e.g. educational market). Legitimacy is a generalized perception or assumption that the actions of an entity are desirable, proper or appropriate within some socially constructed system of norms, values, beliefs and definitions (Suchman, 1995). Legitimacy is created subjectively by the reaction of observers towards the organization, yet it is possessed objectively in that someone may or may not have it. By extension, organizations that lack acceptable legitimated accounts of their activities are more vulnerable to claims that they are negligent, irrational or unnecessary.

Legitimacy implies that an organization is accepted by its environment with regard to its aims or that its actions may be taken for granted and deemed appropriate (Meyer and Rowan, 1977). At the individual level of analysis, Lawrence (1998) suggested that legitimacy indicates that one is qualified for a particular profession, so that this person has the knowledge, skills or competence to be a member of that profession. Weber (1978) has also shown that professionalism is a concept that legitimizes institutions because activities classified in specific categories become

easily understood and can be analyzed more appropriately (see also Zuckerman, 1999).

Suchman (1995) differentiated between two questions regarding legitimacy. First is the question of who confers legitimacy to a firm. In this respect, several typologies of legitimacy have been proposed among which a) moral, b) pragmatic and c) cognitive legitimacy which can be further analyzed into more subcategories (Suchman, 1995). However, Aldrich and Fiol's (1994) classification of a) sociopolitical and b) cognitive legitimacy encompasses a rather simple and practical definition of the term, so that legitimacy can be better operationalized (cf. Deeds, Mang and Frandsen, 2004; Deephouse and Carter, 2005). Sociopolitical legitimacy reflects "the extent to which a new form conforms to recognized principles or accepted rules and standards", while cognitive legitimacy refers to the extent "that a new form is taken for granted" by its environment (Aldrich and Fiol, 1994: 646). In essence, sociopolitical legitimacy describes how a firm visibly conforms to regulations or standards imposed by the government, whereas cognitive legitimacy stems from the observations, judgments and evaluations of the organization's environment. Thus, legitimacy can be offered to an organization by governments or regulators as objective outside participants or by its environment which incorporates such elements directly linked to the firm as its customers, suppliers or competitors.

A debate has erupted in recent years particularly over cognitive legitimacy with regard to how it can be obtained. Some researchers argue that cognitive legitimacy is developed through strategic efforts by firms, while others believe that it is granted to them by influential institutional factors (Singh, Tucker and House, 1986). For example, Rao (1994) has shown that in the early days of the American automobile industry, it was the manufacturers' strategic actions (i.e. certification

contests) that generated favorable perceptions for their products and eventually legitimized their presence in the market. In a rather different context, Pollock and Rindova (2003) have shown that the media can influence the level of underpricing suffered by start-up firms that seek to go public, by granting them legitimacy through positive or negative media coverage. The media, thus, may affect perceptions of legitimacy and must be seen as an active force that firms need to manage strategically in the pursuit of legitimacy (Hoffman and Ocasio, 2001). However, the media can also reflect public evaluation through unbiased coverage of events so that legitimacy is simply magnified and transferred to audiences through media lenses. These kind of media effects are core considerations in my own research projects.

Other contemporary students of sociology have also shown that a synthesis of social movements theory and institutionalism can explain the process of institution building in organizational fields (Rao, Monin and Durand, 2003). These scholars support the view that social movements are collective challenges to authority in political and cultural domains that endeavor to affect change at various levels of social life, thereby granting some forms of organizing more legitimate than others.

The second issue regarding legitimacy is the question of legitimacy for what. It is widely accepted that legitimacy is an intangible asset (Lounsbury and Glynn, 2001) that may help a firm by making its audiences more likely to supply it with resources due to its credibility and continuity (Suchman, 1995). A company may seek passive support from its environment (for example the authorities' consent for its operations) or active support evident when the accumulation of resources becomes easier. Terreberry (1968) claims that legitimacy can be assessed by the level of resource transactions flowing into the firm so that legitimate firms are able to attract

more resources not because they are famous or well known, but because they are considered rational, meaningful entities.

Since legitimacy is critical for a firms' survival, managers rarely can afford to treat legitimacy as a completed task (Suchman, 1995). In a world characterized by relentless innovation that favors early adopters of new forms or activities (including among educational institutions), competing organizations are in danger of conceding legitimacy to others. To maintain their legitimacy, organizations must therefore perceive future changes in their environment (proactive) or protect past accomplishments (reactive). Managers can also stockpile cognitive legitimacy primarily by constructing communication links between the organization and its social surroundings (Suchman, 1995).

A final note in this introductory literature review has to do with how legitimacy differs from reputation or status. Legitimacy focuses on the degree to which firm products, practices and structures are consistent with societal expectations rather than on their distinctive performance outcomes as the latter two concepts would do. For example, both of two firms with and without reputations for being high quality producers must create products with a minimum level of quality in order to be legitimate/acceptable (Rindova, Pollock, Hayward, 2006). Therefore, while legitimacy is measured by comparing a firm's actions to a set of socially or politically acceptable standards, reputation is expressed by directly comparing two organizations, so that one of them will have the same or better reputation than the other (Deephouse and Carter, 2005). Rao (1994) suggests that if one extends the idea of legitimacy further, then reputation becomes the outcome of the process of legitimation. In this respect, third parties such as professional societies or rating agencies may endorse an organization (legitimacy), and the very act of endorsement

embeds an organization in a certain status hierarchy thereby building reputation for the organization.

3.3 Population and Community ecology

The second major theoretical perspective of my dissertation is organizational ecology. The application of ecological models to the study of organizations derives from biology and human ecology (Hawley, 1986) and started around the same time as institutional theory and organizational legitimacy in the mid-1970s. Hannan and Freeman (1977), Freeman and Hannan, (1975) and colleagues (e.g. Carroll and Hannan, 1989) introduced the population ecology perspective as an alternative to the then existing theories of organizational adaptation. In their seminal papers, they contrasted the efficiency-based assumptions of adaptation and resource dependence theories by arguing that organizations suffer from inertia and are less rational or efficiency-oriented (Hannan and Freeman, 1984).

Organizational ecology is closely linked to evolutionary theory: it describes how organizations are selected out of their population based on the degree of fit between their individual adaptations (better, inertia) and the environmental demands placed upon the whole field/industry (Aldrich and Ruef, 2006). The theory has therefore evolved based on a clear research paradigm and methods using classic mathematical models of demography (e.g. Lotka-Voltera equations, event-history studies) deriving from biology. Organizational ecology also relies on population-data (e.g. archival data) to capture the interdependence of organizations within that population (Carroll and Hannan, 2000: 163).

Early conceptualizations of ecological models in organizational studies have focused on two core density-dependent assumptions. At the population level, the so

called first-order density dependence implies that initial density (high number of organizational births) is seen as a mechanism that confers legitimacy to individual organizations and to entire industries, because more entries mean higher levels of information and learning on the industry, thus making it look more legitimate. In contrast, second-order density pushes organizations towards competition, as too many organizational entries in an industry will eventually have to fight for limited resources or niche markets (Carroll and Hannan, 1989).

At the individual organizational level, there are two ecological processes that affect mortality rates (i.e. deregistration or liquidation) of firms. The first category has to do with age-dependent processes such as the liability of newness (Stinchcombe, 1965; Freeman, Carroll and Hannan, 1983), the liability of adolescence, the liability of obsolescence and the liability of senescence (Carroll and Hannan, 2000: 281). Each of these processes deals with the importance of organizational age in how quickly or easily the focal organization is selected out of the population. The second type of ecological process at the individual organizational level has to do with the size of the organization (Carroll and Hannan, 2000: 313) and the impact of size on its fit with environmental demands/changes.

The population ecology theory has been criticized on several fronts. The main criticism, by institutional theorists, has to do with the way legitimacy is measured and operationalized (Young, 1988; Zucker, 1989). It has also been recognized that the focus on organizational inertia is overemphasized – population ecologists have responded to this by incorporating more dynamic models of competition (Barnett and Pontikes, 2008), cooperation (Barnett, 2006) and learning (Bruderer and Singh, 1996) to the main ecological assumptions.

Recently, cooperative and competitive dynamics among industries have developed to a higher level of ecological analysis, the community ecology level (Astley, 1985). Drawing from bioecology and social exchange theory (Cropanzano and Mitchell, 2005), community ecology uses populations as the unit of analysis, examining their co-dependence and co-evolution within wider social systems. The collective power and interests of these populations thus enable them to formulate strategies to the benefit of all industry players – joint action can lead to increased legitimacy and protection from "predator" fields or industries (Astley and Fombrun, 1983; Vermeij, 1994). As one would have expected, population and community ecology perspectives are hardly ever applied to non-profit organizations and, in particular, educational institutions. In this work, I use population ecology in ch. 6 to argue about the legitimacy of spinoffs. In ch. 7, I conceptualize about how cooperative dynamics between universities and spinoffs (seen as two distinct industries) can positively affect their mutual, legitimization and subsequent performance.

4. METHODOLOGY

The methodological design of this study combined quantitative and qualitative data sources. In total, I collected spinoff and university-related information that filled over 9 million datapoints. I also conducted 6 in-depth interviews with key Technology Transfer Managers at selected universities across England and Scotland. The need to create a full UK spinoff database has been enormous. Various government- and industry-sponsored reports (HM Treasury, 2003, 2007; Minshall and Wicksteed, 2005) as well as individual scholars (Shane, 2004a) have called for such an initiative, as it has been recognized that lack of data hampers policy making. Indeed, it is remarkable that after so many years of expansion, the population of UK spinoffs and their demographics is still unknown. Below, I first elaborate on the qualitative and then on the quantitative methodological approaches.

The research design of this thesis involved both inductive and deductive logics in addressing the main research questions. While the deductive approach allowed me to develop testable hypotheses and a theoretical structure based on existing accumulated knowledge, the inductive approach allowed me to move away from the empirical findings to the construction of explanations and theories about what was observed (Gill and Johnson, 2002). During the course of this study, there was a constant dialogue between the theory and the data. The process I followed could be captured by the following stages: (a) developing an initial understating of the study's research question and relevant issues, (b) developing hypotheses as emerging from the relevant literature of the field and through secondary data, (c) refining these hypotheses by interviewing TTO managers, (e) developing a final set of testable hypothesis, (f) collecting appropriate data to test the hypotheses, and (g) interpreting the data drawing from the empirical findings and relevant theory.

4.1. Qualitative data

The inductive element of the research design involved the collection of primary data from the TTO managers of six universities in England and Scotland. The six universities were treated at instrumental cases (Stake, 2000), with the rationale to gain better understanding of the particular issues universities faced in their commercialisation activities between 1993-2007. Yin (2003) argues that case studies as research tools allow exploring questions of "how" and "why", providing a contextual understanding of the research question. In the entrepreneurship field, there have been calls for further attention to "how" and "why" (Ucbasaran, Westhead and Wright, 2001; Ireland, Webb and Coombs, 2005). Among the advantages of a case study is its capacity as a research method in developing intense, detailed and subtle observations around the unit of analysis (Goode and Hatt, 1952). The main limitations of case studies are the inability of scientific generalization (Stake, 2000; Eisenhardt, 1989), the narrowness and idiosyncrasy of its theory outcomes leading to a complex theory that "lacks simplicity of overall perspective" (Eisenhardt, 1989: 547), and its inability to prevent equivocal evidences and biased views to influence the direction of the findings (Yin, 2003). In this study, I did not wish to form any case study – I used the data obtained from six universities in order to explore questions of "how" and "why" they got involved and continued to be involved in spinoff activities over the years.

For the selection of the six universities, I employed theoretical sampling techniques (Eisenhardt, 1989). I used as criteria a) the geographical location of universities, b) the number of spinoffs they had created, c) the size of their TTO in terms of staff and d) their research budget. All this information was available to me from my large quantitative database. I finally chose to interview the TTO managers

of the following six universities to look at their historical and current spinoff activities:

- London South Bank University (London; few spinoffs; small team; very small budget)
- University College London (London; many spinoffs; medium team; very large budget)
- Oxford University (England; many spinoffs; large team; very large budget)
- Surrey University (England; medium spinoffs; small team; medium budget)
- Strathclyde University (Scotland; medium spinoffs; medium team; small budget)
- Edinburgh University (Scotland; many spinoffs; very large team; large budget)

I collected primarily qualitative data in the six cases of these universities, by employing semi-structured interviews with the TTO manager of each University. Qualitative methods are appropriate to study the dynamics of a process, as they are sensitive to the organizational context and are useful in uncovering the sequence of activities and events related to the research question (Pettigrew, 1992). Further, qualitative methods are argued to minimize bias from the researchers before the ultimate outcomes become apparent (Van de Ven and Engleman, 1990), taking into consideration the influence of individuals' perceptions and engagement to the phenomenon (Lee, 1999; Patton 2002), as an element of the phenomenon. The main criticism of qualitative data collection and analysis methods are the lack of standardized protocols for analyzing data, with the findings of qualitative research been questioned over the degree of subjective interpretation of the researcher (Golden-Biddke and Locke, 1997).

The use of semi-structured interviews was in accordance with my goal to gain understanding of the empirical content of the study without imposing a-priori hypotheses to be tested (Fontana and Frey, 2000). The advantage of this type of interview in comparison to the heavily structured interview is the ability of the former to be sufficiently open and to be improvised in "a careful and theorized way" (Wengraf, 2001: 5). I developed an interview guide which aimed at (a) retrospectively exploring the involvement of the university in commercialization activities, (b) exploring the outcomes of this engagement and c) uncovering the role of media/discourse in this historical process.

Each interview lasted for about 60 minutes and was face-to-face. I emailed the interview guide to the interviewees prior to our meeting to facilitate the discussion and familiarize them with the research questions of the study, taking into account their time commitments. I was using a standardized interview format at the beginning of each interview defining the phenomenon of university spinoffs, then I would allow a narrative to emerge on the way spinoff formation has been experienced in the universities, adjusting the sequence of the themes and concepts of the questions of the interview guide. After each reply from the informant I would provide them with my interpretation of the reply, as well as occasionally some propositions from the relevant literature, asking for validation or reflection.

All interviews were tape recorded after having acquired the consent of the informants. I also kept fieldwork notes to help the transcription of the interviews and facilitate the data analysis phase. In the data analysis, I transcribed each interview in a verbatim format and I listened to the interview tapes again, while reading the transcriptions allowing further familiarization with the data. At that stage I incorporated the hand-notes that I had kept during the interview (e.g. drawings, key

words, names, ideas) and associated them with the actual data. As suggested by Dey (1993) and Miles and Huberman (1994: 69-72), the analysis went through three distinct stages: First level coding, pattern coding and, finally, mapping. The pattern coding and quotes from the interview are presented in Appendix 10.4.

4.2. Quantitative data

Acknowledging the need for a full spinoff database, I proceeded based on a demographic data collection plan (Carroll and Hannan, 2000). Human demographers evaluate census data in terms of coverage and content – coverage refers to the extent that the data sources include information about all organizations that fit a definition (and avoid missing data or duplicate entries); content refers to the time period and detail that characterize the information (Carroll and Hannan, 2000: 164). Temporal population data such as those in a demography plan are the most often available sources to sociologists and are organized as panel data (Blossfeld, Golsch and Rowher, 2007). Panel data normally contain more information that cross-sectional or time-series data and have the benefit of allowing researchers to extract better insight on the population/industry examined (Blossfeld *et al*., 2007; Brooks, 2008).

I actually needed full demographics of both universities and spinoffs. Consequently, I consulted a large number of resources for each of these populations (cf. Westphal and Zajac, 1994; Davis and Greve, 1997), including archival data, industry directories, encyclopedias, government registries and proprietary or survey data over a large period of time (Carroll and Hannan, 2000). I coded this information in a spreadsheet (see Appendix 10.3) that would allow me to extract the right information for each of my research projects. According to Ventresca and Mohr (2006), a careful organization of archival and secondary data for ecological or demographic studies such as mine has the benefit of allowing the researcher to use

multiple levels of analysis, focusing on cause and effect (network) relationships among variables, over time (2006).

In separate chapters, I detail the statistical analysis that I carried out. While for linear and hierarchical regression analyses it suffices to maintain a standard format in the database, the circumstances are different for event history studies on panel data (Blossfeld *et al*, 2007). In particular, I used both time-constant and time-dependent covariates to analyze transition rates across a set of states [e.g. 0,1] and this required the specification of at least two dimensions: state space and time axis (Blossfeld *et al*., 2007; Yamaguchi, 1991). State space refers to the starting (origin) and ending (destination) point of the organizations being examined (e.g. starting from state 0 and moving to state 1, or starting from state 1 and moving to state 2); the time axis helps define the waiting time until that happens (Allison, 1984). I used the STATA statistical package for all my analyses.

4.2.1. Spinoff data

The major challenge with spinoff data is to distinguish spinoffs from other startups that are somehow related to universities. I collected data from individual university websites (pages usually dedicated to technology transfer, e.g. "services for business" or "knowledge transfer") and contacted almost all English and Scottish universities directly through emails and telephone. I further looked extensively at recent reports on spinoffs including the following publishers:

- Library House spinoff reports, 2006-2007
- Ernst & Young biotech reports, 2005-2007
- Chemistry Leadership Council report, 2005
- University Companies Association (UNICO) annual surveys, 2001-2006
- British Venture Capital Association (BVCA)

- Higher Education Funding Council of England (HEFCE)
- Scottish Funding Council (SFC)

I crosschecked the above sources to complement my initial database and made additions to the list of spinoffs for each university. I amended the information based on whether spinoffs had ceased trading, had been acquired by larger corporations or had been merged. Some companies were not located in the UK companies' registry (FAME), so they were excluded from the database even though they did appear in universities' technology transfer web pages. Most of these entities must have remained dormant or appeared in the FAME database for a very short period of time. Still others were mentioned in university web sites but were not found to be linked to a university either in terms of a) *location*, b) *ownership* or c) *board appointments* of the founders/inventors, and were therefore excluded from the database as start-ups.

Specifically, when firms were located outside the UK or at geographical regions far away from the inventor university, I contacted them to verify that they satisfied the definition of a spinoff. Regarding university ownership in the spinoffs, this is admittedly not a solid criterion since ownership of spinoffs by universities is not a universal practice; I nonetheless preferred to follow a conservative approach in my methodology: if a spinoff did not satisfy other criteria and no university had a stake in it, it was excluded from the database. Finally, if at least one of the managers/directors of the company was listed as being a Doctor or Professor in the FAME registry, then further research was conducted to decide whether it was a spinoff or a start-up. Yet other companies were non-profit organizations that had gained autonomy from the university since their inception, and they were therefore also excluded.

Particularly difficult was the distinction between firms that grew up in or migrated to university science parks. Some universities could not provide me with a list of their spinoffs and referred me to their Science Park websites and corporate managers. Consequently, I applied the location-ownership-board appointments methodology to decide which science park firms were true spinoffs and which ordinary startups that were simply renting space in the park. Typically, I would first check their website and if it was mentioned that the company had been formed by a (former) MBA student from the university, I would exclude it from the sample as a start-up immediately.

I finally double-checked my data with the spinoff companies listed in the pan-European "Proton Europe" university spinoff database. Proton Europe is a database supported by the European Knowledge Transfer Association (EKTA) that was established in 2003 by the European Commission. Its data is by no means as extensive as mine either in terms of length or breadth of the information available, not least because it incorporates Knowledge-Transfer Partnerships (KTPs) and other forms of university commercialization that do not satisfy the classic spinoff definition (Shane, 2004a). Applying the same process as above, I found that a lot of firms in the latter were not university spinoffs but ordinary start-ups by former employees or students at universities. For example, I found no trace of these firms being spinoffs either in the companies' "About Us" websites or in terms of ownership (equity stakes) in them by universities in the FAME database.

Further clean-up was necessary to arrive at a unified spinoff database. For example, in some cases, universities reported that a company was formed years before the official date of incorporation in the public registry, but I used the latter instead of the former. Also, when it was mentioned that a company was "acquired" it

followed that the firm had ceased operating under that name (dissolved) and that its final accounts were those of the year that the merger/ acquisition took place. With all the data organization and modifications, we finally arrived at a total of 1,459 spinoffs between the year 1963 and the end of 2007. Of these, 55 were joint spinoffs (intellectual property was owned by more than one universities that somehow collaborated) leaving me with a total of 1,404 unique spinoff entities. Basic demographics of the firms and universities in the database can be found in figures 4.1 and 4.2.

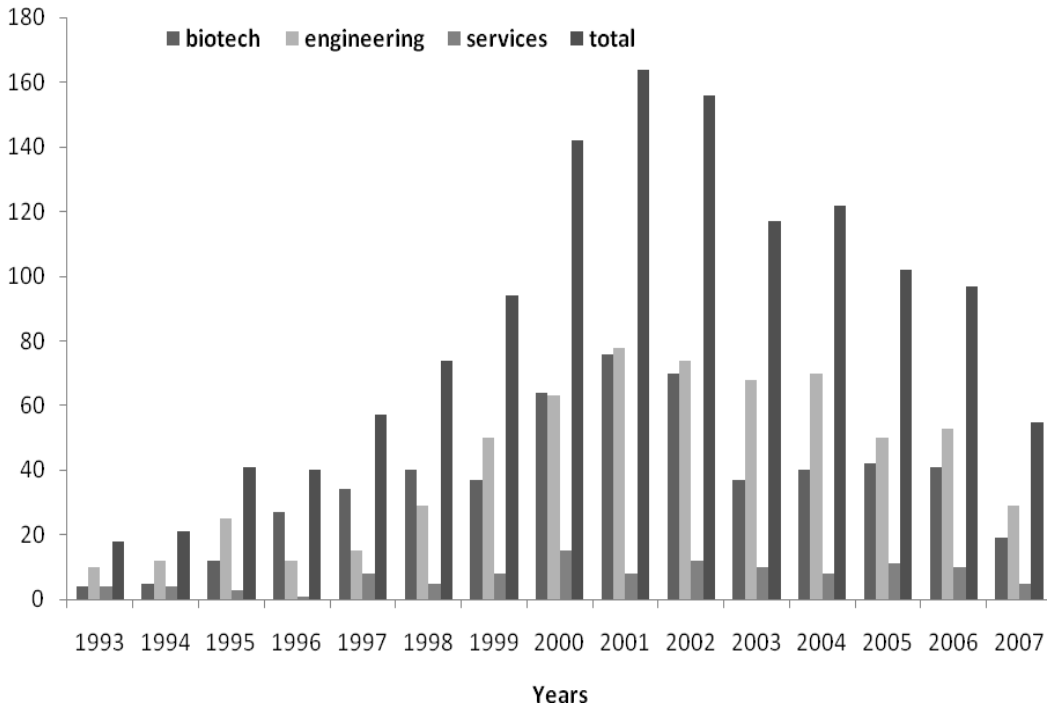

Figure 4.1: Types of spinoffs formed in England and Scotland by year

For my research purposes, I also needed indicators of spinoff growth; consequently, I collected university spinoff revenue figures from the FAME registry. Some spinoffs, however, either did not produce or did not report revenues, especially early in their lives. For this reason, I also collected information on their assets, an alternative indication of firm size. Some authors like Harcourt (1965), Hawawini,

Subramanian and Verdin (2003) and Fisher and McGowan (1983) argue against the use of accounting ratios (e.g. net assets, ROA) as proxies for economic profitability, not least because accounting methods of measuring profitability do not reflect cash flows, and returns are not adjusted for risk. It should be recognized, however, that data on value-based measures of performance for a quite large number of spinoff companies and over a long time period were not available until recently. This might explain why past research traditionally had no alternative to accounting measures, and why this approximation was preferred in my work too.

4.2.2. University data

A whole series of information regarding universities needed to be collected and used, primarily as control variables. I consulted directly university websites and, when necessary, public educational authorities, registries and government publications. For example, universities founding dates (age) were obtained from individual websites. Because most universities existed as colleges or schools but were not granted full university status until at least 1992 (Higher and Further Education Act, 1992), the latter was included, as opposed to the original date of college founding. This would rather fairly reflect their experience as established educational institutions, thus making them comparable with non-polytechnic ones.

Regarding university status, I collected information on Nobel prizes from the online registry of the Nobel Foundation. I did not distinguish among academic disciplines but, admittedly, in most cases prizes had been awarded to members of traditional spinoff-generating faculties and research departments such as biology or engineering. As an example, the University of Manchester has earned the prize 23 times of which 8 Nobel Prizes were in chemistry, 10 in physics, 2 in medicine and 3 in economics.

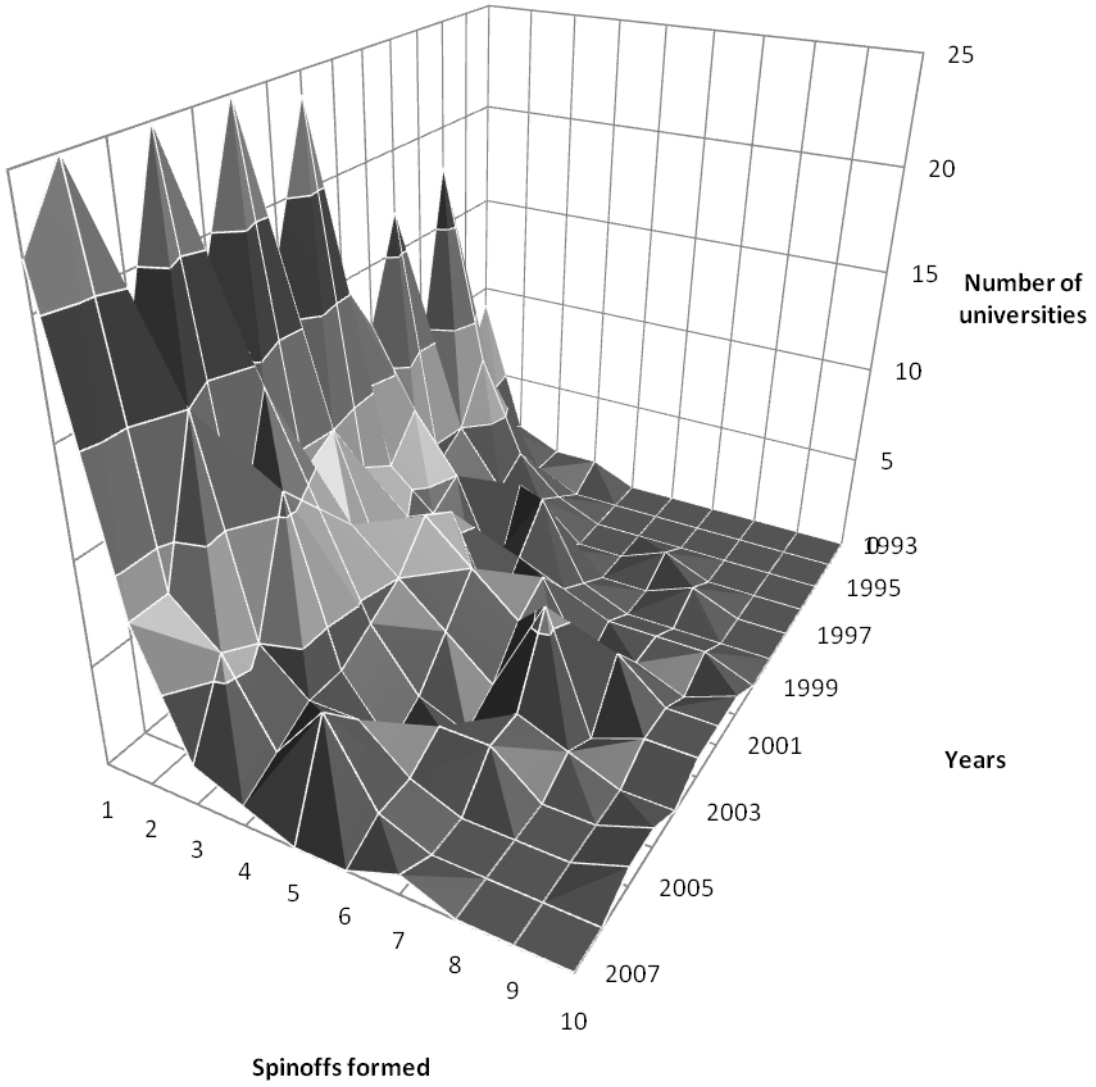

Figure 4.2: University spinoff productivity in England and Scotland by year

A special note is important for the University of London (UoL) which represented a unique case. As a confederation of colleges and schools, UoL embraces 8 educational institutions that I treated as independent universities in my research. These are: the Institute of Cancer Research, King's College, Queen Mary, the Royal Veterinary College, the School of Pharmacy, St George's, University College London and the Wolfson Institute for Biomedical Research. I considered UoL too broad a confederation to merge its colleges into one, and I would have encountered great

difficulties in assigning a single value to variables such as university age (most colleges were founded at different calendar years and some joined/left UoL quite recently) or status (some colleges have won many Nobel prizes, others none). Further, for the University of London's various colleges, some spinoffs may have been assigned to one college with another also claiming the same privilege. To overcome this, I assigned the spinoff to both research colleges (for example, IXICO Ltd. was assigned to both UCL and King's College).

I collected extensive, detailed information on university funding. The primary sources for this were the four core British science Research Councils (BBSRC, ESRC, EPSRC, MRC) and government publications that I mentioned above (e.g. HEFCE, SFC etc). I looked at the mission of each Research Council to evaluate their priorities for awarding grants over the years. For example, I found that one criterion based on which grants were given is the technology/knowledge transfer applicability of the research project seeking funding. Overall, the mission of all councils from which I collected data was extremely important: the discourse at their websites and Annual Reports reveals that university commercial activities and spinoffs were regarded as important, further reinforcing my research hypotheses (see below). An important methodological hurdle had to do with how awards were assigned to individual researchers or entire universities. For example, the list of Biotechnology awards that I downloaded from the BBSRC online database is based on the "institution of grant", i.e. the university or department that had applied for the grant. A lot of the times, the principal investigator in these projects had moved to another institution. Yet, despite the fact that the funds could now be used at spinoffs in the new institution, I did not assign these awards to the new institutions to which the investigator was now embedded.

Information on university networks was pretty straight-forward to collect. British Universities are grouped into three federations: a) the Russell Group, b) the 1994 Group, and c) the former Polytechnics, that include the Million+ network and d) the University Alliance network of educational institutions. I gathered this information from university websites, the alliances websites and other online encyclopedic sources such as Wikipedia.

Finally, I tracked all media clippings of spinoffs and their parent universities. This piece of information was crucial for many of my research hypotheses. The research process I used in my primary database of LexisNexis was as follows:

- An initial search was done with "company name" + "university name" as keywords. If no results were obtained, I repeated the search with "company name" and "location of the university", e.g. the city of Cambridge.
- If the company was reported with its initials or trading name, I also checked for these, e.g. Nano-porous Solutions (n-psl) Ltd.
- When the company had changed its name voluntarily or due to a merger/acquisition, I checked with both names (old and new), e.g. Citrix Systems R&D Ltd (previously known as XenSource UK Ltd)
- In the cases where a spinoff was established by more than one universities (e.g. Spirogen), I conducted separate searches for each university to see how much coverage each had accumulated in the media. This was important in particular because some joint ventures (e.g. Viratis Ltd) may have had different levels of media coverage because of differential university investments on this. As an example, Sterix Ltd was jointly created by Imperial College and Bath University: a search on LexisNexis revealed 95 hits associated with Imperial College and only 56 with Bath University during the same period of time.

5. THE DIFFUSION OF INNOVATIONS AMONG PUBLIC ORGANIZATIONS: FASHION AND ISOMORPHISM UNDER VARYING STATE INTERVENTION[2]

5.1 Abstract

This paper draws from the academic entrepreneurship literature using data on the population of English and Scottish universities and their spinoff firms over a period of 15 years, to unpack the full process of innovation adoption by public organizations. We distinguish among two different periods of normative and regulatory state intervention. We find that, despite pressures for compliance to state mandates, weak government intervention in the early years pushed universities towards the adoption of spinoff activities based on mimetic behaviors, industry norms and fashion mechanisms. When government regulations and norms were introduced to the higher education industry, the adoption rate collapsed and was now dependent more on efficiency explanations – only universities with strong prior success at spinoff formation were able to continue the process. Our work has implications for institutional and diffusion theories. We show that the rapid, unconditional compliance of public organizations to state mandates that has been previously proposed by diffusion theorists does not hold unless these mandates are closely regulated. As with private corporations, we also find that isomorphic behaviors and fashion diffusion processes are possible among public organizations.

[2] Earlier versions of this paper were presented at the Babson Entrepreneurship Research conference, London Business School, Tilburg University and Maastricht University.

5.2 Introduction

This paper draws inspiration from the empirical context of academic entrepreneurship (Etzkowitz, 2003; Shane, 2004a) to unfold the complexity of diffusion processes among public organizations. The diffusion of new activities and innovations has been the focus of organizational theorists for decades (e.g. Rogers, 2003; Wejnert, 2002). For public organizations, institutional theorists have convincingly argued that compliance to state regulatory and normative demands and the dependence of these entities upon the state for resources force public organizations to adopt state-mandated practices rapidly and unconditionally (Scott, 1981; Rowan, 1982; Ruef and Scott, 1998; Tolbert and Zucker, 1983). Public organizations – for example the higher education industry – are in need for legitimacy perhaps more so than private corporations, because they are evaluated based on institutional and "public good" components that guarantee their accountability to the public, rather than technical criteria of efficiency or profit (Scott, 1981: 140). However, these conclusions have been based on the assumption that the state regulatory and normative demands are explicit. How will public organizations respond to state requirements when the norms and regulations imposed by the state change over time? It is likely that concentrating on the alternatives of institutional vs. technical pressures greatly limits our understanding of these processes. We believe that contemporary research should incorporate core elements of Rogers's (2003) seminal definition of diffusion as the process where a) a novel organizational form is b) communicated through certain channels, c) over time, d) among members of a social system.

In contrast to those limitations, diffusion theorists have significantly advanced our knowledge on the adoption trajectories among private corporations. Rogers's

(2003) initial enquiry on the diffusion trajectory of innovation focused on the agricultural industry but more recent projects have looked at the adoption of new practices in diverse industries such as health care (D'Aunno, Sutton and Price, 1991), professional services firms (Lee and Pennings, 2002), computing (Attewell, 1992; Bothner, 2003), or industrial corporations (Palmer, Jennings and Zhou, 1983). An alternative theoretical perspective on diffusion has been proposed by management fashion theorists (Abrahamson, 1991; 1996; Nelson, Peterhansl and Sampat, 2004). Their research aims to explain the diffusion of non-beneficial practices and the rejection of beneficial ones. Here, management innovations spread due to various fashion-setters such as market gurus and media corporations that promote their own irrational, non-validated practices as efficient management techniques to a field (Abrahamson, 1991, 1996). Institutional theorists have also emphasized the role of mimetic behaviors in conferring legitimacy and respectability to those organizations that model their structures and behaviors to the early adopters of a practice. This process leads organizations that belong to the same industry towards a state of isomorphism (Deephouse, 1996; DiMaggio and Powell, 1983) that buffers claims of illegitimacy against them. Organizational theorists have also placed great emphasis on the role of professional associations and accreditation agencies as sources of legitimacy – membership to these associations can explain the adoption of practices by peer organizations in a field (Casile and Davis-Blake, 2002; Greenwood, Suddaby and Hinings, 2002; Greve, 2006). Recently, the literature on diffusion among private corporations has expanded to incorporate organizational characteristics (Ahmadjian and Robinson, 2001), competition dynamics (Bothner, 2003), learning (Attewell, 1992), cultural linkages (Strang and Meyer, 1993) organizational strategy (Spell and

Blum, 2005), leadership styles (Kimberley and Evanisko, 1981) and contagion and structural equivalence (Burt, 1987) as antecedents to widely accepted new practices.

One reason why so many explanations have been proposed in models of innovation diffusion among private firms is the uncertainty found in the institutional environmental. In particular, scholars have seen as an important source of uncertainty the often conflicting government regulatory and normative pressures placed upon firms (Greenwood, Oliver, Sahlin and Suddaby, 2008). For example, D'Aunno, Sutton and Price (1991) discussed how mixed regulatory policies at the federal, state and city level forced private mental health organizations to adopt practices contradictory to their previous operations. Henisz and Delios (2001) examined the role of the market policymaking apparatus in explaining the decision among Japanese multinational corporations on the location of their manufacturing plants. In this study, we emphasize the importance of uncertainty that stems from government regulation and normative intervention in the diffusion of innovations among public organizations. We argue that state mandates create niches for the adoption of new practices but the adoption trajectory depends on the actual regulatory and normative regime that defines the field over time (Scott, 1998). Thus, we challenge previous assumptions that state mandates or requirements are quickly and unconditionally adopted by public organizations (Tolbert and Zucker, 1983; Rowan, 1982) by testing various propositions that are commonly employed by studies on the diffusion of innovations by private firms (for an exception see Kraatz and Zajac, 1996 on the adoption process by public universities). The United Kingdom university spinoff industry that we study here can be an ideal context for this (Lockett and Wright, 2005; Shane, 2004a).

Intensive government mandates for university technology transfer and spinoff activities in the early 1990s pushed English and Scottish universities to adopt spinoff formation as a novel management innovation. Spinoffs are private corporations that are based on intellectual property from university laboratories, and are often controlled by universities through equity stakes. Spinoff formation represented a significant departure from the traditional mission of universities (Etzkowitz, 2003; Shane, 2004a) away from research and teaching to "big business" (Bok, 2003; Etzkowitz, 2003). This diversification presented universities with great challenges in their decision as to whether or not to engage in spinoff formation. Further, there were no clearly defined norms or best practice advice as to how spinoff activities should be regulated. Many universities were forced to learn dealing with private industry actors such as Venture Capitalists and angel investors for the first time in their long histories. Spinoffs were initially seen as risky endeavors in contrast to the steady but secure income flows from licensing agreements to the private sector (Shane, 2004a). These factors created imbalance among university audiences (Rowan, 1982) as to whether spinoffs were really worth the investments needed for them to be established and grow. Over the last 15 years, the normative and regulatory government regime further increased market uncertainty. In the early years, the preferred norm was in favor for large numbers of spinoff firms neglecting to put emphasis on the spinoff survival and success rates. Later, the UK government shifted its attention from quantity to spinoff quality and established specific financial reward schemes aimed at universities that succeeded in high-growth spinoff activities. We detail the natural history of the spinoff industry by examining the entire population of English and Scottish public universities to uncover the full spinoff diffusion process.

5. 3 The diffusion of English and Scottish spinoffs

Spinoffs are new ventures that are dependent upon licensing or assignment of university intellectual property for initiation (Shane, 2004a; Lockett and Wright, 2005). This definition distinguishes spinoffs from other university startups that are established by students, graduates or researchers that are not affiliated with research conducted based on university intellectual property. Spinoffs are complex organizations that rely on some form of patent or invention and seed funding from private investors to be set up and grow. They were historically seen as a rare route for knowledge commercialization since other forms of technology transfer such as licensing had been prevalent for decades (Shane, 2004a). The origins of the United Kingdom spinoff industry can be traced back in 1977 when the then Patents' Act gave inventors the right to share financial benefits from their research with their employer. State legislation in the United Kingdom had similar effects on university technology transfer as the United States' Bayh-Dole act (Rafferty, 2008; Shane, 2004b) by providing incentives to universities to encompass commercial activities. In 1986, the UK government abolished the British Telecom Group's monopoly in telecommunications and further privatizations throughout the 1980's incentivized research and development among private companies that sought to enter industries now open to competition. A lot of these companies looked at universities to provide them with technology expertise through patenting and licensing.

In 1993, a government White Paper designated universities as key to the realization of the UK's research potential and suggested policies to increase university-industry collaboration (HM Treasury, 1993). In response, university Technology Transfer Offices spread in the early 1990's and universities debated over strategies for the most efficient route to commercialize technology as mandated by

the government. Although spinoff firms had been formed for many years prior to 1993, their numbers were characteristically low and their emergence could be described as naturalistic. Our data show that between 1963 (when the first spinoff was registered) and 1993, only 103 spinoffs had been incorporated, at an average rate of 3 per year among all 113 universities. In contrast, by the late 1990's, most English and Scottish universities had incorporated at least one spinoff within their campus (figure 5.1).

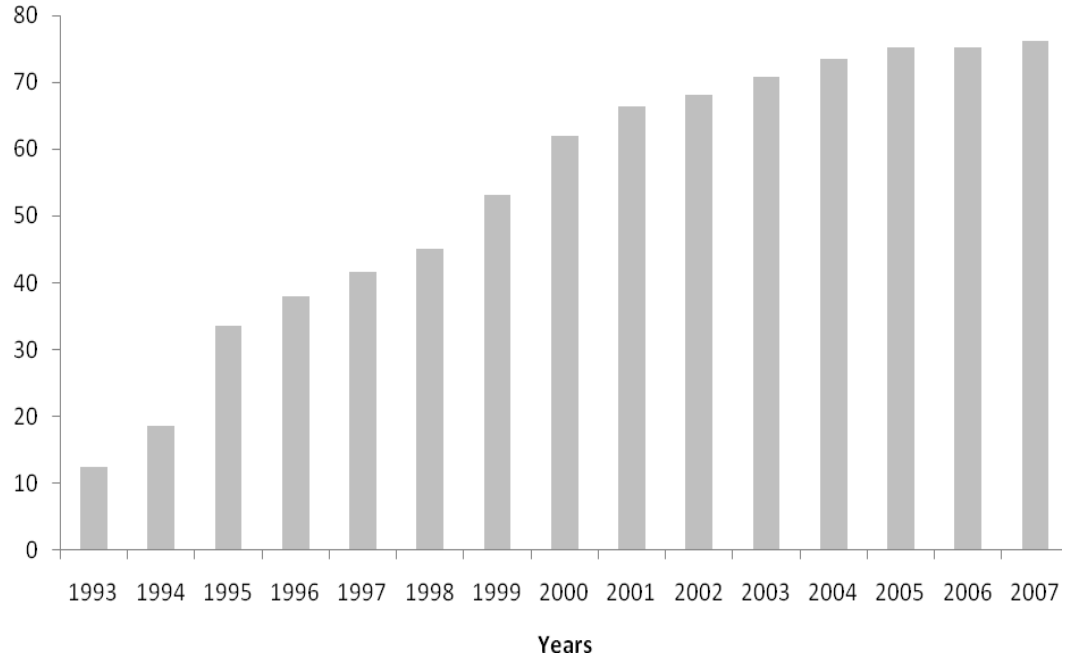

Figure 5.1: Percentage of English and Scottish universities with at least one spinoff formed, 1993-2007

To understand the spread of spinoff firms over the years, it is important to differentiate between two periods in the United Kingdom government's normative and regulatory intervention. When we refer to norms guiding the spinoff industry, we focus on government preferences with regards to the quantity vs. quality dimensions of spinoff generation by public universities. On the other hand, we define as regulatory intervention specific actions undertaken by state authorities to foster spinoff activities through financial and other incentives. Our window of observation

starts with the White Paper of 1993 (HM Treasury, 1993), continues all the way through to the White Paper of 2001 (HM Treasury, 2001) and concludes at 2007. In the UK political system, white papers such as these are authoritative reports that guide public opinion as well as businesses and lawmakers within the country's political, economic and social spheres.

Following the first white paper, in the period between 1993-2000, and despite continuous discourse by the government in favor of commercial activities, the UK government never monitored or regulated the spinoff industry. In 1996, the first major university Research Assessment Exercise (RAE) took place. RAEs are the most important, full-breadth university evaluation exercises conducted every 5-7 years by the higher education authorities of England and Scotland and they incorporate performance assessments of university teaching and research collapsed into numerical scores. RAE scores are extremely important because they guide university funding for the years until the next RAE. The 1996 assessment did not make any explicit mention on technology transfer, nor did it produce scores for commercial activities and spinoff formation. In contrast, during the second RAE that took place in 2001, the assessment process included minor technology transfer criteria for the evaluation of research at engineering and medical departments of UK universities. The test of 2001 referred to aspects of research that had "immediate commercial applications" in the UK industry. Further, between 1993 and 2001, and in contrast to its approach with regards to university teaching and research activities, the UK government had not assigned any form of state association or authority to exclusively oversee spinoff activities. The most relevant such watchdog, the University Companies Association (UNICO), was established in 1994 by university managers themselves to coordinate spinoff and other commercial activities within

university Technology Transfer Offices (TTO). Lack of such professional bodies that could oversee the spinoff industry prior to 2001 was in contrast to mainstream diffusion explanations, particularly in higher education where state normative intervention is important for the professionalization and, eventually, institutionalization of novel practices (Meyer and Rowan, 1977; Scott, 1981). Other agencies, such as the Higher Education Funding Council of England (HEFCE) or the Scottish Funding Council (SFC) that hold responsibility for the allocation of university funds were also left uninvolved in providing financial and other incentives for university spinoff generation. In the early years, the assumption supported by state discourse was that spinoff production would be financially self-rewarding for universities. State expectations were that spinoffs would directly compensate universities through equity investments that, when liquidated, would result in cash flowing into schools and their individual inventors (Feldman *et al.*, 2002; Shane, 2004a). There was also the expectation that commercial agreements with external industry financiers linked to spinoffs (e.g. venture capitalists) would bring substantial investments into university laboratories and other research facilities.

By 2001, following the last Research Assessment Exercise, government suggestions to halt the acceleration of spinoff formation among universities were loudly voiced for the first time. Reflecting world-wide evidence on the spinoff industry, a major review by the UK government concluded that the number of spinoff firms being formed was hard to sustain unless a radical shift towards spinoff performance in the universities' general incubation model was urgently implemented (HM Treasury, 2003). The government's white paper focused on indentifying key performance indicators of university commercial activities as a major public policy priority. At the same time, to promote successful technology transfer strategies, in

2000 the government established a £50million University Challenge venture capital fund and sponsored several Science Enterprise Centers based at universities throughout England and Scotland (Lockett and Wright, 2005). The following year, the government extended invitations at universities to apply for special funding targeted at commercial activities and by 2002 the first substantial public funds dedicated to technology transfer were distributed to universities by the English and Scottish authorities (HEIF funds). There were three more rounds of HEIF funding introduced in 2004, 2006 and 2008. In all of these rounds, the government signified that the norms guiding the allocation of funds would be based on prudent university investments in high-growth spinoff formation.

There was thus a significant shift in government regulatory (financial incentives) and normative (quality vs. quantity of spinoffs) focus in the early 2000s. This change in focus was primarily triggered by the Higher Education Business Interaction survey that took place for the first time during 2001-2002. The survey (which has been running annually ever since) wished to identify university strategies for the exploitation of intellectual property by collecting quantitative information from educational institutions across the UK. The government's aim was to provide "invaluable intelligence for knowledge exchange practitioners and policy makers" (HEBCI, 2008) and it therefore focused on gathering historical information relevant to spinoffs (e.g. number of employees, spinoff revenues and growth, university licensing income, academic staff involvement in the provision of services to local businesses) for the first time. By the time of the second white paper and the second Research Assessment Exercise (2001), spinoffs were clearly established as a standard practice in academia. However, following the Higher Education Business Interaction survey spinoff numbers collapsed. This process sounds familiar to what institutional

and diffusion theorists would call the deinstitutionalization of a diffused practice (Oliver, 1992). Deinstitutionalized practices lose their appeal due to functional pressures from new definitions of what is technically efficient. The impact of the Higher Education Business Interaction survey rests with the fact that the process of resetting the technical criteria emerged from freshly unearthed information on the performance of university spinoffs. Diffusion theorists content that new evidence on a diffused practice that was previously unknown can destabilize shared understandings in a field (Oliver, 1992: 574; Nelson *et al.*, 2004) leading to the collapse of support for its participant organizations.

Furthermore, if the perpetuation of a diffused practice is no longer seen as rewarding, organizations will abandon it and understandings of what is legitimate and appropriate in a field may change (Abrahamson, 1991). Institutional theorists posit that specifying new rational codes and technical criteria that regulate a field rests with the state's professional agencies and associations such as government departments, the higher education authorities or local school systems. If the state no longer confers lucrative financial subsidies and endorsement to widely used practices, the latter will be abandoned by its users (Oliver, 1992). However, the UK government started providing lucrative spinoff subsidies to universities only post-2001, and it is therefore surprising that spinoff formation diminished after that year. Our data on the English and Scottish spinoff industry show that firm foundings concentrated around the years 1996 and 2001 when the two Research Assessment Exercises took place, indicating elements of compliance to state mandates (figure 5.2). However, after 2001, not only did spinoff foundings decline, but spinoff deaths also increased sharply[3]. According

[3] Our data indicate that a lot of spinoffs founded before 2001 had remained dormant for years. These firms had no prospects for growth and had never reported revenues or assets in their accounts. When

to Abrahamson (1996:256), a bell-shaped pattern of diffusion similar to the one observed in the UK spinoff industry is typical of a management fashion. Weak regulatory and normative intervention (no financial rewards on quality, emphasis on spinoff numbers) in the early years of the phenomenon created uncertainty among universities (HM Treasury, 1993). It is likely that this market uncertainty forced universities to adopt spinoffs based on industry norms, mimetic behaviors or other external influences placed upon university decision makers.

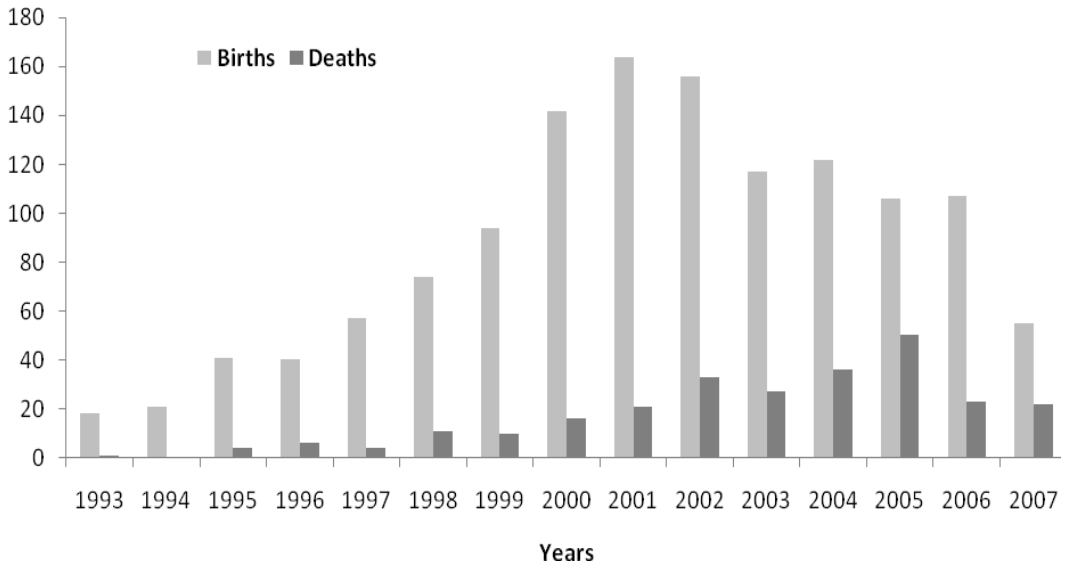

Figure 5.2: Spinoff births and deaths in England and Scotland, 1993-2007

In trying to explain the diffusion of spinoffs, we formulate hypotheses distinguishing between the two periods, 1993-2000 and 2001-2007. As we noted, we treat 2001 as the turning point in our analysis for several reasons. First, it was the year of the last Research Assessment Exercise that incorporated spinoff assessment criteria to university evaluations for the first time. Second, it was the year that the government introduced dedicated spinoff funds accompanied by specific demands and guidelines for growth-oriented university venturing activities. These and other regulatory and normative changes were implemented as a result of the government

the government started monitoring the industry more closely, universities abandoned them altogether through deregistration.

starting forming clear impressions on the spinoff industry based on the Higher Education Business Interaction survey (Abrahamson, 1991; Oliver, 1992). To further advance theory on the diffusion of innovations among public entities (and contrary to previous studies by scholars such as Scott, 1981; Rowan, 1982; Ruef and Scott, 1998; Tolbert, 1985; Tolbert and Zucker, 1983), we focus on diffusion approaches (Rogers, 2003) that are commonly used in studies of for-profit organizations (e.g. Burns and Wholey, 1993).

Association Membership. The uncertainty caused by the changing governmental rules and norms was left to be filled by universities. Institutional theorists argue that uncertainty breads mimetic behaviors among organizations as the latter attempt to define what constitutes acceptable behavior versus not (DiMaggio and Powell, 1983; Ruef and Scott, 1998). Emerging activities and practices are defined by professional bodies, training organizations and other industry associations that confer legitimacy to those espousing the practice (Rowan, 1982). To participate or be monitored as a member of such a group or association makes organizations legitimate players that abide by newly defined professional standards (Zuckerman, 1999). The role of associations in educational markets is particularly important: formalized educational markets with clear regulations, associations, organized communities, bodies and groups of interests are important in guiding the process of accrediting newly diffused practices (Meyer, Scott and Strang, 1987; Scott, 1981). In 1994, English and Scottish universities founded their own professional body, the University Companies Association (UNICO) as a natural reaction to the emerging spinoff population. The Association was focused on exchanging best practice and training universities technology transfer personnel. Membership into UNICO increased rapidly as its members attempted to design university strategies and

structures that would increase spinoff venturing. University participation into UNICO during the early years was an act that sought legitimacy and a sense of belonging for these universities into a group of pioneers that abided by governmental demands for reform. Membership into UNICO can therefore explain the intention of universities to generate spinoffs early in the 1990's – it was a symbolic and substantive gesture towards convergence to a specific business incubation model that UNICO members defined themselves in view of absence of any state norms or monitoring mechanisms that would guide the industry. However, the spinoff industry was later redefined based on new evidence (Abrahamson 1996; Oliver, 1992; HEBCI, 2002) and the role of UNICO may have lost its importance in predicting university spinoff formation. Following the second government white paper, the introduction of financial incentives for high-growth spinoff activities, may have slowed the impact of industry norms as defined by universities through their association. We can hypothesize:

H1a. There is a positive relationship between UNICO membership expressed in years since joining the association and a university's decision to adopt spinoffs.

H1b. The effect of UNICO membership on a university's decision to adopt spinoffs was stronger in the first period than in the second.

Mimetic behaviors. In public organization settings, institutional theorists have rarely attributed the diffusion of new practices to mimetic pressures. Institutional theorists claim that isomorphism through mimicry is rare among public organizations because the state apparatus is assumed to have clear rules and sanctioning mechanisms that regulate their conduct (Meyer and Rowan, 1977). Because of their dependence upon the state, public organizations will rush to adopt changes, lest they are seen as illegitimate. Tolbert and Zucker (1983) have examined how the adoption

of civil service reforms begun due to state regulatory requirements and attributed the rapid diffusion of the reforms to institutional compliance of city administrators towards state mandates (cf. Edelman, 1990, 1992). In the UK spinoff context, as universities were trying to designate behavioral norms (DiMaggio and Powell, 1983), the spread of spinoffs depended upon schools mimicking each other in order to appear appropriate and modern within their changing field. The imitation process took place without universities being truly concerned with successful spinoff formation. Elements of a mimetic legitimization process (DiMaggio and Powell, 1983; Rowan, 1982) were evident in many cases. Most universities restructured their commercial activities around almost identical Technology Transfer Offices and around the same time period. Other structural and administrative arrangements such as outsourcing of spinoff activities to external corporations took place mostly after 2001. We believe that if mimetic forces were in place, prior adoption of spinoff activities by universities within a geographical region would have further predicted the adoption of spinoffs by those universities that had not done so already. Geographic proximity and network embeddedness are common parameters affecting the diffusion trajectory among private organizations (Lee and Pennings, 2002; Wenjert, 2002). Yet, mimetic behaviors among geographically proximate public entities such as universities could explain equally well why other alternatives were eliminated, and why universities treated spinoffs as a taken-for-granted practice early in the history of the spinoff industry (DiMaggio and Powell, 1983). We propose:

H2a. There is a positive relationship between spinoff adoption by geographically proximate universities and the decision of another university in that region to adopt spinoffs.

New state requirements such as technology transfer through spinoff formation were occasionally seen as technically impossible or as having a negative impact on organizational performance, so that adopting organizations could decouple the new activities from their technical core (Scott, 1981). In organization studies, decoupling refers to a "ceremonial" adoption of state-mandated practices that organizations employ in order to appear legitimate and avoid government sanctions without wholeheartedly paying too much attention to the technical requirements of state mandates (Westphal and Zajac, 2001). In practice, decoupling is often achieved through externally visible organizational structures and practices that have no real substance (Westphal and Zajac, 1997; Westphal and Zajac, 2001). However, institutional theorists are unable to explain the overwhelming contradiction between strong government pressures and decoupling among public organizations. How can public organizations conform to state requirements so quickly in fear of punishment (Tolbert and Zucker, 1983) when others can get away with decoupling? Existing theories of innovation adoption by public entities are unable to explain how decoupling organizations consistently avoid the scrutiny of regulators, associations, professional bodies and other agencies that surround these entities. We argue that isomorphic convergence towards spinoff generation among universities lost its importance after 2001, because new government evidence over the potential of the spinoff industry (HEBCI, 2002; HM Treasury, 2003) made decoupling impossible. After 2001, the government was able to distinguish between universities that were truly oriented towards high-growth spinoffs and was willing to reward these institutions financially. This policy was in contrast to university strategies aiming at spinoff formation for legitimacy purposes, often decoupling it from efficiency requirements. We propose:

H2b. The effect of spinoff adoption by geographically proximate universities on the decision of another university in that region to adopt spinoffs was stronger in the first period than in the second.

Fashion dynamics. As we briefly mentioned earlier, management fashions are relatively transitory collective beliefs disseminated by exogenous to a group of organizations opinion leaders such as the media, lobbyists or major consulting agencies (Abrahamson, 1991) that certain management choices lead to progress (Abrahamson, 1996: 257). The illusion of the rational progress is temporary: short-lived examples such as total quality management (TQM) exemplify this trend in recent management literature. Fashions take place because there is no objective evaluation or feedback on the usefulness of the new practices. Thus, the illusion of efficiency owes its strength to the lack of systematic knowledge gathering from the adopting organizations, or from other bodies responsible for the regulation of the industry (Nelson *et al*, 2004; Wejnert, 2002). According to Abrahamson and Fairchild (1999), fashions occur through certain triggering events. Triggers are not the same with solid institutional decisions that affect change through regulation, accreditation or administrative monitoring (Strang and Sine, 2002: 507). Changes in government discourse as that concerning university technology transfer in 1993 may have been a trigger of the new practices that spread, but they were less important than laws that contain specific sanctioning or rewarding powers. Fashion theorists contend that fashions tend to be frequent but short-lived in countries wherein norms of rationality and efficiency are clearly specified (Abrahamson, 1996: 263). Nonetheless, popular practices that have been state-mandated may also lose their appeal if the government withdraws its mandate (Abrahamson, 1996: 256).

Research on the diffusion and abandonment of fashions has predominantly taken place in for-profit organizational settings. In the context of academic entrepreneurship, media coverage (a fashion-setting mechanism) gathered pace from the early 1990's with the population of spinoff firms attracting almost 500 press articles by the year 2000 (figure 5.3). The average number of media reports per spinoff also increased from 1.12 in 1995 to 2.74 in 1998 and 3.76 in 2000. Typical mentions in the UK press hailed spinoffs as taking research methods "from the laboratory bench to the hospital ward" (*Observer*, 2000) and as "building the new knowledge-driven economy" (*M2 Presswire*, 1998).

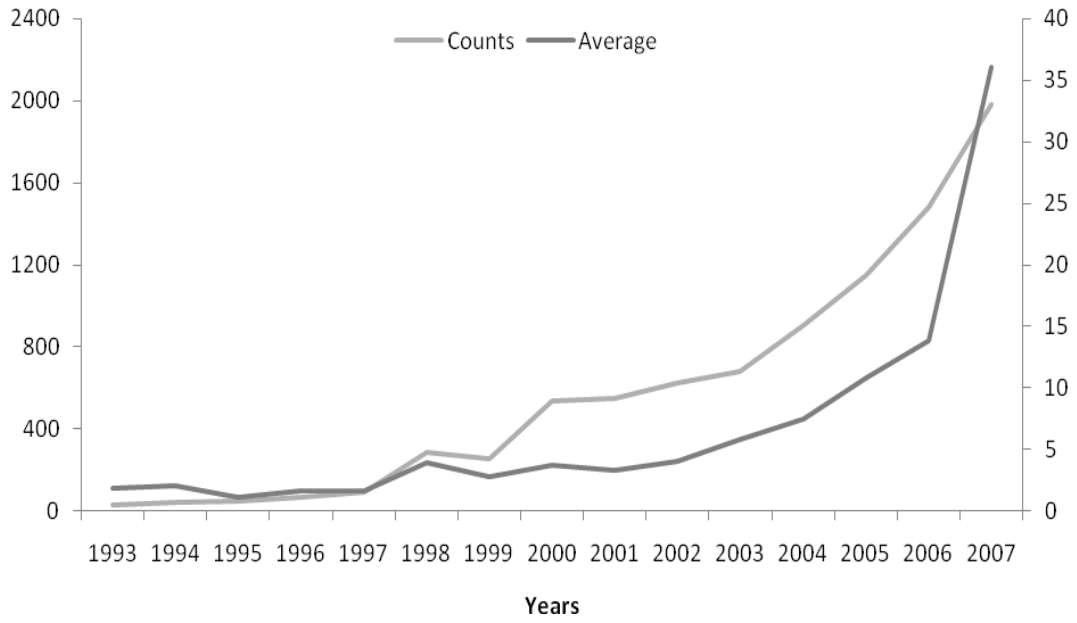

Figure 5.3: Media coverage of English and Scottish spinoffs, 1993-2007 (average on right axis)

In this media hype, one university was seen as planning to form "80 spinoffs in only three years", highlighting excessive hopes on the "role that spinoffs would play in the national economy" (Sheffield Star, 2002). The influence of media coverage is central to the diffusion of innovations and fashion literatures (Abrahamson, 1991; Rogers, 2003), however, research on university spinoffs has ignored it focusing instead on efficiency-based explanations (Lockett and Wright,

2005; O'Shea *et al*, 2005). We argue that the UK media magnified spinoff events granting them legitimacy and respectability (Deephouse, 2000) even among audiences negatively positioned towards them. This may have attracted universities that were previously not engaged in the process to follow suit by forming spinoffs in a rapid bandwagon trajectory. For reasons that we highlighted earlier (Abrahamson, 1991; Oliver, 1992), the influence of the media may have been less important in the second period of the spinoff industry evolution. We propose:

H3a. There is a positive relationship between spinoff media coverage and a university's decision to adopt spinoffs.

H3b. The effect of spinoff media coverage on a university's decision to adopt spinoffs was stronger in the first period than in the second.

Efficiency explanations. Scholars in the United States and Europe looking for answers as to why spinoffs spread so quickly have offered efficiency-based explanations of how university strategies and initiatives as well as general economic conditions favored the diffusion of these firms (DiGregorio and Shane, 2003; Lockett and Wright, 2005; O'Shea, Allen, Chevalier and Roche, 2005). Researchers have implicitly assumed that more spinoffs were better for national economies and universities, without considering the prospects of survival and growth of these companies or the benefits that spinoffs brought back to universities. Diffusion and fashion theorists such as Abrahamson (1991) have claimed that this dominant perspective in the diffusion literature is indicative of the pro-innovation bias which suggests that diffused innovations will benefit the adopters, despite lack of such evidence. He and other theorists have proposed that lack of evidence is a predictor of fashion diffusion processes (Abrahamson, 1991; Nelson *et al*, 2004) because the

resulting ambiguity forces organizations to accept practices that are not beneficial or financial sustainable within their structure. By collecting information and setting standards for financial rewards around 2001, the government made steps towards rationalizing the spinoff industry. Few universities had formed spinoffs with clear growth prospects since 1993 because most had seen high spinoff productivity as necessary or sufficient given the government mandates (HM Treasury, 1993). Figure 2 indicates that post-2001, not only did spinoff numbers decrease but spinoff deaths increased markedly. We contend that, following new evidence and new governmental guidelines, universities that did not consider the production of potentially successful spinoffs as feasible within their capabilities and resource capacity would abandon the practice. In contrast, those few that had prior experience in successful spinoff formation would continue after the government introduced financial incentives such as the HEIF funds. Thus, continuing to generate successful spinoffs was a natural but also strategic university choice based on criteria of efficiency. We hypothesize:

H4a. There is a positive relationship between prior spinoff growth and a university's decision to adopt spinoffs.

H4b. The effect of prior spinoff growth on a university's decision to adopt spinoffs was stronger in the second period than in the first.

5.4 Methodology

5.4.1 Sample and Measures

We gathered panel data on the population of universities (113) and spinoffs firms (1404) in England and Scotland covering a period of 15 years between 1993 to 2007. We located most data in publication outlets such the Higher Education Statistics Authority (HESA) and supplemented it with information from primary

sources such as direct contacts with universities and Technology Transfer Offices. The need to create a full UK university spinoff database has been enormous. Various government- and industry-sponsored reports (HM Treasury, 2003, 2007; Minshall and Wicksteed, 2005) as well as individual scholars in the UK (Lockett and Wright, 2005) and internationally (Shane, 2004a) have called for such an initiative, as it has been recognized that lack of data hampers policy makers in the field. Indeed, it is remarkable that after so many years of expansion, the population of UK spinoffs and their demographics was still unknown. In the following paragraphs, we explain the various data sources that we used in this project.

Dependent variables. We defined two dependent variables in our study. First, a binary variable measuring whether a university founded any spinoff in a given year (0=no, 1=yes) and second, a positive integer capturing the total number of spinoffs founded each year by a university.

Independent variables. *Membership* into the universities' spinoff association UNICO was measured as years since joining. As some universities left the association earlier than others, we used a decreasing yearly ratio of 0.80 to capture the slowly-fading effect of a UNICO membership over time. The reason for this is that having left UNICO did not automatically erase the cumulative UNICO experience of a university that participated in the union for years.

Local diffusion was measured as the percentage of universities in a UK region that had formed at least one spinoff in a year. We used the UK's classification of 9 geographic regions of England (Government Office regions) plus Scotland to assign universities in each of these. We then counted the number of universities that had formed a spinoff in each region and divided the figure by the total number of

universities located in that region. This approach has been employed in several diffusion studies, including in Strang and Tuma's (1993) heterogeneous diffusion model as well as in deterministic diffusion models (e.g. Hedstrom, 1994; Fiss and Zajac, 2004).

Media coverage of spinoffs was assessed by counting the number of UK press clippings that related to a university and its spinoff firms in a single article. We searched the LexisNexis database for articles with the name of a university and each of its spinoff firms as keywords and marked such articles in our 15 year period. For example, we searched with "University College London" and "Company X" for all universities and spinoffs and recorded a total of 8866 articles linked to 1404 spinoffs and their parent universities. Although we could group articles based on their negative or positive tenor (Pollock and Rindova, 2003), an examination of our database showed that there were hardly any articles negatively positioned towards spinoff-related events. We therefore proceeded to measure the independent variable "media coverage" as the total number of media articles of all universities and their spinoff firms minus the focal one, at any year. Content analysis of this type has been used in various other settings in organizational studies (e.g. Holden, 1986; Myers, 2000).

Efficiency in spinoff formation was measured as the logarithm of a university's prior spinoffs firms' total assets. Theoretically, we expected that past spinoff growth would affect the decision to form spinoffs in the future (yes/no) or the number of spinoffs generated in the future (Deephouse, 1996). Assets are frequently used as firm size indicators and can capture common endowments at the time of a spinoff founding such as patents, office space and personnel granted to them by universities. We see these endowments as indications of a university's commitment to

generating successful future spinoffs. In this context, assets are better estimates of growth than revenues since revenues are hard to generate in the early years of a spinoff's life due to its liability of newness. Also, revenues are commercial results often generated when the spinoff has become completely autonomous or has been acquired/merged with another external firm; thus, revenue figures are irrelevant in our study.

Control variables. We controlled for a number of university-level and environmental factors that may affect the diffusion of spinoffs. To control for *university performance*, we collected yearly data on the number of publications in ranked journals by each university as listed in the ISI Web of Knowledge. University performance measured like this (cf. Keith and Babchuk, 1998) often called "stock of knowledge" has been used by other researchers on the spinoff industry (O'Shea *et al*, 2005). We controlled for *industry funding* and university *endowments* as indicators of university exposure to businesses and individual entrepreneurs who invest through various contracts with or donate to these institutions. Funding from private sources rather than the central government have been seen as indicators of a university's propensity to engage in startup formation (DiGregorio and Shane, 2003). To avoid potential multicollinearity problems between these funding covariates and university performance we took the average funding figures per full-time student instead of absolute figures. Consistent with previous research (Deephouse, 2000; Fombrun and Shanley, 1999; Roberts and Dowling, 2002), we controlled for *university reputation* based on scores in the Times Higher Education university guide that is published annually since 1993. Many scholars have cast their doubts as to whether media rankings can accurately measure reputation because they consider them as rather noisy and inconsistent indicators of quality. However, ratings and rankings collapse

the diverse and complex information necessary to evaluate organizational quality into a single number and "it is precisely this synoptic nature of rankings that makes them have a strong impact on an organization's prominence" (Rindova, Williamson, Petkova and Sever, 2005:1038). Similar to reputation, we included a measure of *university status* defined as the cumulative number of Nobel Prizes won over the years. Status is different from reputation because the former is based on network theory and the demonstration of past quality, while reputation stems from signaling theory that emphasizes the ability to send signals to stakeholders through *current* organizational actions (Feldman *et al*, 2002; Rindova, Pollock and Hayward, 2006: 54; Sine, Shane and DiGregorio, 2003).

We controlled for *prior experience* in spinoff formation before 1993, when our window of observation started, by coding 2 those universities that had such experience and 1 those that did not. We also controlled for *Technology Transfer Office experience* by measuring its age in each university. Various authors have highlighting the importance of TTO staff training and expertise as factors affecting the successful coordination of spinoff generation (Lockett and Wright, 2005; DiGregorio and Shane, 2003). To control for *university age*, we measured the number of years since the founding of each institution. We also controlled for relative *university size* by taking the total number of full-time university students. Rowan (1982) has shown that the size of educational organizations is not always a good predictor of their behavior, but it can be used as a control variable when other constructs are included in analyses. We also included a dummy variable to distinguish between the two countries in our sample, coding *Scottish universities* as 1 and English as 0. Scotland has had a distinctive approach to its spinoff industry compared to England with many English TTO managers envying the Scottish approach. The

main reason for this is Scottish Enterprise, a national, well-structured scheme for the financial support of high-tech businesses in the country.

Finally, we included two environmental controls, i.e. *regional GDP* and re*gional R&D* intensity, measured as private industry investments in R&D. The mechanism through which these operate is twofold: when economic development or R&D investments are high, it is natural to expect that entrepreneurial activities including academic entrepreneurship will increase. Alternatively, when GDP and R&D investments are low in a region, spinoff formation could be used a stimulus for the regional economy with the government supporting investments in research and knowledge transfer (Lockett and Wright, 2005). We collected data from the National Statistics Authority on per-capita GDP and per-capita R&D investments in each of the ten UK regions in our sample: nine in England plus Scotland.

5.4.2 Analysis

As stated above, we defined the dependent variable in two ways: first, as the university decision to form spinoffs each year (yes/no) and second, as the number of spinoffs formed each year. The reason for the two alternative specifications is that spinoffs were formed not only in different years and periods (pre- vs. post-2001) but also with different intensity across years, thus we wanted to account for this sensitivity in our dataset. In the first case, we employed discrete-time event history analysis estimating maximum likelihood logistic regression. Our data were discrete-time rather than continuous because the exact timing of a spinoff founding was not included in the analysis (even thought it was known for most firms) as information on the other covariates was only available on a yearly basis. Because we had repeated events in our sample (i.e. the same university remained in the sample every year) we pooled yearly events over time as suggested by Allison (1984).

In the second case, we estimated negative binomial regression models as we were concerned with count variables that take small positive values. For easier interpretation, instead of coefficients (b), results of the negative binomial regression were reported as incident-rate ratios (exp(b)), where a one point change to an independent variable, holding the others constant, would lead to a change equal to the incident-rate ratio (IRR) of the dependent. To test our hypotheses and the differential impact of late government regulatory and normative intervention, we split our sample in two periods: 1993-2000 and 2001-2007.

All independent and control variables in the models were lagged by one year to allow for their effects on the dependent variable to unfold smoothly.

5.5 Results

Table 5.1 shows descriptive statistics and correlations among variables in the models. Most correlations range from small to moderate, however, to examine possible problems with multicollinearity we computed variance inflation factors (VIF). In both periods and with both event history and negative binomial analyses, we found that all variables had VIF well below the usual warning level of 10, with the highest VIF not exceeding 6.5 and the mean VIF always below 3 (Gujarati, 2003).

Tables 5.2 shows results for the entire period of observation; in both analyses we find strong support for hypotheses 1a, 2a, 4a but not for 3a. Membership into UNICO, local diffusion and prior spinoff growth (efficiency) were all found to be significant predictors of spinoff diffusion. Media coverage had a negative impact on spinoff formation that was significant in the negative binomial regression. This is perhaps a consequence of the popularity of spinoffs increasing dramatically in the second period, even as spinoff numbers declined. A possible explanation is that

spinoffs in the new era were judged based on higher success compared to the previous period, therefore fewer champion spinoffs attracted more press coverage compared to the many spinoffs attracting less average media coverage before the year 2001.

Tables 5.3 and 5.4 show results of event history analysis on the decision to form spinoffs (yes/no). Overall, we find support for hypotheses 1a, 2a, 3a and 4a once more, as the four variables increase X^2 and decrease the log likelihood in all models except 10. Model 12 shows that media coverage cannot explain spinoff productivity in the second period, a fact that further supports hypothesis 3b (model 6 shows that media coverage is significant pre-2001). Results also support hypotheses 2b and 4b as local diffusion was less important and prior spinoff growth was more important when government rewards were first introduced. However, we did not find support that early membership into UNICO (1b) was more important than after 2001.

In tables 5.5 and 5.6, results of negative binomial regression provide partial support to our arguments. Specifically, we find local diffusion and media coverage to be more important predictors in the unregulated era (negative effect in the regulated era) as predicted by 2b and 3b but we find mixed support for membership and prior spinoff growth. Membership into UNICO was significant in both periods' overall models, however model 8 on table 6 shows that, when added alone to the baseline model, membership in the second period was not significant as in model 2 in table 5.5, therefore granting some support to hypothesis 1b. In contrast, model 11, table 5.6 indicates that prior spinoff growth was not a more significant predictor of spinoff diffusion in the second period than in the first as suggested by hypothesis 4b. In summary, we found support for most hypotheses across both analyses indicating that results confirm our theoretical explanations on spinoff diffusion.

	Variable	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Publication output	1.00															
2	Industry funding	0.28	1.00														
3	Endowments	0.14	0.42	1.00													
4	Reputation	-0.57	-0.52	-0.47	1.00												
5	Status	0.54	0.13	0.14	-0.32	1.00											
6	Prior experience	0.52	0.12	0.02	-0.54	0.27	1.00										
7	TTO age	0.58	0.17	0.05	-0.40	0.43	0.50	1.00									
8	Age	0.56	0.16	0.18	-0.46	0.66	0.37	0.44	1.00								
9	Size	0.27	-0.14	-0.10	-0.11	0.16	0.17	0.31	0.11	1.00							
10	Scotland	0.03	0.02	-0.02	-0.03	-0.05	0.16	0.21	0.24	-0.10	1.00						
11	Local GDP	0.20	0.18	0.14	0.05	0.05	-0.00	-0.03	0.08	-0.05	-0.12	1.00					
12	Local R&D	0.00	-0.00	0.00	0.00	0.17	-0.09	-0.12	0.03	-0.07	-0.29	0.19	1.00				
13	Membership	0.33	0.08	0.01	-0.11	0.09	0.09	0.29	0.07	0.39	-0.02	0.16	-0.05	1.00			
14	Local diffusion	0.19	0.16	0.12	0.07	-0.02	0.06	0.15	0.16	0.00	0.45	0.62	-0.03	0.22	1.00		
15	Media coverage	0.17	0.11	0.08	-0.28	-0.01	-0.01	0.13	-0.01	0.16	-0.00	0.47	0.09	0.38	0.52	1.00	
16	Prior spinoff growth	0.34	0.10	0.07	-0.24	0.26	0.45	0.35	0.24	0.17	0.16	0.12	0.04	0.23	0.19	0.29	1.00
	N	1695	1658	1658	1464	1695	1695	1693	1695	1665	1695	1695	1695	1695	1695	1695	1694
	Mean	154	266	217	56	0.49	1.30	4.38	65.7	14k	0.12	15k	1148	2.45	7.07	451	6.40
	S.D.	284	661	1179	33	2.54	0.45	6.58	145	8359	0.33	4639	941	3.68	4.65	431	7.25

All correlations above 0.056 significant at $p<0.05$

Table 5.5.1: Correlation matrix and descriptive statistics

	Event history on the decision to form spinoffs by year				Negative binomial regression on the number of spinoffs formed by year			
Variables	Model 1	s.e.	Model 2	s.e.	Model 3	s.e.	Model 4	s.e.
Publication output	1.00**	(0.00)	1.00	(0.00)	1.00	(0.00)	-0.99	(0.00)
Industry funding	1.00*	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00†	(0.00)
Endowments	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)
Reputation	-0.98***	(0.00)	-0.97***	(0.00)	-0.97***	(0.00)	-0.97***	(0.00)
Status	-0.99	(0.08)	1.08	(0.10)	-0.98	(0.02)	1.01	(0.02)
Prior experience	1.45*	(0.25)	1.42†	(0.28)	1.28*	(0.13)	1.11	(0.12)
TTO age	1.10***	(0.02)	1.08***	(0.02)	1.04***	(0.00)	1.03***	(0.00)
Age	-0.99	(0.00)	-0.99	(0.00)	-0.99	(0.00)	-0.99	(0.00)
Size	1.00***	(0.00)	1.00*	(0.00)	1.00***	(0.00)	1.00***	(0.00)
Scotland	1.87*	(0.49)	-0.35**	(0.13)	1.69***	(0.22)	-0.62*	(0.01)
Local GDP	1.00***	(0.00)	-0.99***	(0.00)	1.00***	(0.00)	-0.99**	(0.00)
Local R&D	0.99	(0.00)	1.00	(0.00)	-0.99	(0.00)	-0.99	(0.00)
Membership			1.07**	(0.03)			1.03*	(0.02)
Local diffusion			1.33***	(0.06)			1.15***	(0.03)
Media coverage			-0.99	(0.00)			-0.99*	(0.00)
Prior spinoff growth			1.06***	(0.01)			1.05***	(0.01)
X^2	653.31***		745.88***		762.80***		864.61***	
Log likelihood	-625.08		-578.79		-1424.07		-1373.17	
df	12		16		12		16	

N=1457; ***p<0.001, **p<0.01, *p<0.05, †p<0.10

Table 5.5.2: Results on the entire period of observation: 1993-2007

Variables	Model 1	s.e.	Model 2	s.e.	Model 3	s.e.	Model 4	s.e.	Model 5	s.e.	Model 6	s.e.
Publication output	1.00	(0.00)	1.00	(0.00)	1.00†	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)
Industry funding	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)
Endowments	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)
Reputation	-0.97***	(0.01)	-0.97***	(0.01)	-0.97***	(0.01)	-0.97***	(0.01)	-0.97***	(0.01)	-0.97***	(0.00)
Status	0.98	(0.09)	1.02	(0.09)	1.03	(0.09)	1.00	(0.09)	1.00	(0.09)	1.06	(0.10)
Prior experience	1.51†	(0.35)	1.89**	(0.46)	1.86*	(0.46)	1.74*	(0.42)	1.20	(0.30)	1.87*	(0.51)
TTO age	1.11***	(0.02)	1.08***	(0.02)	1.08**	(0.03)	1.08***	(0.02)	1.10***	(0.02)	1.06**	(0.02)
Age	-0.99	(0.00)	-0.99	(0.00)	-0.99	(0.00)	-0.99	(0.00)	-0.99	(0.00)	-0.99	(0.00)
Size	1.00***	(0.00)	1.00**	(0.00)	1.00*	(0.00)	1.00*	(0.00)	1.00**	(0.00)	1.00	(0.00)
Scotland	2.95**	(1.02)	3.36***	(1.16)	-0.50	(0.24)	2.70**	(0.93)	2.52**	(0.89)	-0.64	(0.32)
Local GDP	1.00**	(0.00)	1.00**	(0.00)	-0.99*	(0.00)	1.00	(0.00)	1.00**	(0.00)	-0.99*	(0.00)
Local R&D	1.00*	(0.00)	1.00*	(0.00)	1.00*	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)
Membership			1.18**	(0.06)							1.06	(0.05)
Local diffusion					1.35***	(0.08)					1.27***	(0.07)
Media coverage							1.00***	(0.00)			1.00**	(0.00)
Prior spinoff growth									1.05**	(0.02)	1.02	(0.01)
X^2	333.75***		344.46***		365.97***		358.93***		343.58***		381.91***	
Log likelihood	-341.06		-336.05		-325.30		-328.82		-336.14		-316.98	
Df	12		13		13		13		13		16	

N=835; ***p<0.001, **p<0.01, *p<0.05, †p<0.10

Table 5.5.3: Event history analysis on the decision to form spinoffs by year: 1993-2000

Variables	Model 7	s.e.	Model 8	s.e.	Model 9	s.e.	Model 10	s.e.	Model 11	s.e.	Model 12	s.e.
Publication output	1.00	(0.00)	1.00	(0.00)	-0.99	(0.00)	-0.99	(0.00)	1.00	(0.00)	-0.99	(0.00)
Industry funding	1.00	(0.00)	1.00	(0.00)	1.00†	(0.00)	1.00†	(0.00)	1.00	(0.00)	1.00	(0.00)
Endowments	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00†	(0.00)	1.00	(0.00)	1.00	(0.00)
Reputation	-0.98***	(0.00)	-0.98***	(0.00)	-0.97***	(0.00)	-0.97***	(0.00)	-0.98***	(0.00)	-0.97***	(0.00)
Status	3.45*	(1.70)	3.42*	(1.69)	3.96**	(1.99)	3.55*	(1.75)	3.16*	(1.56)	3.43*	(1.73)
Prior experience	1.93*	(0.52)	2.22**	(0.62)	1.84*	(0.52)	1.77*	(0.49)	1.67†	(0.47)	1.83*	(0.54)
TTO age	1.07***	(0.02)	1.05**	(0.02)	1.11***	(0.03)	1.11***	(0.02)	1.07***	(0.02)	1.09***	(0.02)
Age	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)
Size	1.00*	(0.00)	1.00	(0.00)	1.00*	(0.00)	1.00**	(0.00)	1.00†	(0.00)	1.00*	(0.00)
Scotland	1.00	(0.42)	1.18	(0.49)	-0.14**	(0.09)	1.05	(0.45)	-0.90	(0.37)	-0.59	(0.45)
Local GDP	1.00	(0.00)	-0.99	(0.00)	-0.99***	(0.00)	1.00	(0.00)	-0.99	(0.00)	-0.99	(0.00)
Local R&D	-0.99***	(0.00)	-0.99***	(0.00)	1.00	(0.00)	-0.99***	(0.00)	-0.99***	(0.00)	-0.99	(0.00)
Membership			1.05*	(0.03)							1.07*	(0.03)
Local diffusion					1.39***	(0.12)					1.12	(0.11)
Media coverage							-0.99***	(0.00)			-0.99***	(0.00)
Prior spinoff growth									1.04*	(0.02)	1.03†	(0.02)
X^2	331.36***		335.84***		348.27***		350.95***		335.09***		363.78***	
Log likelihood	-261.51		-259.27		-253.05		-251.71		-259.05		-244.71	
Df	12		13		13		13		13		16	

N=618; ***p<0.001, **p<0.01, *p<0.05, †p<0.10

Table 5.5.4: Event history analysis on the decision to form spinoffs by year: 2001-2007

5.6 Discussion

In this paper, we examined the diffusion of state-mandated practices among public educational organizations. The paper has important implications for the diffusion (Rogers, 2003) and fashion (Abrahamson, 1991; Abrahamson, 1996; Nelson *et al*, 2004) theories for a number of reasons. First, rather than static explanations, we move towards a theory of more dynamic diffusion processes among state-owned organizations. The explicit assumption among diffusion studies dealing with public, non-profit organizations, is that there exist clear government guidelines that organizations follow in order to appear legitimate (Casile and Davis-Blake, 2002; D'Aunno *et al*, 1991; Davis, 1991; Greve, 1996). This sensitivity for compliance is presumably extremely high among educational institutions because changes in their mission or structure are not evaluated in "technical terms" unless they have first been evaluated in terms of conformity to the state requirements (Rowan, 1982; Scott, 1981). We do not deny the role of "public-good" evaluations of state-owned enterprises on their decision to comply with state demands. But we argue that state powers have been misrepresented to describe the cognitive aspects of neoinstitutional theory, thus replacing other explanations of practice diffusion among public organizations. Because government intervention in public good markets is seen as extremely important, authors have assumed that organizations adopt practices automatically (Mizruchi and Fein, 1999) due to those pressures. Instead, we suggest that state powers are not so rigid, therefore leaving plenty of space for mimetic or fashion mechanisms to dictate the diffusion process. This conceptualization brings us closer to the true cognitive aspects of organizational change that lie at the heart of neoinstitutional theory: public organizations are driven by the need to appear legitimate and comply to state mandates as much as by cognitive dynamics outside

the realm of the government, such as fashions and peer strategies. In fact, weak monitoring of government-mandated practice implementation is the reason why public organizations are left exposed to fashions and mimetic processes.

Further, in most diffusion studies, authors misattribute the adoption of practices to institutional compliance and coercive pressures for two reasons (Greenwood *et al*, 2008). First, they assume that the state has rationally examined clear benefits for the adopting institutions before mandating the new practices or that it has formalized its monitoring mechanisms with regards to how adopting and non-adopting entities are rewarded and punished. In this instance, mimetic behaviors or fashion trajectories are excluded from the analysis as the taken-for grandedness of the new activities is assumed to be given exclusively by state approval ("sociopolitical legitimacy", Aldrich and Ruef, 2006). Second, in organizational studies of practice diffusion among public organizations, very few authors have satisfactorily operationalized both normative and regulatory intervention in a single study (Mizruchi and Fein, 1999) and in some cases institutional theorists have deliberately blended these elements to form a composite "institutional profile" (Greenwood *et al*, 2008: 16) that supposedly affects diffusion. This has led researchers to commonly attribute the diffusion of practices to some unspecified government "institutional forces" that they designate at will. Contrary to these studies, we show that examining the adoption of innovations under different levels of regulatory or normative regimes (e.g. high vs. low) can help us significantly in understanding the true forces of innovation adoption among public organizations.

Variables	Model 1	s.e.	Model 2	s.e.	Model 3	s.e.	Model 4	s.e.	Model 5	s.e.	Model 6	s.e.
Publication output	1.00	(0.00)	-0.99	(0.00)	1.00	(0.00)	-0.99	(0.00)	-0.99	(0.00)	-0.99	(0.00)
Industry funding	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00*	(0.00)	1.00†	(0.00)	1.00†	(0.00)
Endowments	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)
Reputation	-0.97***	(0.00)	-0.97***	(0.00)	-0.97***	(0.00)	-0.97***	(0.00)	-0.97***	(0.00)	-0.97***	(0.00)
Status	-0.97	(0.02)	1.00	(0.03)	-0.98	(0.03)	-0.99	(0.02)	-0.99	(0.03)	1.02	(0.03)
Prior experience	1.28†	(0.19)	1.46**	(0.22)	1.38*	(0.20)	1.53**	(0.23)	1.14	(0.17)	1.55**	(0.25)
TTO age	1.07***	(0.01)	1.06***	(0.01)	1.06***	(0.01)	1.05***	(0.01)	1.06***	(0.01)	1.04***	(0.01)
Age	-0.99	(0.00)	-0.99†	(0.00)	-0.99	(0.00)	-0.99	(0.00)	-0.99	(0.00)	-0.99	(0.00)
Size	1.00***	(0.00)	1.00***	(0.00)	1.00***	(0.00)	1.00***	(0.00)	1.00***	(0.00)	1.00***	(0.00)
Scotland	2.19***	(0.35)	2.58***	(0.44)	-0.96	(0.24)	2.07***	(0.34)	1.78***	(0.30)	1.10	(0.29)
Local GDP	1.00***	(0.00)	1.00***	(0.00)	1.00	(0.00)	1.00**	(0.00)	1.00***	(0.00)	-0.99	(0.00)
Local R&D	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	-0.99	(0.00)	1.00	(0.00)
Membership			1.10***	(0.03)							1.06*	(0.03)
Local diffusion					1.14***	(0.03)					1.11***	(0.03)
Media coverage							1.00***	(0.00)			1.00***	(0.00)
Prior spinoff growth									1.03***	(0.00)	1.02†	(0.01)
X^2	476.68***		489.68***		497.47***		509.71***		493.50***		528.55***	
Log likelihood	-689.80		-683.66		-679.76		-673.64		-681.40		-663.87	
df	12		13		13		13		13		16	

N=835; ***p<0.001, **p<0.01, *p<0.05, †p<0.10

Table 5.5.5: Results of negative binomial regression on the number of spinoffs formed by year: 1993-2000

Variables	Model 7	s.e.	Model 8	s.e.	Model 9	s.e.	Model 10	s.e.	Model 11	s.e.	Model 12	s.e.
Publication output	1.00	(0.00)	1.00	(0.00)	-0.99	(0.00)	-0.99	(0.00)	1.00	(0.00)	-0.99*	(0.00)
Industry funding	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)
Endowments	1.00	(0.00)	1.00	(0.00)	1.00	(0.00)	1.00†	(0.00)	1.00	(0.00)	1.00	(0.00)
Reputation	-0.97***	(0.00)	-0.97***	(0.00)	-0.97***	(0.00)	-0.97***	(0.00)	-0.98***	(0.00)	-0.97***	(0.00)
Status	-0.99	(0.02)	1.00	(0.02)	-0.98	(0.02)	-0.97	(0.02)	1.00	(0.02)	-0.98	(0.03)
Prior experience	1.30†	(0.18)	1.35*	(0.19)	1.24	(0.17)	1.17	(0.16)	1.26	(0.18)	1.21	(0.17)
TTO age	1.01*	(0.00)	1.01†	(0.01)	1.02**	(0.00)	1.04***	(0.00)	1.01†	(0.01)	1.03***	(0.01)
Age	-0.99	(0.00)	-0.99	(0.00)	1.00	(0.00)	-0.99	(0.00)	-0.99	(0.00)	-0.99	(0.00)
Size	1.00***	(0.01)	1.00*	(0.01)	1.00**	(0.00)	1.00***	(0.01)	1.00**	(0.00)	1.00***	(0.00)
Scotland	1.21	(0.21)	1.26	(0.23)	-0.52*	(0.16)	1.19	(0.21)	1.16	(0.20)	1.28	(0.23)
Local GDP	-0.99	(0.00)	-0.99	(0.00)	-0.99	(0.00)	1.00†	(0.00)	-0.99	(0.00)	1.00**	(0.00)
Local R&D	-0.99***	(0.00)	-0.99**	(0.00)	-0.99	(0.00)	-0.99**	(0.00)	-0.99**	(0.00)	-0.99**	(0.00)
Membership			1.01	(0.01)							1.04**	(0.02)
Local diffusion					1.15***	(0.05)					-0.94*	(0.03)
Media coverage							-0.99***	(0.00)			-0.99**	(0.00)
Prior spinoff growth									1.02	(0.01)	1.01†	(0.01)
X^2	345.03***		346.74***		358.56***		380.16***		347.18***		393.65***	
Log likelihood	-688.56		-688.28		-682.37		-671.57		-687.49		-664.25	
df	12		13		13		13		13		16	

N=618; ***p<0.001, **p<0.01, *p<0.05, †p<0.10

Table 5.5.6: Results of negative binomial regression on the number of spinoffs formed by year: 2001-2007

Our research has implications for management fashion theories. Despite Abrahamson's call (1996: 274) there has been limited operationalization of fashion diffusion models. Here, we show that given a country's norms of rationality, fashion theories are unable to explain alone the infiltration of fashion setters such as media into public organizations settings. We believe that a more fine-tuned process of measuring the normative environment and its codes of rationality is necessary if we are to understand the fashion market with its suppliers and buyers (Abrahamson, 1996). This is critical for both public and private organizations that wish to avoid management fashions within their fields. In the case of public organizations, government regulations and financial rewards for spinoff formation were significant predictors of the spinoff collapse after 2001. Perhaps monitoring an industry and defining reward standards based on efficiency criteria is the answer to non-profit, as well as for-profit organizational fields.

Third, the way we operationalized our research shows that diffusion per se does not signify institutionalization, a major point in need for clarification among institutional theorists (Greenwood *et al*, 2008: 11). Despite early media coverage and mimetic behaviors that affected the rate of spinoff creation, spinoffs never acquired a taken-for-granted status: alternative routes for technology transfer always existed. Although we cannot provide the evidence, we believe that universities abandoning spinoffs post-2001 moved back to such alternatives as technology licensing. This conceptualization runs in parallel with management fashion assumptions because the latter have been argued not to be associated with permanent adoption of practices: a fashion diffusion is a short-lived illusionary process that never acquires taken-for-grandedness (Abrahamson, 1991; 1996). We add to this literature by arguing that

government legislation in previously mandated but unregulated fields can bring down an adopted practice. This might sound obvious and, as Abrahamson has pointed out (1991: 256), "the popularity of a management technique can anyway change based on government mandates". Nonetheless, we emphasize the theoretical importance of a clearly defined regulatory or normative framework at the time that the practice starts spreading because, if these do not exist, the true institutionalization of a field will eventually be delayed. We thus see the institutionalization process as closely linked to audiences that oversee industries and fields through specific norms.

Our study is different from work on institutional logics (Thornton, 2002) because logics define the content and meaning of institutions and prescribe specific actions in certain periods (Thornton, 2002; Thornton and Ocasio, 1999). In the first period of the study, rather than spinoff numbers or spinoff growth, there was no central logic guiding government preferences other than the general need for "technology transfer". If there existed one, that logic was vague enough to accommodate (and not punish universities with) large numbers of spinoffs that had extremely diverse chances for survival and growth. In the second period, a logic was clearly formed in that spinoff growth was seen as the truly necessary, meaningful action that should be rewarded. Thus, contrary to previous assumptions, we show how market or institutional logics cannot be constructed simply through government mandates or "triggers of change" and static legislation. Institutional logics are based on crafting meanings through specific normative, regulatory and cognitive beliefs of what constitutes appropriate behavior in a certain period. Institutional logics do require a certain level of balance among various institutional audiences in order to function properly (Rowan, 1982) and this balance must be dynamically reassessed at all times.

The paper has also important managerial and public policy implications. It shows how public money and efforts can be wasted when "compliance" and "conformity" to government pressures are left as the only driving forces behind public administration and restructuring. After the initial legislation of the 1980's and 1990's, there were plenty of opportunities for the government to design specific policies for the spinoff industry including the accreditation of Technology Transfer Offices, the formation or endorsement of a spinoff association such as UNICO or other measures towards spinoff regulation. Such timely intervention would have been beneficial not least because alternative routes for the commercialization of university intellectual property existed prior to the spinoff growth and could have been better unitized instead of spinoffs. The existence of alternatives such as these is a major reason why strict monitoring and accreditation standards must be enforced to secure the avoidance of public organization management fashions.

A second reason why spinoffs emerged not based solely on efficiency explanations is the degree of differentiation that the new demands for change represented relative to existing practices (Etzkowitz, 2003; Shane, 2004a). The insistence on greater technology commercialization given prior licensing or other business-university interaction signaled a significant departure from the traditional mission of the educational system (Bok, 2003). Because industry deals were previously done in a naturalistic way and the new demands were moving universities towards a more professional business model, state preparations should have been a priority. Work done on the diffusion of educational innovations has always assumed some sort of relevance between old and new practices, for example, the addition of a new course or administrative office within schools (Clark, 1968; Meyer and Rowan, 1977). These kind of mandates do not challenge importantly the core foundations of

educational systems, hence balance among school audiences (Rowan, 1982) is easier to achieve as there is no fundamental opposition against them. Also, rapid compliance to such state mandates does not incur any extraordinary financial or administrative costs to universities. In contrast, our spinoff setting shows how diversifying activities that carry great financial risks are more susceptible to a fashion style diffusion. To avoid wasting resources, governors and managers should therefore closely match their expectations from public organizations with equally well defined norms that guide and assist these organizations towards successful compliance.

6. LEGITIMATE PRACTICES AND ACQUISITION OF FINANCIAL RESOURCES BY PUBLIC ORGANIZATIONS[4]

6.1 Abstract

We draw from legitimacy definitions of the institutional and population ecology theories to assess the impact of legitimate practices on the rate of resource acquisition among public organizations. The empirical context is academic entrepreneurship and, specifically, university spinoffs in the UK public education industry. Results indicate that the number of spinoffs (density-related legitimacy), the performance of spinoffs (performance-related legitimacy) and the publicity generated by spinoffs help universities acquire critical resources from both public and private constituents. The empirical contribution of this paper lies in examining the impact of university spinoffs on their parent institutions' financial well being for the first time, using a completely novel database of spinoff firms. Theoretically, we show how legitimacy dynamics and elements of a socially constructed reality considerably shape the resource flow dynamics among public organizations.

6. 2 Introduction

How do organizations acquire resources? This central question in the management literature has attracted the attention of scholars drawing from several theoretical perspectives. For example, some researchers have emphasized the role of individual strategic actions such as entering into alliance formation with reputable partners (Gulati, 1991), while others have looked at environmental embeddedness and inter-organizational linkages within networks (Baker and Faulkner, 2006; Wiewel and Hunter, 1985) in order to explain resource acquisition. One of the most recent contributions to this debate has been proposed by institutional (Greenwood, Oliver,

[4] Earlier versions of this paper were presented at the Babson Entrepreneurship Research conference, the Academy of Management, and the European Academy of Management

Sahlin and Suddaby, 2008) and organizational ecology (Hannan and Freeman, 1977) theorists who argue that organizations can enhance their resource acquisition by managing the legitimacy of their actions given the surrounding social system.

Legitimacy has been seen as a direct prerequisite of organizational resources, because it refers to how the focal organization is seen by the environment that holds these resources (Suchman, 1995). Social players (e.g. customers, suppliers, governmental agencies) observe organizations, and if the latter are seen as not behaving in a way that respects the beliefs and values of the social system, they may withhold their financial endorsement as a way of punishment against these organizations (Suchman, 1995; Zuckerman, 1999). Such restrictions in the access to resources can be critical, not least because resources are important for a firm's performance and its potential strategic advantage against competitors (Barney, 1991; Suarez and Lanzolla, 2007).

Nonetheless, scholars have mostly examined routes to resource acquisition among for-profit organizations. One of the reasons why the management literature often differentiates public from private organizations is their different structural and strategic focuses. For example, public organizations rely upon the state for most of their resources (Tolbert, 1985) and are therefore expected to comply with government rules and expectations lest they lose one of their key financial supporters (Scott, 1981). Form a legitimacy perspective, the organization studies literature posits that legitimate public organizations attract resources from the central government in a standardized, routine fashion (Rankin, 1956). Thus, it is conceptually and empirically unclear how public organizations can draw government and industry resources when there are no clearly specified reward standards. Not having clearly specified standards may be the result of a novel diversification (e.g. new products, new markets)

undertaken by public organizations. This diversification further raises claims of illegitimacy for these organizations due to their lack of expertise in the new fields. In this paper, we examine the mechanism through which the legitimacy of public entities' actions (i.e. the legitimacy of the new products) helps them acquire resources.

We draw from the context of academic entrepreneurship (Djokovic and Souitaris, 2008; Rothaermel, Agung and Jiang, 2007; Shane, 2004a) and, specifically, university spinoffs from public universities in the United Kingdom to test the above legitimacy assumptions. Spinoffs were mandated by the UK government during the early 1990's as a means to expand technology transfer in this country. Despite the risks that spinoff formation embodied for the producing universities, the government never linked spinoff formation to financial rewards for universities. Spinoffs were risky for many reasons: they were completely new activities shifting the attention of public universities from teaching and research to commercial business (Bok, 2003). They were also illegitimate practices in the eyes of many audience members in the public. In this context, it is worth examining whether the gradual legitimation of these state-mandated spinoff practices helped universities acquire resources in any (direct or indirect) way.

We concentrate on three core mechanisms that describe organizational legitimacy. The first has to do with the density-in-numbers effect of certain novel activities and the role of increasing density on the legitimization of the activities (Carroll and Hannan, 2000; Hannan and Freeman, 1977). The second mechanism has to do with the performance/ success of the new activities relative to competing organizations, and how high performance spinoffs confer legitimacy to these educational organizations (Rao, 1994). The third legitimacy element is linked to the

way information about novel activities is transmitted to the relevant organizational audiences. Central to this perspective is the role of media and the socially constructed reality that they help create (Luckmann and Berger, 1991). We first provide a short overview of the spinoff field in England and Scotland, and then we formulate hypotheses based on the institutional and ecological perceptions of legitimacy.

6.3 University spinoffs in England and Scotland

University spinoffs are "new firms created to exploit commercially some knowledge, technology or research results developed within a university" (Lockett and Wright, 2005; Shane, 2004a). The origins of the United Kingdom spinoff firms can be traced back in 1977 when the then Patents' Act gave employee inventors the right to share financial benefits from their research with their employer. This regulatory state intervention had similar effects to the United States' Bayh-Dhole Act, by incentivizing academic researchers to claim royalties and commercial benefits owned by their university (Rafferty, 2008; Shane, 2004b). In 1993, a UK government White Paper designated universities as key to the realization of the UK's research potential and suggested policies to increase spinoff formation (HM Treasury, 1993). Historically, although spinoff firms had been formed for many years prior to 1993, their numbers were characteristically low and their emergence could be described as naturalistic: interesting ideas would diffuse to the market without a structured university approach.

Spinoffs were initially seen as a dangerous deflection away from academic research and teaching and towards big business (Bok, 2003; Etzkowitz, 2003). There was considerable opposition to them both from within and outside universities (Shane, 2004a). Researchers have considered that, given the risks that spinoffs embodied, universities were expected to waste taxpayer money in unnecessary

venture formation (Bok, 2003). Despite these facts, the numbers of spinoffs rose steadily over the last 15 years. Extant literature on academic spinoffs has looked for answers as to why they spread so quickly (Lockett and Wright, 2005; O'Shea, Allen, Chevalier and Roche, 2005) or how increased numbers of spinoffs have contributed to the national economy (Shane, 2004a). But researchers have overlooked the question of whether spinoff firms directly affect the universities that create them. In this paper, we look at whether the diffusion of spinoff firms impacted the acquisition of financial resources by public universities. What is more, we consider how social actors beyond the actual numbers or success of the spinoffs formed by individual universities impacted on their resource acquisition. Specifically, we assess the role of the national media in explaining the "social construction" (Luckmann and Berger, 1991) of the university-funding process. This perspective is in contrast to efficiency explanations of financial resource acquisition among public universities that have been previously proposed repeatedly in the management literature (Rankin, 1956; Tolbert, 1985).

The examination of the impact of spinoff activities on university funding is important for a number of reasons. First, leading authors in the field have lamented that "we lack systematic explanations for the effects of spinoffs on the universities that create them" (Shane, 2004a: 3). Second, the phenomenon is extremely important for policy makers not only with regards to university performance in commercializing their knowledge, but also in terms of the institutional monitoring of new public organization activities. In specific, how does the government respond to fundamental changes taking place in the educational market? How quickly? How are universities rewarded within the general innovation policy frame of the state? The paper is also relevant to the extent that universities can exploit strategic changes in their

environment to enhance their financial potential. In line with long-existing trends in the academia towards more financial autonomy among universities (Bok, 2003; Slaughter and Leslie, 1997), spinoff activities instilled a strong element of commercial orientation to the higher education market. We argue that public universities could exploit this change strategically by actively managing the legitimacy of their spinoff activities (Suchman, 1995).

We test the above on the population of English and Scottish universities using a unique panel database ranging from 1993 to 2007. The database contains data on all 1,404 unique spinoff firms established by 113 universities over the years. In summary, this study will examine the effect of a) the number of spinoffs, b) the performance of spinoffs and c) the publicity of spinoffs on the acquisition of financial resources by public universities.

6.4 Theory and hypotheses

Organizational legitimacy is a generalized perception that the actions of an entity are desirable, proper or appropriate within some socially constructed system of values, beliefs and definitions (Suchman, 1995). Legitimacy is particularly important for public organizations because non-conformity to behavioral requirements dictated by the state can incur costs to these organizations. This sensitivity for compliance is particularly high among educational institutions because changes in their structure carry high levels of uncertainty due to their less technically- and more socially-evaluated nature (Baldridge and Burnham 1975; Rowan, 1982; Scott, 1981: 139; Zajac and Kraatz, 1993). Public universities for example, and unlike for-profit organizations, are monitored by professional and governmental agencies that greatly restrict their freedom of movements due to the universities' "public good" organizational nature.

Institutional theorists have recognized that not appearing as a legitimate social player can inhibit organizational efforts to acquire resources (DiMaggio and Powell, 1983; Suchman, 1995). Legitimacy and conformity to what is widely accepted as appropriate behavior is critical because organizations depend on audiences that surround them with resources. If members of these audiences do not endorse certain organizational behaviors, they are likely to divert their resources to those they see as legitimate organizational alternatives (Zuckerman, 1999). Social definitions of what is legitimate practice may also change over time as powerful social actors constantly reevaluate behaviors and field norms. Recent studies in the organization theory literature treat legitimacy as a continuum whereby certain actions are more or less legitimate than others (Suchamn, 1995; Zimmerman and Zeitz, 2002). Thus, it is important that organizations seeking to draw resources from their social environments constantly manage (adapt) their actions to the newly defined criteria of legitimacy (Suchman, 1995).

To measure the effect of legitimacy on resources, authors in the institutional and organizational ecology streams of research have proposed several operationalizations of the legitimacy construct (see for example, Deephouse, 1996; Deephouse and Carter, 2005; Deephouse and Suchman, 2008). We chose to apply three of these specifications to the UK spinoff phenomenon, namely the density-dependence legitimacy (Hannan and Carroll, 1992), the performance-related legitimacy (Rao, 1994) and the media-effect legitimacy (Deephouse and Carter, 2005). In particular, in the following paragraphs, we assess the legitimacy of university spinoffs using these approaches and link that legitimacy to the acquisition of financial resources by the universities that formed the spinoffs in the first place.

The rationale behind the decision to operationalize legitimacy as above is twofold. First, legitimation processes through density, performance and media coverage are some of the most commonly used research approaches (Deephouse and Carter, 2005). However, these measurements have been used predominantly in for-profit organizational settings by management scholars. Second, the UK spinoff context is idle for the examination of legitimacy processes among public entities, especially given the change in direction towards business and commercial activities that the government-mandated spinoffs signaled (Bok, 2003). Dramatic shifts such as these challenge the legitimacy of organizations in a field, and the latter need to actively manage their behavior in order to appear legitimate enough in the eyes of resource holders. In this context, we ask: how did the numbers, performance and press coverage of spinoff firms affect university resource acquisition?

6.4.1 Density-based legitimacy

Population ecologists see legitimacy stemming from the safety-in-numbers effect (Hannan and Freeman, 1977; Ahmadjian and Robinson, 2001), so that increased numbers of a certain organizational behavior or form slowly acquire legitimacy within their field. Density owes its effect to the increased information that is presumably disseminated among audience members, hence the new practice or form is gradually accepted as the appropriate one (Hannan and Carroll, 1992). Population ecologists posit that high density increases the flow of available resources to organizations in an industry; however, density beyond a certain point in the industry's life cycle will inhibit the rate of resource acquisition because competition ensues. Competitors will thus have to soon search for niches in their focal markets and concentrate their efforts in managing their resources accordingly (Hannan and Carroll, 1992).

In the UK, government legislation in the late 1970's was the trigger of changes in academia (Strang and Sine, 2002: 507). The expansion of the English and Scottish spinoff industry was inspired by consecutive regulatory initiatives that, although did not completely specify organizational structures that universities should follow (e.g. the Technology Transfer Office, the intensity or locus of university-industry linkages etc), they certainly precipitated efforts at reform among universities (Strang and Sine, 2002). The creation of spinoff firms was seen as an alternative to technology licensing that was common before 1993, or to Knowledge Transfer Partnerships that were also emerging as new technology transfer routes. Certainly, some universities engaged in spinoff formation more than others, for example due to university motives such as the need for greater financial autonomy, or university top management strategic initiatives (fig. 4.2). Further, because the number of universities that engaged in spinoff formation increased every year and because spinoff numbers also increased as a consequence, information about these activities gradually enhanced knowledge of the spinoff industry's usefulness (Hannan and Carroll, 1992).

The important stakeholders in the empirical setting of university spinoffs are the public and private sources of funding that stood as observers of the increasingly dense spinoff population. As noted above, legitimate organizational practices endorsed by key audiences can attract sources of university funding more quickly (Parsons, 1960) because they empower organizations by making them look meaningful to the members of their immediate audience (Suchman, 1995: 576). The effect of high spinoff productivity in enhancing the legitimacy of spinoffs as new university "products" may have taken different trajectories depending on the various audiences. Thus, private industry resource holders may have seen high spinoff density

as an opportunity for commercial deals with universities or as a chance to exploit university inventions. Public bodies may have seen increasing spinoff numbers as proof of university compliance to state mandates for university technology transfer (Tolbert and Zucker, 1983). We therefore expect that increased spinoff formation legitimized these activities, thus also increasing the likelihood of private or public bodies supplying financial resources to universities (Zimmerman and Zeitz, 2002). Based on this analysis, we hypothesize:

H1: All else being equal, there is a positive relationship between density in a university's spinoff portfolio and the acquisition of financial resources by that university.

6.4.2 Performance-based legitimacy

Another way of measuring organizational legitimacy is the performance of organizations in the early phases of an industry. Organizational studies scholars have examined the impact of high performance on a firm's resource acquisition efforts in numerous occasions (Deephouse and Carter, 2005; Fombrun and Shanley, 1990; Rao, 1994; Weigelt and Camerer, 1988). One of the critical findings in the management literature is that high performing organizations can exploit their success by sending signals to resource holders, thus attracting financial endorsements. Market signals travel through informal networks and formal reports and help important stakeholders assess the future potential of an organization (Fombrun and Shanley, 1990). This process may ultimately increase the reputation of a focal organizational relative to competitors and it is therefore likely that resource providers will entrust their support to that organization compared to another (Weigelt and Camerer, 1988).

However, management and sociology theorists draw a distinction between reputation and organizational legitimacy (Deephouse and Carter, 2005; Rindova, Pollock and Hayward, 2006). While reputation refers to the effects of accumulated past performance, legitimacy is an archetype of reputation-building in new or emerging markets (Rao, 1994: 31). Organizational studies scholars view reputation as an outcome of legitimization processes in the early stages of an industry's life cycle. For example, Rao (1994) has shown that novel organizations which participated and won industry competitions enhanced their legitimacy and were able to quickly acquire resources from their environments. Further, if they became successful in establishing themselves over a long period of time, they could increase their reputation relative to the competition. In other words, legitimacy processes take place early in the industry's life cycle because, at that stage, it is important that organizations combat claims against their behavior, given their liability of newness (Stinchcombe, 1965). Once organizations have established themselves against claims of illegitimacy in a market, they can use reputation to combat competition.

We believe that the spinoff population in England and Scotland is a good example of a new market, in that universities started forming spinoffs only few years ago. Further, the early stages of the phenomenon have been awash with opposition to spinoff formation as a new university practice (e.g. Bok, 2003; Shane, 2004a; Slaughter and Leslie, 1997). It is expected that high-performing spinoffs could banish claims of illegitimacy against universities by demonstrating that spinoff activities are healthy, acceptable university functions. One of the main expectations of the UK government was that spinoffs with high growth prospects would help the local or national economy (Shane, 2004a). We therefore believe that the government would sooner or later reward universities with successful spinoff activities for their

contributions. It is also natural that industry financial resource holders would demonstrate their support for university spinoffs relative to how legitimate these activities are, based on their performance. We hypothesize:

H2: All else being equal, there is a positive relationship between the performance of a university's spinoff portfolio and the acquisition of financial resources by that university.

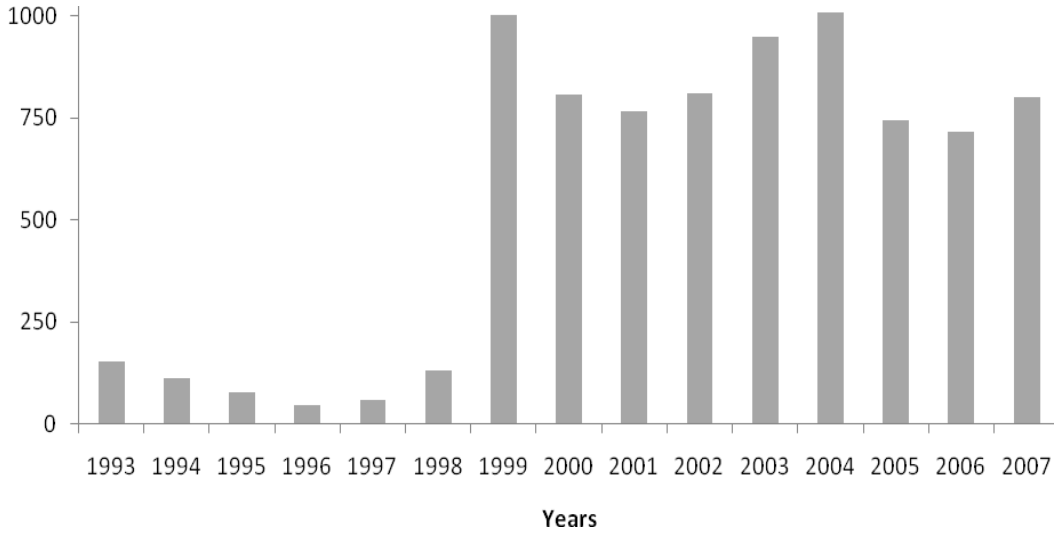

Figure 6.1: Spinoff performance in England and Scotland, 1993-2007 (average revenues in £000's)

6.4.3 Media-based legitimacy

The decision to supply universities that form spinoffs with resources may not always be rational, though. Research in the sociology of organizations has shown that certain institutional intermediaries may affect the decision-making process of social actors. For instance, it has been shown that the categorization of organizations into industries by market analysts can impede their stock market performance, because investors seek the analysts' views to make decisions (Johnson, Ellstrand, Dalton and Dalton, 2005; Zuckerman, 1999). Likewise, perceptions are shaped by various kinds

of media outlets that magnify facts thereby shaping the opinions of investors in IPO markets (Pollock and Rindova, 2003).

The importance of media coverage in legitimizing certain events has been observed in various non-profit settings. Holden (1986) has shown how successful hijacking attempts that were covered by the press in the 1960's were imitated by other individuals to further increase hijacking events in a rapid process of contagion. Myers (2000) has demonstrated how mass media networks helped legitimize incidents of collective violence in the same period. In educational systems, Brint and Karabel (1989: 113) have shown how the mass media were consistently framing inaccurate perceptions among young students on how community colleges should be reformed to accommodate their needs. Media influence, whether by reflecting or by affecting perceptions of what is legitimate and desirable behavior in a social system, have the power to create a "socially constructed" reality that shapes the process of rewarding or sanctioning organizational behaviors according to their own criteria of appropriateness (Luckmann and Berger, 1991).

As we discussed, English and Scottish universities vary in the amount and success of spinoffs they generate, and spinoff publicity may also vary. This can be attributed not only to media outlets themselves but also to university attempts at covering spinoff events. For example, as our quantitative dataset demonstrates, in England the founding of a spinoff organization has been treated internally with different intensity by educational institutions, partly due to internal opposition from faculty members and partly due to the time required for the legitimation of the phenomenon as a whole. For instance, Imperial College London has been seen a pioneer in promoting its commercial business successes. Consistent with research in other studies (Brint and Karabel, 1989; Holden, 1986; Pollock and Rindova, 2003),

we expect that dissemination of information about universities' spinoff companies through the national press could increase the awareness and favorability of these activities because knowledge of a field increases its legitimacy (Hannan and Freeman, 1977). The more media coverage its spinoffs attract, the more legitimate or appropriate the university looks to its audiences and, further, the more financial resources it may eventually be able to attract (fig. 5.3). We propose:

H3: All else being equal, there is a positive relationship between media coverage of a university's spinoff portfolio and the acquisition of financial resources by that university.

6.4.4 2001 as a critical juncture

So far we have argued about the density, performance and media effects of spinoff formation on university funding. However, it is worth investigating whether these effects have been constant over the life cycle of spinoff formation in the two countries. One of the reasons why this is important is that density effects on resource acquisition change depending on the life cycle of an industry (Hannan and Carroll, 1992). Another reason is that perceptions of legitimacy among audience members may change in a field. Alterations in the preferences of an organization's environment can thus impact on what is legitimate practice over time, forcing organizations to manage their legitimacy accordingly (Suchman, 1995) in order to continue enjoying the environment's support.

Our database on the English and Scottish spinoffs covers a period of 15 years, spanning between 1993 to 2007. The year 1993 is widely acknowledged as the starting point in technology transfer activities in England and Scotland (HM Treasury, 1993) and the explosion in spinoff formation after that year has been

documented by various scholars in the academic entrepreneurship literature (Djokovic and Souitaris, 2008). However, lack of a unified database on spinoffs has made it impossible for scholars to trace the evolution of spinoff activities over time. Our database shows that by 2000, most English and Scottish universities had established at least one spinoff, and the total number of spinoff firms among all universities climaxed over that year. In the post-2001 period, there were a lot fewer firms formed by universities. Further, considerable changes in the institutional environment of the industry took place around that time.

Following 2001, government suggestions to halt the acceleration of spinoff formation among universities were loudly voiced for the first time in the industry's live cycle. Reflecting world-wide evidence on the spinoff industry, a major review by the UK government later concluded that the number of spinoff firms being formed was hard to sustain unless a shift from quantity to quality in the universities' general incubation model was urgently implemented (HM Treasury, 2003). The government white paper also indentified the need for assessing key performance indicators of university commercial activities within its general technology transfer policy frame. Meanwhile, the English and Scottish higher education authorities introduced their first special funds for spinoff formation targeted at universities (HEIF funds). In this context, it was increasingly recognized that prudent university investments in spinoff formation should be distinguished from unsuccessful spinoff activities (Lockett and Wright, 2005). Finally, the UK financial industry was getting cautious with the potential of many spinoff ventures, as deaths remained high relative to new births. After the initial enthusiasm of the early years, venture capital investors were less likely to support spinoffs unless there was real potential for a quick return on their investments (HM Treasury, 2003). The general economic downturn of 1999-2000

may have further precipitated this trend as the dot-com bust constrained investment funds towards start-ups in the UK.

We believe that these alterations in the universities' environment may have had significant impact on the field's perceptions of legitimacy. Institutional theory argues that when social assumptions of which behaviors are taken-for-granted in a field change, actions may have different effects on an organization's legitimacy and resource acquisition process (DiMaggio and Powell, 1993; Powell and DiMaggio, 1991). The legitimacy of the spinoff industry was contested because it had not realized the potential envisaged in 1993 and both government and industry were looking for alternative arrangements that would guarantee its future success. We believe that, as the diffusion of the spinoff phenomenon reached its peak levels, the density of the spinoff population gradually lost its impact on the field's legitimacy and now increased competition dynamics among universities (Hannan and Freeman, 1977; Hannan and Carroll, 1992; Carroll and Hannan, 2000: 213). Competition among universities may have heightened not only for resources that universities themselves wished to attract for their operations, but also for venture capital support aimed at their spinoff portfolios. For these reasons, it is reasonable to assume that the effect of density-based legitimacy of spinoffs on university resource acquisition was stronger in the first years of the phenomenon, than after its peak.

The performance-based legitimacy of spinoffs may have taken the opposite direction in helping universities acquire resources. We assume that by 2000, most universities would have been able to increase the performance of their spinoffs, due to experiential learning and peer imitation that perhaps took place while the industry was becoming legitimate (DiMaggio and Powell, 1983). As we argued above, the increased spinoff density that heightened competition for university resources may

have had a significant impact on the role of spinoff performance as a reputational asset for universities (Deephouse and Carter, 2005; Rindova, *et al.*, 2005; Rao, 1994). Thus, we expect that the role of spinoff performance was more important in the later years of the spinoff industry (fig. 6.1). Finally, we argue that media coverage of spinoffs may have been more important in the second period in helping universities acquire resources. As we argued, media coverage refers to legitimacy in the early phases of an industry, and to reputation in the later years. While this may sound like a definitional debate (Rao, 1994), it is important to acknowledge that legitimacy affects organizations at the individual level (either one is legitimate or not), whereas reputational effects are measured against competitors (one is better than another based on their performance). Assuming that spinoff performance issues became more prominent at later stages in the industry, it is reasonable to expect that the role of media was more critical for the acquisition of resources during that period, as competitors could potential absorb those resources away from a focal university (Deephouse and Carter, 2005; Rindova *et al*., 2005). We finally propose:

H4: The impact of density-based legitimacy on university resource acquisition was stronger in the early years of the phenomenon. In contrast, the impact of performance-based and media-based legitimacy on university resource acquisition was stronger in the later years of the phenomenon.

6.5 Methodology

6.5.1 Sample and analysis

To test our hypotheses, we gathered longitudinal data on the population of universities and spinoffs firms. Our panel dataset included all 113 universities in England and Scotland and all spinoff companies (n=1404) of these universities along with their full demographics, covering a period of 15 years between 1993 and 2007.

Our purpose was to examine the impact of spinoff productivity, performance and press coverage on university funding from various sources. To test hypothesis 4, we further split our sample in two parts, one for the period between 1993 and 2000 and another for the remaining years until 2007. We initially combined several funding sources into one dependent variable (total university funding) and then conducted robustness checks by treating three major funding sources as dependent variables in separate analyses. Because we are concerned with count variables that can take large values, hierarchical ordinary least square regression (OLS) is the appropriate statistical method (Brooks, 2008; Gujarati, 2003). Consequently, we run 4 hierarchical regression models for each period adding explanatory variables to the baseline model in three steps.

To account for unobserved heterogeneity, I have relied on random effects linear regression. To control for endogeneity, all university-level independent and control variables were lagged by two years (this also allowed for their impact on the decision making process of the funding bodies to develop). The two environmental factors were left without time lag.

6.5.2 Measures

Dependent variable. The dependent variable of our study was total university funding relative to size (i.e. *average university funding* per full-time student). We took the average figures to account for changes in the size of universities over the years as some recruited students quicker than others. We collected funding figures from two main sources: a) annual publications of the Higher Education Statistics Authority of England (HESA) and the Scottish Funding Council (SFC), which contain separate databases on income from research grants and contracts,

endowments and UK charity donations, and b) directly from the four main UK research councils, i.e. the Engineering and Physical Sciences Research Council (EPSRC), the Economic Sciences Research Council (ESRC), the Medical Research Council (MRC) and the Biotechnology and Biological Sciences Research Council (BBRSC). Together, the combined income from these sources accounts for more than 90% of the English and Scottish universities' funding[5].

To simplify our data and conduct the robustness analyses, figures on total funding were grouped into three categories: a) UK government, b) UK research council, and c) UK industry, including endowments. Respectively, these categories represent university income from a) *non-competing government grants*, b) *competing government grants*, and c) the *industry*. Funds from the central government were coded as "non-competing government" for a very important reason. These funds are allocated based on university performance in teaching and research as they are measured in the Research Assessment Exercise (RAE) of the UK government. RAEs are conducted every 5-7 years and guide university funding until the next RAE assignment. Consequently, the central government funds are called "recurrent" in that little variation is expected between those 5-7 years. Further, universities do not compete for these funds directly, but only through their relative performance as individual institutions. Income from the various research councils was coded as "competing government" because research councils draw their resources from the central government but allocate them based on the quality of competing bids made by universities. We used the three categories as alternatives against the initial dependent variable *average university funding* in separate regression analyses.

[5] These figures exclude income from student fees. Fees are at the discretion of universities to collect and are mostly related to teaching

The theoretical assumption that the various funding bodies would support universities committed to spinoff activities was not explicitly stated by any of these bodies. However, over the years, their mission statements would hint at the increasing importance of university commercial activities. For example, aside from support to improve human health and produce skilled researchers, the Medical Research Council mentions the "advancement and dissemination of knowledge to improve the economic competitiveness of the UK" as one of its main goals. Similarly, UK government funding in the form of recurrent grants has been emphasizing the importance of research and, to a lesser extent, knowledge transfer alongside teaching in its allocation decisions. Recurrent grants are largely based on the RAE scores that were last conducted in 2001, the critical juncture in our analysis.

Independent variables. We gained information on the number of spinoffs from each university independently. The exact birth dates were captured from the Financial Analysis Made Easy (FAME) database. The independent variable *density-based legitimacy* was measured by the number of spinoff firms formed by universities each year in our window of observation.

Next, we collected yearly information on revenues of spinoff firms from the FAME database. The independent variable *performance-based legitimacy* was therefore measured by the average spinoff revenues (Ahmadjian and Robinson, 2001; Haveman, 1993) of all live spinoffs in a university's portfolio at any point in time. Theoretically, we expected that spinoff performance would enhance university funding (Deephouse, 1996).

The *media-based legitimacy* of spinoffs was assessed by counting the number of UK press clippings that related to a university and its spinoff firms in a single

article. We searched the LexisNexis database for articles with the name of a university *and* each of its spinoff firms as keywords and marked such articles in the 15 year period that we were interested in. We recorded a total of 8866 articles linked to our 1404 spinoffs and their parent universities. Although we could group articles based on their negative or positive tenor (Pollock and Rindova, 2003), an examination of our database showed that there were hardly any articles positioned negatively towards spinoff-related events. We therefore proceeded to measure the independent variable "media coverage" as the cumulative number of media articles for each university at any year. Content analysis of this type has been used in various other settings in the organizational studies literature (e.g. Deephouse and Carter, 2005).

Control variables. We controlled for a number of university-level and environmental factors that may affect the decision of financiers to support universities. To control for *university performance*, we collected yearly data on the number of publications in ranked journals by each university as listed in the ISI Web of Knowledge (cf. Keith and Babchuk, 1998). Organizational performance is a construct linked to legitimacy (Deephouse, 1996) and likely funding bodies would consider this as the primary criterion to evaluate universities.

Consistent with previous research (Deephouse, 2000; Fombrun and Shanley, 1990; Roberts and Dowling, 2002), we controlled for *university reputation* based on scores in the Times Higher Education university guide that is published annually since 1993. Many scholars have cast their doubts as to whether media rankings can accurately measure reputation because they consider them as rather noisy and inconsistent indicators of quality. However, ratings and rankings collapse the diverse and complex information necessary to evaluate organizational quality into a single

number and "it is precisely this synoptic nature of rankings that makes them have a strong impact on an organization's prominence" (Rindova, Williamson, Petkova and Sever, 2005:1038).

Similar to reputation, we included a measure of *university status* defined as the cumulative number of Nobel Prizes won over the years. Status is different from reputation because the former is based on network theory and the demonstration of past quality, while reputation stems from signaling theory that emphasizes the ability to send signals to stakeholders through *current* organizational actions (Feldman, Feller, Bercovitz and Burton, 2002; Rindova *et al.*, 2006: 54; Sine, Shane and DiGregorio, 2003).

To control for *university age*, we measured the number of years since the founding of each institution and took the natural logarithm of this value. The reason for this was that not all universities were considered as such during our period of observation. In the UK, a lot of educational institutions were granted university status during the 1990's and 2000's and they were formerly designated "polytechnics" or colleges with no independent degree-awarding powers. The change was part of the Quality Assurance Agency's plan to transform the educational industry and incentivize polytechnics that were old (some were formed in the 19th century) but not as good as established universities. We also controlled for relative *university size* by taking the natural logarithm of the total number of full-time students of a university. Rowan (1982) has shown that the size of educational organizations is not always a good predictor of their behavior, but it can be used as a control variable when other constructs are included in analyses. According to Deephouse (1996) and others, the organizational attributes of size and age are linked to legitimacy, so that older and

bigger universities could attract more resources than inexperienced or smaller ones, because the former are seen as more legitimate.

We controlled for the relative *political power* of groups of universities (Pfeffer, 1992: 101). Almost simultaneously with the emergence of the spinoff industry, four university associations were established in 1994. Of these, Russell Group was formed first and, in reaction, the 1994 Group, the Million+ and the University Alliance followed immediately after. The associations were intended at lobbying government, parliament and private bodies for financial and other support and have been forming common positions on important matters such as sponsoring, exploitation of intellectual property, the definition of UK educational standards and other relevant initiatives. Members of these political alliances often benchmark themselves against other members to secure alignment in the scope and performance of the initiatives in a given academic year (Edinburgh University Minutes, 2004). Participation in each of these alliances was measured with a dummy variable taking the values 0 and 1. Despite 1994 being their founding year, not all current members joined simultaneously. Some institutions joined an association years after 1994, hence there is considerable variation in the distribution of the variable's prices.

Finally, two environmental controls were included, i.e. *regional economic development* and re*gional R&D intensity*. The mechanism through which these operate is twofold: when economic development or R&D investments are high, it is natural to expect that a big part of these funds will end up to universities. Alternatively, when development and R&D investments are low in a region, the various financial resource providers can try stimulating the regional economy by investing in teaching, research or knowledge transfer. In the technology transfer literature, regional GDP and R&D have also been used to predict the opposite

direction of our own research, i.e. the formation of spinoffs by universities (Lockett and Wright, 2005). We collected data from the National Statistics Authority on per-capita GDP and per-capita R&D investments of each of the ten UK regions in our sample: nine in England plus Scotland.

6.6 Results

Descriptive statistics and correlations among variables are reported in Table 6.1. To check for problems with multicollinearity, we conducted Variance Inflation Factor (VIF) tests. The VIF scores were well below the warning level of 10 (Gujarati, 2003), thus we proceeded with the data analysis normally. Table 6.2 shows results for the entire period of observation. Tables 6.3 and 6.4 show results of hierarchical regression of ten models, five for the period between 1993 and 2000 and five for the period 2001-2007, predicting average total university funding. Model 1, table 6.3 includes only the control variables – university performance, reputation, status, age and size; regional GDP and R&D; and membership into networks. For the first period, almost all control variables are significant with a positive effect on our dependent variable, except for university age and regional R&D. The negative sign of reputation is justified by the data coding, because highly reputable universities are measured as having small values in the league tables (e.g. the University of Cambridge's score is 1 out of 113, meaning it is the institution with the highest reputation). The negative impact of size is perhaps justified as relatively large universities cannot be entirely funded by government or industry sources. These entities often focus on teaching; therefore fees from students are a core source in their budgets. Of the three political power associations, Russell Group has the most important effect as it includes some of the most well performing and internationally recognized universities of England and Scotland. The 1994 Group has some positive

influence on university funding and the Million+, comprising mostly of former polytechnics, none.

As predicted in hypothesis 1, Model 2, table 6.3, shows that high spinoff density has a positive effect on average total university funding. Consistent with the density-based legitimacy assumption, the number of university spinoff firms formed strongly affects the decision of funding bodies to allocate resources to universities. Spinoff performance has also a positive impact on university funding (model 3), although in the over model (model 5), the effect is not significant. Finally, spinoff media coverage significantly increases university funding both in models 4 and 5. Taken together, the effect of the three independent variables explains close to 30% of the average university funding sources.

In the second period of the study (2001-2007), spinoff density, performance and media publicity again support hypotheses 1-3 (models 7-9 in table 6.4). The three independent variables are able to explain around 35% of the total university funding variance. Comparing tables 6.3 and 6.4, we also find strong support for hypothesis 4. As predicted, whereas spinoff density was more important in the first few years of the phenomenon, spinoff performance and media coverage were more important in the later years. In particular, the spinoff performance effect is significant for the first time in model 10, and the spinoff popularity has increased its impact on university funding from 11% to 31%.

Overall, we found support for all four hypotheses. However, we conducted further analyses, also as a robustness check, by splitting financial resources into three categories – UK government, UK research council and UK industry, representing respectively income from non-competing government grants, competing government

	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13	14
1	Total funding	1.00													
2	Research output	.35*	1.00												
3	Reputation	-.61*	-.56*	1.00											
4	Status	.24*	-.53*	-.32*	1.00										
5	Age[a]	.35*	-.58*	-.76*	.35*	1.00									
6	Size[a]	-.29*	-.19*	-.18*	.14*	.16*	1.00								
7	Regional GDP	.21*	.22*	.06*	.04	.18*	-.02	1.00							
8	Regional R&D	.02	.01	.00	.17*	-.11*	.01	.18*	1.00						
9	Russell Group	.23*	-.63*	-.56*	.43*	.38*	.31*	.00	-.02	1.00					
10	1994 Group	.03	-.00	-.39*	-.06*	.26*	-.02	.04	.10*	-.15*	1.00				
11	Million+	-.14*	-.20*	.51*	-.09*	-.21*	.16*	.17*	-.04	-.18*	-.17*	1.00			
12	Spinoff density	.23*	-.61*	-.46*	.44*	.45*	.24*	.07*	-.02	.57*	.03	-.15*	1.00		
13	Spinoff performance	.08*	-.15*	-.14*	.15*	.18*	.07*	.13*	.04	.09*	-.00	-.09*	.13*	1.00	
14	Spinoff popularity	.26*	-.59*	-.28*	.36*	.33*	.14*	.23*	.04*	-.38*	-.03	-.08*	.40*	.21*	1.00
	N	1665	1695	1476	1695	1695	1665	1695	1695	1695	1695	1695	1690	1693	1695
	Mean	777	146	56.5	0.49	2.71	9.35	15.3k	1148	0.14	0.13	0.17	0.77	355k	21.96
	S.D.	2058	276	33.2	2.52	1.80	0.81	4.6k	941	0.35	0.33	0.38	1.64	1527	86.58

*p<0.05
[a] Natural logarithm

Table 6.1: Descriptive statistics and correlations

Independent variable	Model 1		Model 2		Model 3		Model 4		Model 5	
Research output	0.16***	(0.27)	0.11**	(0.32)	0.15***	(0.28)	0.14**	(0.29)	0.11**	(0.32)
Reputation	-0.29***	(1.89)	-0.29***	(1.89)	-0.30***	(1.90)	-0.30***	(1.90)	-0.30***	(1.91)
Status	0.09**	(24.7)	0.08**	(25.6)	0.09**	(25.1)	0.10***	(24.8)	0.08**	(27.1)
Age[a]	0.12	(0.44)	0.02	(0.44)	0.00	(0.45)	-0.00	(0.46)	0.00	(0.48)
Size[a]	-0.16***	(0.00)	-0.17***	(0.00)	-0.17***	(0.00)	-0.16***	(0.00)	-0.17***	(0.01)
Regional GDP	0.18***	(0.01)	0.18***	(0.10)	0.18***	(0.01)	0.18***	(0.01)	0.18***	(0.01)
Regional R&D	-0.04†	(0.05)	-0.03	(0.05)	-0.04†	(0.05)	-0.04†	(0.05)	-0.04†	(0.05)
Russell Group	-0.04	(211)	-0.04***	(211)	-0.03	(212)	-0.03	(212)	-0.03***	(212)
1994 Group	-0.10***	(154)	-0.10***	(154)	-0.09**	(154)	-0.09**	(154)	-1.00**	(155)
Million+	-0.00	(304)	-0.00	(304)	-0.00	(304)	-0.00	(304)	-0.00	(304)
Spinoff density			0.08**	(6.72)					0.07*	(7.79)
Spinoff perform.					0.04*	(2.16)			0.02	(2.55)
Spinoff popularity							0.05†	(1.10)	0.01	(1.45)
R^2	0.24		0.24		0.24		0.24		0.25	
Adj. R^2	0.23		0.24		0.24		0.25		0.25	
ΔR^2			0.01		0.01		0.01		0.01	
F for ΔR^2			4.98		1.86		3.03		0.14	
F	51.79***		56.77***		53.65***		54.83***		51.93***	

N=1649; ***p<0.001, **p<0.01, *p<0.05, †p<0.10 (2-tailed)
[a] Natural logarithm; Standardized coefficients reported; standard errors in parentheses

Table 6.2: Results of hierarchical OLS regression on average total funding: 1993-2007

Independent variable	Model 1		Model 2		Model 3		Model 4		Model 5	
Research output	0.09*	(0.18)	0.01	(0.18)	0.01	(0.18)	0.04	(0.18)	-0.02	(0.18)
Reputation	-0.26***	(1.06)	-0.25***	(1.02)	-0.25***	(1.05)	-0.29***	(1.04)	-0.26***	(1.01)
Status	0.34***	(7.46)	0.30***	(7.32)	0.34***	(7.46)	0.30***	(7.51)	0.28***	(7.38)
Age[a]	0.38	(19.0)	0.05	(18.3)	0.03	(19.0)	0.01	(18.7)	0.02	(18.3)
Size[a]	-0.17**	(33.7)	-0.18***	(32.5)	-0.18***	(33.6)	-0.18***	(32.9)	-0.18***	(32.1)
Regional GDP	0.12***	(0.01)	0.10***	(0.01)	0.11***	(0.01)	0.12***	(0.01)	0.10***	(0.01)
Regional R&D	-0.01	(0.02)	-0.01	(0.02)	-0.01	(0.02)	-0.01	(0.02)	0.01	(0.02)
Russell Group	0.29***	(74.3)	0.27***	(71.7)	0.29***	(74.2)	0.31***	(72.9)	0.29***	(71.2)
1994 Group	0.06*	(56.3)	0.06*	(54.2)	0.07**	(56.6)	0.08**	(55.2)	0.07**	(53.9)
Million+	-0.03	(52.1)	-0.02	(50.2)	-0.02	(52.3)	-0.03	(50.1)	-0.02	(49.8)
Spinoff density			0.21***	(12.9)					0.18***	(13.2)
Spinoff perform.					0.05*	(0.00)			0.02	(0.00)
Spinoff popularity							0.15***	(0.88)	0.11***	(0.93)
R^2	0.67		0.70		0.68		0.69		0.71	
Adj. R^2	0.67		0.69		0.67		0.69		0.71	
ΔR^2			0.02		0.02		0.02		0.04	
F for ΔR^2			14.07		4.61		36.11		27.33	
F	151.81***		154.22***		139.11***		147.90***		135.67***	

N=744; ***p<0.001, **p<0.01, *p<0.05, †p<0.10 (2-tailed)

[a] Natural logarithm; Standardized coefficients reported; standard errors in parentheses

Table 6.3: Results of hierarchical OLS regression on average total funding: 1993-2000

Independent variable	Model 6		Model 7		Model 8		Model 9		Model 10	
Research output	0.37***	(0.12)	0.36***	(0.12)	0.40***	(0.13)	0.22***	(0.11)	0.24***	(0.11)
Reputation	-0.14**	(1.35)	-0.13**	(1.36)	-0.14**	(1.44)	-0.11**	(1.22)	-0.10*	(1.21)
Status	0.27***	(10.1)	0.26***	(10.2)	0.24***	(10.9)	0.24***	(8.72)	0.21***	(9.31)
Age[a]	0.12**	(21.6)	0.11**	(21.6)	0.08*	(23.2)	0.03	(19.7)	0.02	(19.8)
Size[a]	-0.09***	(44.6)	-0.10***	(44.5)	-0.09***	(47.5)	-0.06**	(40.5)	-0.06**	(39.9)
Regional GDP	0.05*	(0.01)	0.05*	(0.01)	0.06**	(0.01)	0.02	(0.01)	0.03	(0.01)
Regional R&D	0.01	(0.02)	0.01	(0.02)	-0.01	(0.02)	-0.01	(0.02)	-0.01	(0.02)
Russell Group	0.15***	(112)	0.13**	(114)	0.14***	(119)	0.15***	(101)	0.15***	(102)
1994 Group	0.11***	(85.2)	0.11***	(85.1)	0.12***	(91.6)	0.16***	(77.8)	0.17**	(77.3)
Million+	0.02	(61.9)	0.02	(61.8)	0.03	(66.1)	0.03	(55.0)	0.01	(55.3)
Spinoff density			0.05†	(14.9)					0.04†	(13.3)
Spinoff perform.					0.07**	(0.00)			0.03†	(0.00)
Spinoff popularity							0.38***	(0.19)	0.31***	(0.23)
R^2	0.71		0.73		0.71		0.80		0.78	
Adj. R^2	0.71		0.72		0.71		0.80		0.78	
ΔR^2			0.02		0.01		0.08		0.06	
F for ΔR^2			2.95		9.27		294.10		62.98	
F	175.13***		171.48***		161.90***		263.37***		196.74***	

N=726; ***p<0.001, **p<0.01, *p<0.05, †p<0.10 (2-tailed)

[a] Natural logarithm; Standardized coefficients reported; standard errors in parentheses

Table 6.4: Results of hierarchical OLS regression on average total funding: 2001-2007

grants and the industry. Public institutions and particularly educational ones traditionally rely on public sources of funding (Rankin, 1956) so we wanted to examine two such public sources. Separately, we examined industry sources of funding to uncover possible differences relative to the public sources. Tables 6.5 and 6.6 show regression estimates when the dependent variable is average non-competing government grants. The results provide mixed support for our main assumptions that spinoff legitimacy increased university funding. Between 1993 and 2000, spinoff density was the only construct with positive effect on funding (models 2 and 5), while spinoff performance and popularity were irrelevant predictors of the dependent variable. After 2001 (table 6.6), the only significant and positive effect on non-competing university funding was from spinoff media coverage (models 9 and 10), while spinoff density and performance did not support our predictions. However, considering the differences between the two tables, we find quite strong support for hypothesis 4.

Tables 6.7 and 6.8 show regression estimates for the dependent variable "average competing government grants". Our findings are again the same, with high spinoff numbers and spinoff media coverage affecting university funding in both periods (table 6.7, models 2 and 4; table 6.8, models 7 and 9), but performance not being a significant predictor in any of the two periods (models 3 and 8). Perhaps because English and Scottish research councils allocate funds based on research proposals made by educational institutions, the media effect was not so strong in the first period. However, after 2001 media coverage of spinoff activities was found to be a significant predictor, possibly due to the fact that a lot of the university research projects were now based on spinoff-related activities that were progressively legitimized in the two countries. Overall, the results can explain around one third of

Independent variable	Model 1		Model 2		Model 3		Model 4		Model 5	
Research output	0.35***	(0.12)	0.31***	(0.13)	0.35***	(0.12)	0.34***	(0.13)	0.30***	(0.13)
Reputation	-0.39***	(0.73)	-0.39***	(0.72)	-0.39***	(0.73)	-0.40***	(0.73)	-0.39***	(0.73)
Status	0.19***	(5.16)	0.17***	(5.18)	0.19***	(5.17)	0.18***	(5.32)	0.17***	(5.30)
Age[a]	0.04	(13.2)	0.05	(13.0)	0.05	(13.2)	0.04	(13.3)	0.05	(13.1)
Size[a]	-0.19***	(23.3)	-0.19***	(22.9)	-0.19***	(23.3)	-0.19***	(23.3)	-0.19***	(22.9)
Regional GDP	0.08***	(0.01)	0.07***	(0.01)	0.09***	(0.01)	0.08***	(0.01)	0.08***	(0.01)
Regional R&D	0.02	(0.01)	0.03†	(0.01)	0.02	(0.01)	0.02	(0.01)	0.03	(0.01)
Russell Group	0.12***	(51.4)	0.10***	(50.8)	0.11***	(51.4)	0.12***	(51.6)	0.10***	(51.0)
1994 Group	0.05*	(38.9)	0.05*	(38.8)	0.05*	(39.2)	0.05**	(39.1)	0.05**	(38.6)
Million+	-0.02	(36.1)	-0.02	(35.6)	-0.02	(36.2)	-0.02	(36.1)	-0.02	(35.7)
Spinoff density			0.10***	(9.20)					0.10***	(9.45)
Spinoff perform.					0.02	(0.00)			-0.03	(0.00)
Spinoff popularity							0.02	(0.63)	0.01	(0.67)
R^2	0.82		0.83		0.82		0.82		0.83	
Adj. R^2	0.82		0.82		0.82		0.82		0.82	
ΔR^2			0.01		0.00		0.00		0.01	
F for ΔR^2			23.57		2.09		1.26		8.73	
F	337.41***		318.32***		307.39***		306.96***		269.77***	

N=744; ***p<0.001, **p<0.01, *p<0.05, †p<0.10 (2-tailed)

[a] Natural logarithm; Standardized coefficients reported; standard errors in parentheses

Table 6.5: Results of hierarchical OLS regression on average non-competing (recurrent) funding: 1993-2000

Independent variable	Model 6		Model 7		Model 8		Model 9		Model 10	
Research output	0.74***	(0.06)	0.75***	(0.06)	0.75***	(0.07)	0.64***	(0.06)	0.65***	(0.06)
Reputation	-0.14***	(0.74)	-0.14***	(0.75)	-0.15***	(0.79)	-0.12***	(0.66)	-0.13***	(0.65)
Status	0.06***	(5.57)	0.06***	(5.64)	0.06***	(5.97)	0.04**	(4.70)	0.04**	(5.02)
Age[a]	0.09***	(11.8)	0.09***	(11.9)	0.08***	(12.7)	0.04*	(10.6)	0.04*	(10.7)
Size[a]	-0.12***	(24.4)	-0.12***	(24.4)	-0.12***	(26.0)	-0.10***	(21.8)	-0.10***	(21.6)
Regional GDP	0.11***	(0.01)	0.11***	(0.01)	0.12***	(0.00)	0.10***	(0.01)	0.10***	(0.01)
Regional R&D	-0.02	(0.01)	-0.02	(0.01)	-0.02	(0.01)	-0.02	(0.01)	-0.02*	(0.01)
Russell Group	-0.01	(61.7)	-0.01	(62.7)	-0.01	(65.4)	-0.01	(54.5)	-0.01	(55.1)
1994 Group	0.13***	(46.7)	0.13***	(46.7)	0.12**	(50.2)	0.17***	(41.9)	0.16***	(41.7)
Million+	0.01	(33.9)	0.01	(33.9)	0.01	(36.2)	0.01	(30.2)	0.01	(29.8)
Spinoff density			-0.01	(8.18)					-0.01	(7.18)
Spinoff perform.					-0.02	(0.00)			-0.01**	(0.00)
Spinoff popularity							0.25***	(0.10)	0.21***	(0.12)
R^2	0.89		0.89		0.89		0.92		0.92	
Adj. R^2	0.89		0.89		0.88		0.92		0.92	
ΔR^2			0.00		0.00		0.03		0.03	
F for ΔR^2			0.31		1.31		318.92		71.92	
F	591.57***		537.30***		503.53***		766.84***		607.63***	

N=726; ***p<0.001, **p<0.01, *p<0.05, †p<0.10 (2-tailed)

[a] Natural logarithm; Standardized coefficients reported; standard errors in parentheses

Table 6.6: Results of hierarchical OLS regression on average non-competing (recurrent) funding: 2001-2007

Independent variable	Model 1		Model 2		Model 3		Model 4		Model 5	
Research output	0.04	(0.11)	-0.07	(0.11)	0.04	(0.11)	-0.01	(0.11)	-0.10	(0.11)
Reputation	-0.19**	(0.65)	-0.17**	(0.62)	-0.19**	(0.66)	-0.21***	(0.65)	-0.18**	(0.63)
Status	0.21***	(4.58)	0.16***	(4.44)	0.21***	(4.58)	0.18***	(4.66)	0.14***	(4.52)
Age[a]	0.01	(11.7)	0.03	(11.2)	0.01	(11.8)	-0.02	(11.7)	0.01	(11.3)
Size[a]	-0.14***	(20.8)	-0.15***	(19.8)	-0.14***	(20.8)	-0.14***	(20.6)	-0.15***	(19.8)
Regional GDP	0.19***	(0.01)	0.16***	(0.01)	0.19***	(0.01)	0.18***	(0.01)	0.17***	(0.01)
Regional R&D	-0.01	(0.01)	0.01	(0.01)	-0.01	(0.01)	-0.01	(0.01)	0.01	(0.01)
Russell Group	0.41***	(46.7)	0.39***	(44.6)	0.40***	(46.9)	0.43***	(46.6)	0.40***	(44.9)
1994 Group	0.15***	(35.1)	0.15***	(33.5)	0.15***	(35.5)	0.16***	(34.9)	0.16***	(33.7)
Million+	-0.01	(31.7)	-0.03	(30.3)	-0.04	(31.9)	-0.04	(31.3)	-0.03	(30.4)
Spinoff density			0.27***	(7.87)					0.25***	(8.02)
Spinoff perform.					-0.00	(0.00)			-0.02	(0.00)
Spinoff popularity							0.12***	(0.55)	0.08**	(0.57)
R^2	0.56		0.60		0.56		0.57		0.60	
Adj. R^2	0.55		0.55		0.55		0.56		0.59	
ΔR^2			0.04		0.00		0.01		0.04	
F for ΔR^2			73.61		0.01		15.72		26.76	
F	90.48***		97.24***		82.14***		85.36***		83.25***	

N=731; ***p<0.001, **p<0.01, *p<0.05, †p<0.10 (2-tailed)

[a] Natural logarithm; Standardized coefficients reported; standard errors in parentheses

Table 6.7: Results of hierarchical OLS regression on average competing (council) funding: 1993-2000

Independent variable	Model 6		Model 7		Model 8		Model 9		Model 10	
Research output	0.33***	(0.08)	0.32***	(0.08)	0.35***	(0.09)	0.17***	(0.08)	0.17***	(0.79)
Reputation	-0.22***	(0.96)	-0.21***	(0.96)	-0.22***	(1.02)	-0.18***	(0.87)	-0.18***	(0.86)
Status	0.16***	(7.24)	0.15***	(7.31)	0.15***	(7.75)	0.11***	(6.23)	0.11***	(6.65)
Age[a]	0.07†	(15.4)	0.06	(15.4)	0.05	(16.4)	-0.02	(14.1)	-0.02	(14.1)
Size[a]	-0.08**	(31.8)	-0.08**	(31.7)	-0.08**	(33.7)	-0.04†	(28.9)	-0.05†	(28.5)
Regional GDP	0.07**	(0.01)	0.07**	(0.01)	0.08**	(0.01)	0.03†	(0.00)	0.05*	(0.00)
Regional R&D	0.02	(0.02)	0.02	(0.02)	0.01	(0.02)	0.00	(0.01)	0.01	(0.01)
Russell Group	0.17***	(80.1)	0.16**	(81.4)	0.16**	(84.8)	0.18***	(72.3)	0.17***	(72.9)
1994 Group	0.13***	(60.6)	0.14***	(60.6)	0.12***	(65.1)	0.19***	(55.5)	0.19***	(55.2)
Million+	0.04	(44.2)	0.04	(44.1)	0.04	(47.0)	0.03	(40.0)	0.02	(39.6)
Spinoff density			0.06†	(10.6)					0.06*	(9.50)
Spinoff perform.					0.00	(0.00)			-0.04†	(0.00)
Spinoff popularity							0.42***	(0.13)	0.37***	(0.16)
R^2	0.63		0.63		0.63		0.73		0.70	
Adj. R^2	0.62		0.62		0.62		0.72		0.70	
ΔR^2			0.00		0.00		0.10		0.08	
F for ΔR^2			3.45		0.01		270.70		61.13	
F	120.12***		109.89***		104.16***		172.90***		129.95***	

N=722; ***p<0.001, **p<0.01, *p<0.05, †p<0.10 (2-tailed)

[a] Natural logarithm; Standardized coefficients reported; standard errors in parentheses

Table 6.8: Results of hierarchical OLS regression on average competing (council) funding: 2001-2007

Independent variable	Model 1		Model 2		Model 3		Model 4		Model 5	
Research output	0.14**	(0.10)	0.09*	(0.10)	0.15***	(0.10)	0.08*	(0.10)	0.07	(0.10)
Reputation	-0.31***	(0.59)	-0.30***	(0.59)	-0.31***	(0.59)	-0.33***	(0.58)	-0.32***	(0.58)
Status	0.42***	(4.21)	0.39***	(4.24)	0.41***	(4.18)	0.38***	(4.24)	0.37***	(4.25)
Age[a]	0.06	(10.7)	0.07	(10.6)	0.05	(10.7)	0.03	(10.6)	0.04	(10.5)
Size[a]	-0.19**	(19.0)	-0.20***	(18.8)	-0.19***	(18.8)	-0.19***	(18.5)	-0.20***	(18.4)
Regional GDP	0.05†	(0.01)	0.04***	(0.00)	0.02	(0.01)	0.04†	(0.00)	0.02	(0.00)
Regional R&D	0.01	(0.01)	0.01	(0.01)	0.01	(0.02)	-0.01	(0.01)	0.01	(0.01)
Russell Group	0.11**	(41.9)	0.10**	(41.5)	0.12**	(41.6)	0.13***	(41.1)	0.12**	(40.9)
1994 Group	-0.04	(31.7)	-0.04	(31.4)	-0.03	(31.7)	-0.03**	(31.1)	-0.03	(31.0)
Million+	-0.01	(29.4)	-0.01	(29.1)	-0.01	(29.3)	-0.01	(28.7)	0.01	(28.6)
Spinoff density			0.12***	(7.53)					0.09**	(7.58)
Spinoff perform.					0.08***	(0.00)			0.05*	(0.00)
Spinoff popularity							0.15***	(0.49)	0.12***	(0.54)
R^2	0.67		0.68		0.67		0.68		0.69	
Adj. R^2	0.66		0.67		0.67		0.68		0.69	
ΔR^2			0.01		0.01		0.02		0.02	
F for ΔR^2			17.54		13.13		35.81		16.61	
F	146.59***		137.87***		136.67***		142.85***		123.80***	

N=744; ***p<0.001, **p<0.01, *p<0.05, †p<0.10 (2-tailed)

[a] Natural logarithm; Standardized coefficients reported; standard errors in parentheses

Table 6.9: Results of hierarchical OLS regression on average industry funding: 1993-2000

Independent variable	Model 6		Model 7		Model 8		Model 9		Model 10	
Research output	0.38***	(0.05)	0.38***	(0.05)	0.42***	(0.05)	0.27***	(0.05)	0.32***	(0.05)
Reputation	-0.02	(0.59)	-0.01	(0.59)	-0.00	(0.60)	-0.00	(0.57)	0.03	(0.55)
Status	0.38***	(4.48)	0.38***	(4.53)	0.34***	(4.54)	0.38***	(4.10)	0.33***	(4.25)
Age[a]	0.16***	(9.52)	0.16***	(9.55)	0.11**	(9.67)	0.09**	(9.28)	0.08**	(9.04)
Size[a]	-0.11***	(19.6)	-0.10***	(19.6)	-0.18***	(19.7)	-0.08**	(19.1)	-0.08***	(18.2)
Regional GDP	0.01	(0.00)	0.01***	(0.00)	-0.01	(0.00)	-0.00	(0.00)	-0.01	(0.00)
Regional R&D	-0.01	(0.01)	-0.01	(0.01)	-0.02	(0.01)	-0.02	(0.01)	-0.02	(0.01)
Russell Group	0.09*	(49.5)	0.08*	(50.4)	0.10***	(49.7)	0.09**	(47.6)	0.10**	(46.6)
1994 Group	0.06*	(37.5)	0.06*	(37.5)	0.08**	(38.2)	0.10***	(36.6)	0.12***	(35.3)
Million+	-0.01	(27.2)	-0.01	(27.3)	-0.01	(27.5)	-0.01	(26.4)	0.00	(25.3)
Spinoff density			0.02	(6.57)					0.02	(6.08)
Spinoff perform.					0.15***	(0.01)			0.13***	(0.00)
Spinoff popularity							0.27***	(0.09)	0.19***	(0.10)
R^2	0.72		0.73		0.74		0.78		0.77	
Adj. R^2	0.72		0.72		0.74		0.77		0.77	
ΔR^2			0.01		0.02		0.04		0.04	
F for ΔR^2			0.80		52.27		131.42		41.55	
F	189.86***		172.63***		184.40***		225.74***		180.60***	

N=723; ***p<0.001, **p<0.01, *p<0.05, †p<0.10 (2-tailed)

[a] Natural logarithm; Standardized coefficients reported; standard errors in parentheses

Table 6.10: Results of hierarchical OLS regression on average industry funding: 2001-2007

the variance in the dependent variable (models 5 and 10). They also provide moderate support for hypothesis 4, as spinoff density has a stronger impact in the first period, and spinoff publicity is stronger in the second.

We finally provide another robustness check for the dependent variable "average industry funding" (includes endowments from private donors) in tables 6.9 and 6.10. The UK industrial funds matched the research hypotheses more than any other. A significant effect of spinoff performance and publicity on university industry funding was found exactly as predicted in both periods (hypotheses 2, 3 and 4), while spinoff density was more important in the second period (hypotheses 1 and 4) although always in a positive sign.

6.7 Discussion

In this paper, we started with the central question of how public organizations can raise financial resources from their environments. We argued that one of the key themes in the management literature is the legitimacy of organizational actions in helping organizations attract the endorsement of market audiences (Suchman, 1995). In our context, we examined how university funding evolved alongside three legitimacy dimensions of the spinoff phenomenon using institutional (DiMaggio and Powell, 1983) and population ecology theories (Hannan and Freeman, 1977). We found that universities engaging in spinoff formation were rewarded by public and private financial providers in two ways: first, through the impact of increased spinoff density and performance, and second, through the legitimacy/reputational importance of spinoff media coverage.

Our findings are important for the academic entrepreneurship literature (Djokovic and Souitaris, 2008; Rothaermel *et al*, 2007). Specifically, the emergence

of the spinoff industry has been seen as a natural process, despite lack of empirical evidence on how universities can benefit from commercial activities (Shane, 2004a). Emphasis in the existing literature has been placed upon issues such as university attributes that enhance spinoff generation (Lockett and Wright, 2005) and typologies for spinoff incubation (Clarysse, Wright, Lockett, Van de Velde and Vohora, 2005). In the early 1990's, the general perception among policy-makers in England and Scotland was that spinoffs would bring back benefits to universities directly through equity investments. However, we show here how the transformation of the educational market made the exiting major financing bodies reward universities for their spinoff activities through the gradual legitimation of these activities. Further, the particular effect of media coverage is in contrast to efficiency explanations in the academic entrepreneurship and organization studies literatures regarding public universities. Unlike for-profit markets (Johnson *et al*, 2005; Pollock and Rindova, 2003) the role of media in providing organizational legitimacy is not often associated with state-owned enterprises. Finally, contrary to prior survey research methods (e.g. Lockett and Wright, 2005), the results of this study are important because they are based on the most up-to-date, complete panel database of UK spinoffs that has appeared in the literature.

Our study is pioneering in trying to understand how public organizations acquire financial resources using theoretical perspectives that have been utilized in for-profit settings. It has been argued that due to their significant reliance to the state, public entities need only comply to state requirements in order to continue securing financial resources. This compliance usually takes the form of structural adaptations (Rowan, 1982; Scott, 1981; Tolbert and Zucker, 1983) that grant public entities a certain level of legitimacy. Thus, public organizations such as universities can

continue to work based on government contracts and grants (Rankin, 1956). However, organizational studies theorists have rarely examined the legitimacy of new practices when environmental requirements push public organizations towards strategic diversification. Within this context, we argue that examining the gradual legitimation of new practices (rather than general organizational structures) can better explain the endorsement of public organizations by funding bodies. This implies that there is significant flexibility in the way funding flows into public organizations. In the case of UK universities, there were no reward schemes for spinoff formation, yet the gradual legitimation of these activities (through the spinoff density, performance and media coverage) induced public and private funding sources to provide universities with financial resources. This indirect effect has not be recognized in the management literature. More specifically, socially constructed accounts of reality (Luckmann and Berger, 1991) based on mass media influences are extremely rare in explaining public administration behaviors.

A second implication of organization theorists' overwhelming emphasis on the institutional rather than technical aspects of public organizations (Scott, 1981) is the fact that competition dynamics are often excluded from their work. We show that legitimacy dynamics in non-profit fields can change to competition dynamics with time. This may perhaps happen more easily when the new activities of public organizations move towards market-like arrangements as it happened with the introduction of commercial activities among public universities. The spinoff population emerged as a taken-for-granted practice despite initial opposition against it and it later turned to competition among universities as to which would produce the highest number of successful spinoffs (Hannan and Carroll, 1992). Accordingly, our

results show that after a certain point, competition was quite important in explaining university resource acquisition.

The study's findings are in contrast to other sociological explanations on scientific practices among public educational organizations. For example, Merton's (1973:439) "Matthew effect in science" suggests that allocation of financial rewards is based on university networks and status, so that there is relatively little variation in resource acquisition: high status universities "will take it all", even at times when they are not performing well. We found similar support in our analyses in that university reputation, status and publications record inevitably affect their financial resource acquisition. However, the legitimacy of their new practices and the evolution of market competition had an equally strong effect in the UK higher education sector.

Key policy implications of study lie at the importance of the legitimation mechanism of public organization practices within national innovation systems. The central government in the UK took legislative measures to incentivize universities towards greater links with the industry and greater knowledge transfer (HM Treasury, 1993; 2003). However, as our results indicate, financial support from recurrent (non-competing grants) were less aligned with trends in the spinoff industry: when resources from competing grants, the UK industry and private endowments were flowing into universities as a result of the increased legitimacy of spinoff activities, recurrent grants remained less aligned to these trends even after more than 10 years of spinoff experience in the two countries. This perhaps demonstrates organizational inertia among government agencies in the way they reward public organizations under their jurisdiction. More specifically, several authors (e.g. Etzkowitz, 2003) have proposed that, given governmental mandates for more university commercial activities, these activities should be incorporated as a third function in the university's

mission, along with teaching and research. They should thus be monitored and rewarded accordingly.

Our work has implications on how organizations respond to institutional pressures and manage their legitimacy. As Suchman (1995: 593) notes, when there is contestation over an organization's legitimacy because of changing audience preferences, the organization has two options in order to maintain its legitimacy: a) perceive change and b) protect accomplishments. We found that universities that perceived the changes and placed emphasis on spinoff productivity and performance managed to accumulate resources quicker than others. Also, universities that had their accomplishments promoted through the press were able to secure even higher financial support throughout the entire period of observation. This has implications as to how public organizations can manipulate their environment in their favor (cf. Pollock and Rindova, 2003; Zuckerman, 1999).

Like any other study, this one has its limitations. First, we argued about the influence of spinoff media coverage, yet there is a chance that university, spinoff or institutional characteristics may affect the possibility of a university and/or spinoff attracting media coverage. For instance, the physical distance between universities and/or spinoffs from media centers is one such factor (cf. Pollock and Rindova, 2003). Prior links that a university or spinoff may have with the media can cause the same endogeneity problem. We were unable to control for this possible bias due to lack of data about spinoff location and the sheer volume of the database that would make such an endeavor virtually impossible.

In addition, we treated universities as the unit of analysis but there is possibly significant variation at the departmental level within universities. Most papers in

organizational studies distinguish among industries because different industries have different characteristics and levels of legitimacy. In our context, it is likely that spinoffs from medical and engineering departments are much easier to be established, grow and attract media attention than spinoffs from other faculties (Jong, 2006; O'Shea *et al.*, 2005). Also, treating the entire university as the unit of analysis cannot reveal differences in the accumulation by or distribution of resources to certain departments. Instead, we have used funding figures in aggregate for all departments or faculties in a university.

A major theme for future research would therefore be to examine the impact of certain kinds of spinoff companies (services, biotech, engineering) on revenues or other university benefits. For example, because spinoff firms generate publicity for universities, it might worth examining the impact on university reputation. Also, spinoff firms may be linked to changes in the productivity of researchers or to the recruitment of faculty members and PhD researchers. Short discussions that we had with university Technology Transfer officers revealed that there have been cases where faculty teams moved to another university simply because they found appealing the prospect of working on spinoff-related projects.

7. COMMUNITY ECOLOGY: A GENERAL MODEL OF RECIPROCAL LEGITIMACY BETWEEN TWO ORGANIZATIONAL POPULATIONS[6]

7.1. Abstract

Drawing from empirical contexts of mutualism and symbiosis among populations of organizations (e.g. corporate entrepreneurship units and the organizations they create), we build theory on the legitimation process among populations. We advance previous work in the community ecology literature by bringing in the concept of reciprocity in social exchanges to argue that reciprocal cooperative transactions help organizational populations gain legitimacy early in their life cycles. Propositions on the exact antecedents (power balance, communication capabilities and technological capabilities) of reciprocal transactions are formulated. These elements lead to a reciprocal legitimation of interacting organizational populations. We finally develop propositions on the consequences (network sustainability, protection from competition, population growth) of reciprocal legitimacy.

7.2. Introduction

This paper deals with how organizational populations gain legitimacy through their interaction with other populations in a larger community. The focus of the study is on exchanges among two or more populations based on the norms of reciprocity in their community (Blau, 1964; Cropanzano and Mitchell, 2005). Gouldner (1960) named reciprocity as the core property that defines the stability and harmonious coevolution of two interrelated entities. Reciprocity is based on the understanding among the participants in a community that giving away freely will be reciprocated, thus fostering bonds among the parties. This paper focuses on the social relationships

[6] An earlier version of this paper was presented at the American Sociological Association conference.

where reciprocity can be found, i.e. cooperation rather than competition, among organizations.

The emphasis of the study is on legitimacy among populations of organizations within communities (community ecology), rather than individual organizations within populations (population ecology). In organization studies, measuring legitimacy at the individual or population levels has been key to institutional and population ecology theorists but has received little attention at the community level of analysis. We believe that examining legitimacy processes at the community level is a fruitful research path in understanding how populations (e.g. industries) can acquire and manage legitimacy through their own collective actions. We specifically address this theoretical gap in the community ecology literature by introducing the concept of legitimacy based on reciprocal exchanges among populations.

But why should exchanges be important at all? When studying the interrelatedness of populations, community ecologists have traditionally looked at a) location, b) functional complementarity and c) connections/exchanges among populations[7]. Reviewing this body of work, Scott (2006: 183) claimed that community theorists' early focus was more on colocation (e.g. Barnett and Carroll, 1987) than on functional interdependence or exchanges. This led to important connections and exchanges among organizations being ignored (Astley, 1984; Astley, 1985; Astley and Fombrun, 1983), thus weakening the way we understand communities. Ignoring connections and exchanges in community ecology has also been criticized by early institutional theorists. Because of this limitation, institutional

[7] Similarly, Freeman and Audia (2006) recently classified organizational communities into four categories. According to them, communities can be distinguished based on two criteria: a) spatial differentiation and b) functional complementarity.

theorists drew their attention to what they called "community fields", large establishments that include all possible population exchanges in a system (DiMaggio and Powell, 1983: 148; cf. Scott, 2006). They then proposed that fields gain legitimacy through network connections, structural equivalence and the increased interaction among organizations (Baker and Faulkner, 2006; Gulati, 1998). The aim of this paper is to advance our knowledge on the role of exchanges among populations within the classic ecological framework. Thus, in line with the previous arguments, we shift our attention away from functionalism or collocation and in favor of exchanges in order to understand legitimacy within communities.

What is important in the legitimation theory that we propose is the reciprocal nature of the exchanges between organizational populations ─ reciprocity as a dynamic force that governs the exchange of donations (gifts) between populations. The idea of reciprocal social relationships can be traced back in early sociological and anthropological writings by scholars such as Becker (1956), Mauss (1990), Hobhouse (2004) and Simmel (1964) who identified reciprocity with fundamental ethical behaviors of individual human beings in primitive and contemporary societies. In these societies, the moral applicability of reciprocity lies in its cultural mandate: people ought to reciprocate when they receive a gift in order to preserve social relationships. Further, in social exchange theory, reciprocity has been described as a folk belief involving the cultural expectation that people "get what they deserve" (Blau, 1964; Cropanzano and Mitchell, 2005; Emerson, 1976; Gouldner, 1960).

In this study, because we are interested with organizational settings, we adopt a definition of reciprocity as a transactional pattern in interdependent exchanges (Gouldner, 1960; Cropanzano and Mitchell, 2005: 876). We also change the level of analysis from individual human beings to groups/populations of organizations. Seen

from this point of view, a reciprocal exchange among organizational populations is one that is based on expectations for mutual benefits during an economic transaction that is not based on explicit agreement among the partners (Molm, 1999; Molm, Peterson and Takahashi, 2003). Direct reciprocal exchanges begin with actors performing actions that benefit others, without negotiation and without knowing whether, when or to what extent the others will reciprocate (Molm, Collett and Schaefer, 2007). They are therefore purely based on a belief in sharing, not contracts (Boucher *et al*, 1982: 329). In human as well as in organizational communities, sequential reciprocal actions such as these initiate new rounds of exchange and solidify social relationships (Cropanzano and Mitchell, 2005).

Drawing from these social exchange theory assumptions (Blau, 1964; Cropanzano and Mitchell, 2005; Gouldner, 1960), we examine in detail how interacting organizational populations generate legitimacy in a dyadic system. We first examine the antecedents of this legitimation process by looking at important determinants of successful reciprocal exchanges, for example, the balance of power between two populations. If there is high imbalance between A and B, chances are that reciprocity will fail to materialize, or that one of the partners will increase its legitimacy at the other's expense (exploitation). Then, we examine the outcomes of legitimacy from reciprocal transactions to show that populations coevolving through this process are able to secure three core benefits for their members: a) network duration, b) protection from predator populations (i.e. competition) and c) population expansion (Boucher, James and Keeler, 1982).

The outline of the paper is as follows. We first detail the empirical context from which we drew inspiration to develop a theory of reciprocal legitimacy. We then review the community ecology literature in organization studies focusing on the

antecedents and consequences of community legitimization. Later, we review core aspects of reciprocity within the social exchange theory and formulate propositions that explain how the interaction between populations helps them gain legitimacy.

7.3. Empirical contexts of application

7.3.1. Mutualistic and symbiotic relationships

To be able to generalize a theory that is based on the co-dependence of organizational populations, we consider pairs of populations to which it could be applicable. The community ecology literature in biology (Boucher *et al*, 1982; Pianka, 1994), organizational studies (Astley, 1984; Astley, 1985; Astley and Fombrum, 1983; Barnett and Carroll, 1987) as well as evolutionary theory (Aldrich and Ruef, 2006; Janzen, 1980; Romanelli, 1991) offer many examples of such interacting populations. In the most general formulation, the relationship between populations of species can be characterized by competition, predation, commensalism or mutualism (Boucher *et al*, 1982)[8]. Of these, mutualism is the only cooperative interaction that fully benefits both species. Since we are going to argue about cooperative transactions based on reciprocity, in this paper, we will only focus on mutualistic relationships. For the purposes of theorizing, we will also assume that species or populations are identical to organizational industries (Astley, 1984).

Mutualism is a term applied to populations belonging to the same species (albeit with some differences among them); when the interacting populations belong to different species their relationship is called symbiotic, i.e. one in which two organisms live together in close association (Boucher *et al*, 1982). Mutualism and

[8] Mutualism can be defined as a +/+ interaction, while competition, predation and commensalism as –/–, –/+ and +/0 respectively (Boucher *et al*, 1982). Other scholars use slightly different specifications. For example, Aldrich and Ruef (2006) classify full (–/–) or partial competition (–/0), neutrality (0/0), predation (+/–), and mutualism (+/+) under commensalism and symbiosis (+/+) separately. Barnett and Carroll (1987) only distinguish between competition and mutualism. Finally, Pianka (1994) uses Boucher *et al*'s (1982) classification but adds amensalism (–, 0) and neutralism (0/0).

symbiosis are similar terms: the first refers to positive interdependence based on complementary differences, and the latter refers to positive interdependence based on supplementary similarities (Barnett and Carroll, 1987). Symbiotic and mutualistic relationships need not be obligate: the populations involved may have come together voluntarily ("facultative" mutualism) or accidentally (Boucher *et al*, 1982). This paper will specifically follow voluntary symbiotic relationships between two[9] organizational populations.

In biology, scientists have observed that cooperative relationships between two species have several positive effects on the interacting populations. Mutualism and symbiosis can help with a) nutrition, b) supply of energy, c) protection from predators, and d) transportation to safe areas where the two populations can proliferate without interference from malicious environmental conditions (Boucher *et al*, 1982). Throughout this paper, we consider a lot of these and other biological observations as analogies to the behaviors of organizational populations.

7.3.2. Organization-creating organizations

Although biology can provide us with various specifications of interdependent living organisms, we focus our attention on organizational populations from the management literature. An interesting empirical context for reciprocal transactions is the block of so called organization-creating organizations (OCOs) and their created organizations (Stinchcombe, 1965a; Romanelli, 1991). Stinchcombe conceptualized these entities as special cases of organizations that satisfy the following three conditions: They a) operate in a variable environment that fosters innovation and b) have the resources to create other organizations so long as c) some of these resources

[9] The symbiotic interaction of a single pair of species such as this is called monophily. When the exchanging partners are more than two and less than five, the symbiosis is characterized as oligophily. More than five partners constitute a polyphily.

are explicitly free from vested interests (Stinchcombe, 1965a: 34). OCOs resemble today's corporate entrepreneurship units where the core organization has diverted some of its resources to the formation of new business units that will satisfy new customers or markets. The facilitator of the parent corporation's strategy is the corporate entrepreneurship unit. Due to their interdependence, the corporate entrepreneurship unit and the new business units that it creates develop a symbiotic relationship similar to the one we described above.

From a legitimacy perspective, corporate entrepreneurship units could endanger the legitimacy of the core organization. Consider the extreme possibility of a car manufacturer diversifying its operations to incorporate food production. The danger lies at the potential illegitimacy of both the new entities: the corporate entrepreneurship unit that manufactures products it has no expertise in, and the food business unit that suffers from the classic liability of newness (Stinchcombe, 1965b). How could the two organizational forms acquire legitimacy in a market? To the extent that organization-creating organizations and their organizations form complex exchange systems of interacting populations, the properties of their reciprocal cooperative relationship can greatly predict their legitimization process.

To illuminate this process, we provide another example from the academic entrepreneurship literature (Shane, 2004a). Starting in the early 1990's, public universities across the western world were increasingly asked by governments to incorporate commercial activities to their traditional mission of teaching and research (Etzkowitz, 2003) in order to increase technology transfer to the local economy (Shane, 2004a). A lot of these universities diversified their structures to form spinoffs, independent companies based on university intellectual property. Spinoffs were managed by newly established Technology Transfer Offices (TTO). These

offices acted as intermediary institutions between universities and spinoffs and designed the entire university spinoff strategy. TTOs inherently suffered from a liability of newness (Stinchcombe, 1965a) in that they lacked critical marketing expertise that audiences would point at to avoid supporting universities in their spinoff efforts. Universities needed the support of financial and other audience members in order to demonstrate their legitimacy and adaptability to the new state requirements. At the same time, newly established spinoff ventures suffered from the same liability of newness that most novel organizations experience early in their life cycles (Rothaermel, Agung and Jiang, 2007; Shane, 2004a). Spinoffs were also criticized as risky, illegitimate university practices by a large body of people in the educational market (Bok, 2003; Etzkowitz, 2003). Observing TTOs and spinoffs at the population level, the question is "how could the two populations gain legitimacy and grow"?

A common practice among universities has been the donation of resources to new spinoffs within their capacity. For example, the academic entrepreneurship literature has described how spinoffs often utilize university space without financial costs, even after the incorporation of these entities as independent private firms. Because the inventors of spinoffs are university employees and universities often hold minority stakes in spinoffs, spinoffs save critical resources at the beginning of their lifecycles by receiving such gifts (Shane, 2004a). Further, spinoffs are often managed by former university employees (e.g. academic staff or inventors) who abandon their previous posts to take up managerial positions at the new ventures. Spinoffs therefore gain managerial expertise that could hardly be obtained by ordinary industry startups (Shane, 2004a). Spinoffs benefit from university endowments, for example, continuous support in terms of technology development

and networking that are critical for their legitimation and success (Delmar and Shane, 2006; Shane and Stuart, 2002). Further, a lot of these processes are not confounded to the individual spinoff level, but can be observed at the population level. For instance, joint spinoffs by more than one university draw resources and endowments from various educational institutions at the same time.

The relationship between universities and spinoffs in not a one-way exchange. Novel spinoff technologies have helped universities explore technology commercialization applications, as teams of inventors within universities often work on multiple projects, thus realizing economies of scale in the commercialization process (Shane, 2004a). Further, because universities lacked expertise in commercial business deals prior to engaging in spinoff formation, successful spinoffs have helped them acquire the necessary design, production and marketing knowledge to continue with these operations (Shane, 2004a). This often takes place even after a spinoff has gained its independence from the university. Historically, universities have also been seen as receiving intangible resources from spinoffs. For example, it has been argued that spinoffs enhance university status, and help it recruit better researchers, staff and students due to the appeal of its spinoff firms (Djokovic and Souitaris, 2008; Shane, 2004a).

A lot of the resources exchanged between spinoffs and universities have traditionally not been based on contractual agreements (Djokovic and Souitaris, 2008; Rothaermel *et al.*, 2007; Shane, 2004a). Instead, the behaviors of both parties are based on the understanding that giving freely to each other can be beneficial for both. This can be described as a symbiotic relationship as universities and spinoffs operate supplementary functions within the context of technology transfer (Boucher *et al*, 1982). Further, given the opposition against and the illegitimacy of spinoff activities

early in the field's history, it would be worth examining how spinoffs became taken for granted practices (Suchman, 1995). We believe that looking deeper into the properties of the reciprocal exchanges between universities and spinoffs as populations of organizations can help us understand the process of legitimation.

7.4. The community ecology literature

Organizational ecology draws from biology (Pianka, 1994) and Hawley's human ecology (Hawley, 1986) to examine ecological processes among organizations (Hannan and Freeman, 1997). Hawley conceptualized the ecological paradigm of human behavior and studied human beings not only as individual social actors within certain geographical boundaries, but collectively as populations of individuals within communities (Hawley, 1986). The pattern of interaction and the interdependence between communities within the larger ecosystem were seen as key determinants of human behavior in his theory. In the same way, organizational ecologists study the interaction and coevolution of organizations either as individual entities within populations (population ecology) or as populations within communities (community ecology), using organizational demographics as their tolls (Carroll, 1984; Carroll and Hannan, 2000; Hannan and Carroll, 1992; Hannan and Freeman, 1977).

Relative to population ecology, the attention of ecologists to the community level of analysis has been quite recent (Astley, 1985; Baum and Singh, 1994; Carroll, 1984). The shift has been the result of a recognition that population ecology focuses on established populations and emphasizes factors that homogenize individual organizational forms through inertia (Hannan and Freeman, 1977). Inertia is the chief organizational behavior that preserves population and form stability. In contrast, the promise of community ecology is to "overcome these limitations by focusing on the rise and fall of populations as basic units of evolutionary change, simultaneously

explaining homogeneity and heterogeneity among them" (Astley, 1985: 224). Community ecology has been described as the set of coevolving populations joined by ties of commensalism and symbiosis (Aldrich and Ruef, 2006); it is this dynamic coevolution that is responsible for the rise and fall of populations.

7.4.1 Community legitimacy

The main focus of community ecology has been to explain how populations emerge and fall, without delving deeper into the interceding process of community legitimation. In the classic definition, communities emerge through changes in a) norms and values, b) laws and regulations and c) technology. But these populations need legitimacy in order to acquire resources and prosper[10], otherwise they will disintegrate. The classic ecological definition sees the legitimization process of organizational populations as "supra-organizational" (Aldrich and Ruef, 2006) and is underdeveloped theoretically or empirically. This process is mainly assumed to depend on cross-population actions and laws and regulations that affect the entire community. Given these generalizations, our aim in this paper is to fill the "legitimacy" gap in communities by specifically emphasizing cross-population actions within communities. We propose that reciprocal transactions (exchanges) act as legitimation mechanisms among emerging, symbiotic organizational populations.

A second pillar in community ecologists' work has been the process of strategy formation by populations of organizations (cf. Barnett and Burgelman, 1996). In his seminal work, Astley (1984) contrasted the previous individual organization-environment management theories by proposing an alternative theory of business policy and strategy formulation based on interorganizational collectivities.

[10] Legitimacy is a generalized perception that the actions of an entity (or industry) are deemed appropriate within the values, beliefs and definitions of the surrounding social system (Suchman, 1995).

Management theorists had envisaged the individual organization-environment relationship as one that needs to be managed as to a) the exogenous environmental threats and opportunities, b) the organization's resource interdependence with outside stakeholders and c) competition within industrial arenas. In contrast, Astley (1984) and Astley and Fombrun (1983) drew from bioecology to suggest that organizational adaptations need not be constrained at the business unit or single corporation levels of analysis but that community-level strategizing is possible between different populations of organizations. They proposed that joint action in organizational collectivities can be based on direct/indirect symbiotic relationships among organizational populations (Boucher *et al*., 1982; McKelvey, 1982; Hawley, 1986).

Specifically, ecologists have proposed four core structures of coordination among populations: agglomeration, confederation, conjugation and organic (Astley and Fombrun, 1983). Each of these superstructural relationships indicates different resource flows and forms of control that take place among the participant populations. Astley and colleagues (Astley, 1984; Astley and Fombrun, 1983) placed particular emphasis on how professional associations, organizational leadership and network dynamics shape the coordination pattern among populations in the collectivity.

In the following paragraphs, we build on the antecedents of reciprocal legitimacy to extend the work of Astley and colleagues. In particular, we argue about the role of reciprocity in explaining trust among organizational populations (Blau, 1964). We also examine how trust and the exchange of tangible and intangible resources based on long-term reciprocal cooperative transactions can protect populations from competing populations, thus helping them grow harmoniously. We

call these combined effects the antecedents of the reciprocal legitimation process of organizational populations. Figure 7.1 represents the conceptual model of the study.

7.5. Social exchange theory and propositions

7.5.1 Reciprocal legitimacy defined

The definition of reciprocal legitimacy that we adopt here is one that directly focuses on the exchange pattern between illegitimate market participants. When two organizational populations emerge simultaneously amid information asymmetry and audience ambiguity, none has legitimacy in its own, but together both can. This conceptualization stems from the general norm of reciprocity as defined by Gouldner (1960). According to this, a) organizational populations should help those populations that have helped them and b) organizational populations should not compete with those that have helped them. The idea is not completely new to the management literature − as far as we are aware, there exists one study that treats legitimacy as a reciprocal concept. In his paper about legitimacy of brands among members of gay communities, Kates (2004) argues that: "Legitimacy is a reciprocal concept. While gay men confer legitimacy on Absolut [vodka], Absolut confers social legitimacy on gay men by sticking with the community through thick and thin. Powerful global brands, such as Absolut or Levi's are thought to bestow legitimacy and respectability on the gay community, moving it from its marginalized social position to a more central one" (p. 458). In this case, moral legitimacy is assessed by the extent to which brands truly benefit the gay community, so that illegitimate brands must be punished for their homophobic, religious-bound attitudes.

Situated within the community ecology literature, the proposed reciprocal legitimation theory is one that is based on collective rationality and collective organizational action. Instead of individual human beings or organizations, the unit of

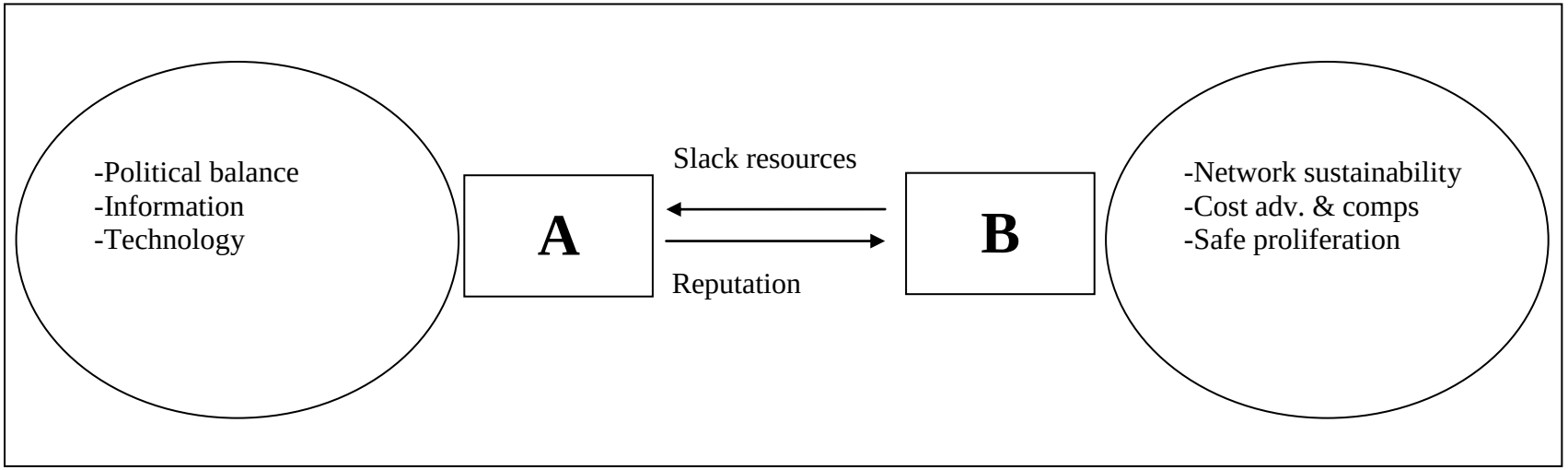

Figure 7.1: Conceptual model

analysis is the collectivity of organizations in a population. Specifically, we are interested in new populations that suffer from some sort of illegitimacy or liability of newness (Stinchcombe, 1965a). Such new populations typically designate all members of an organizational industrial classification. What the reciprocal legitimation process tries to answer is how these new industries gain legitimacy as a result of their symbiotic interdependence.

Reciprocal legitimacy is a self-reinforcing process of evolution. One organizational population confers legitimacy to another and vice versa, thus granting overall legitimacy to the entire community. In this sense, the reciprocal legitimacy process resembles the Red Queen hypothesis of population ecologists (Barnett and Hansen 1996; Derfus, Maggiti, Grimm and Smith, 2008). The Red Queen theory describes the self-reinforcing process of change and adaptation through constant learning: one organization's learning triggers competition, the competition in turn learns and new cycles of adaptation follow indefinitely. In this process, "it takes all the running one can do simply to keep in the same place" (Van Valen, 1973: 17[11]). The difference between reciprocal legitimacy and the Red Queen lies in the nature of the relationships and the level of analysis. The Red Queen describes changes based on competitive dynamics at the organizational level, while reciprocity describes changes based on mutualism and cooperation at the community level. In the Red Queen hypothesis, competition forces organizations to constantly learn and improve, otherwise they are selected out from the industry. In reciprocal legitimacy, symbiotic sets of organizations depend on their sequential cooperative actions to acquire legitimacy and resources.

[11] As quoted in Lewis Carroll's "Through the looking glass and what Alice found there" (1871)

7.5.2. Properties of exchange: slack resources and status

Scholars in the sociology of organizations, including community ecologists (e.g. Astley, 1983), have predominantly looked at contractual agreements that enhance legitimacy and performance. For example, network theorists argue that individual alliances with reputable partners enhance organizational legitimacy (Dacin, Oliver and Roy, 2007; Doz, 1996; Gulati, 1998) because organizations absorb some of the reputational capital of their partners. Others have argued that communities of organizations can strategize together based on agreements for collective action and industrial lobbying (Astley, 1984; Astley and Fombrun, 1983). Instead, recent scholars have shifted their attention away from contracts and towards cooperative dynamics among organizations. They have examined ideas such as the prisoner's dilemma on organizational cooperation (Dollinger, 1990) or the necessity to work with others, including competitors (Ingram and Roberts, 2000) due to regulatory or other environmental pressures (Oliver, 1992) in order to increase the legitimacy of the partners involved.

We believe that reciprocal transactions not based on contracts but on a firm belief in reciprocity can enhance the legitimacy of organizations just as any other cooperative transaction. This can happen through the exchange of a) slack resources and b) status by early-stage populations of organizations[12]. Organization theorists have argued that illegitimate or emerging individual organizations have limited resources to share with others due to lack of previous performance accounts (Stinchcombe, 1965b). Despite this, every organization has some stock of "slack" resources not being utilized at certain times in their lifecycle (Nohria and Gulati,

[12] The amount of goods or services donated need not be identical (Gouldner, 1960:164), although Malinowski (1985) calls for "fairly equivalent" transactions (55). Unequal transactions may depend on the intensity of the receiver's needs at the time of the donation (Gouldner, 1960:171).

1996). Slack resources can be either financial, human or social capital in excess of the minimum required to produce a given level of organizational output. We assume that most novel organizations have some slack that is unabsorbed, i.e. that is easy to recover when needed (Singh, 1986). Many entities in an emerging industry together have enough resources to share with members of another industry due to their sheer collective size. We argue that it is these slack resources they can donate to organizations in another industry at the time they need them.

The second property available for exchange in reciprocal transactions is status. Organization theorists argue that status is the outcome of outstanding past performance (Rindova, Pollock and Hayward, 2006; Rindova Williamson, Petkova and Sever, 2005). Due to lack of successful performance accounts early in the life cycle of an industry, organizations in that industry lack status as much as resources. We assume that, when one group of organizations enhances its status based on successful performance, the other will be able to utilize this incremental reputational stock to advance its own status. In a sequential manner, signals (Spence, 1973; Rindova *et al*, 2005) sent from industry A to its environment can be upheld by industry B's environment due to the symbiotic association between A and B. At the end of the spiraling process, both A and B will have enhanced their reputation significantly based on reciprocal acknowledgments of one another's contribution to their success. Like tangible resources, in social exchange theory, signals and reputational stock are intangible resources that can be donated from one community to another (Blau, 1964; Cropanzano and Mitchell, 2005; Gouldner, 1960).

The tangible and intangible gifts of slack resources and status are the best economic alternatives when contractual agreements are impossible. Organizational populations interact with many populations in a community; however, it is arguably

impossible to form agreements with all of them. Contractual alliances for the exchange of recourses can also be expensive: they carry obligations (Dacin *et al*, 2007) and can generate transaction costs for the parties involved (Williamson, 1975). Given these inefficiencies, relying on reciprocated gifts is the best immediate alternative that can guarantee some sort of reputational and resource advantages at a low cost. In our view, spiraling cooperative transactions based on these norms of reciprocity can therefore enhance the legitimacy of new industries by increasing their visibility to external audiences (due to better resources and reputation). Having defined the resources available for exchange, we now outline the antecedents and consequences of successful reciprocal transactions.

7.5.3 Antecedents of reciprocal exchanges

A critical condition for the success of dyadic reciprocal exchanges is the political balance between two partners (Gouldner, 1960; Oliver, 1992; Rosenkopf and Tushman, 1994). Community ecologists argue that imbalance generates niches for domination, therefore cancelling the possibility that symbiotic relationships will emerge (Aldrich and Ruef, 2006: 244). Dominance through power means that an industrial collectivity controls the flow of resources to another industry, thus expanding at the expense of the latter (Hawley, 1986). Gouldner (1960) argued that the stability of a dyadic relationship between A and B is contingent upon the relative power of the two participants in reciprocal exchanges: if B has the power to demand back the gift it has offered to A, he/she will do so to spare the risk of a delayed counter-donation (cf. Fehr and Gaechter, 1998). On the other hand, a firm belief by members of an industry in helping members of another industry acquire cheap resources when they most need them, solidifies the relationship between the two groups of organizations. According to Malinowski (1985), reciprocity is the antithesis

of exploitation and refers to the interlocking duties which people owe one another: people who depend on each other believe that, in the long-run, the mutual exchange of goods and services will balance out in favor of both. As described in the previous sections, balance in the exchange system between A and B cannot be guaranteed through power, but only by a respectful delivery of tangible or reputational resources back to the initial donor. We propose:

Proposition 1: The lower the political imbalance between two organizational populations, the higher the quality of reciprocal exchanges in the entire organizational community.

Further, Hawley argues that the expansion and development of an ecological system depends on the technological capacity for communication and transportation possessed by its populations (1986:7). Specifically, the interdependence of human populations pushes them to adapt simultaneously. This adaptation is mediated by new information flaws into the system. The new information increases the capacity for the movement of material resources, thus reshaping the populations themselves. Information gathering in reciprocal exchanges is particularly important to also monitor the effectiveness of the exchange system (Gouldner, 1960). Ecologists have previously described the importance of information in designing arrangements between organizational populations based on equality. The need to analyze information in organizational settings is perhaps higher than among human beings, because organizations are complex entities with multiple members and functions that need to be managed effectively (Hannan and Freeman, 1977).

One of the reasons why transactions need to be monitored is to assess the presence of defectors or free-riders: any interorganizational collectivity where

defectors cannot be identified is less likely to produce sustainable norms of reciprocity among its organizations (Gouldner, 1960). In line with this argument, evolutionary theorists have emphasized the role of information in the coevolution of industries (Lewin and Volbeerda, 1999). Gathering feedback from the entire system is a key characteristic that can help reinvent managerial practices within the populations (Baum and Singh, 1994; Lewin and Volberda, 1999). Analyzing feedback on how resources are shared by more than one populations in a community is further crucial for the divisionalization of labor during reciprocal transactions (Stinchcombe, 1990: 113). Dividing job tasks and responsibilities when exchanging gifts from one industry to another is key to securing that resources are not spared unnecessarily and that exchanges are made efficiently. To summarize, the stability of the relationship between coevolving industries is largely dependent on the richness of information they collect during the exchange. We therefore propose:

Proposition 2: The richer the information (feedback) flows between two organizational populations, the higher the quality of reciprocal exchanges in the entire organizational community.

A second element in Hawley's (1986) human ecological paradigm is the role of the means of transportation available to human populations. Drawing an analogy to Hawley's theory, we argue that the same transportational needs are present between cooperating industries. The utilization of industry structures to deliver gifts owed to another industry is crucial for the stability of the community. In particular, it is necessary that existing slack resources are delivered at the right time, to the right recipient and at the right speed (Gouldner, 1960; Hawley, 1986; Malinowski, 1985). If the delivery of goods and services in this manner fails to materialize, the sequence

of reciprocal donations is also destabilized, thus failing to assist populations in their resource acquisition efforts.

Other ecologists such as Astley (1985) have focused on the role of technological capabilities in inter-organizational evolution. They have argued that interdependencies between technologies of different populations can fuse those populations together; for two industries to come together there needs to be a certain degree of agreement between the technologies they use, otherwise cooperation is hard to achieve (McKelvey, 1982). Astley (1985) argues that, consequently, "only those populations that are able to share technologies can function as constituent members of higher level communities and survive"; if they do not share similar technologies, there is little room for synergies and cooperation. Rao (2006) and Aldrich and Ruef (2006) have argued that technology is a core feature that facilitates various links between organizational populations. We assume that the exchange of resources and status between populations in reciprocal dyads is heavily dependent upon the available technologies of the new populations. Sophisticated technologies can also be used for the physical transportation of goods and services from one population to another. We propose:

Proposition 3: The higher the sophistication of technology and transportation between two organizational populations, the higher the quality of reciprocal exchanges in the entire organizational community.

7.5.4 Outcomes of reciprocal exchanges

As we briefly discussed earlier, community ecologists have focused on collective strategizing as one of the core outcomes of legitimate populations' actions. Collective strategizing is carried out through the actions taken by industry or field

associations collectively. Both organizational populations in a dyad coordinate their efforts for the mutual benefit of their members. Astley and Fombrun (1983) conceptualized this kind of strategy as "community adaptation" and divided it into commensalistic and symbiotic. In both commensalistic and symbiotic strategies, community adaptation is guaranteed through cooperation and exchanges that are based on interdependence. Yet, collective strategizing as described by Astley and Fombrun (1983) is the outcome of deliberate, targeted, contract-based population actions. The question is what other immediate benefits can cohabiting populations secure through their reciprocal, free of charge donations within a community?

The first benefit that we have argued about throughout this paper is resources as gifts. Bioecologists argue that symbiotic relationships help partners acquire nutrition in several ways, for example, by facilitating the digestion of goods or by supplying each other with critical nutrients (Boucher *et al*, 1982). The analogy between biology and organizations is obvious. The second core benefit from reciprocal transactions is the sustainability of the network between populations. We conceptualize the duration of the network connections as the equivalent of energy provision among biological species (Boucher *et al*, 1982; Pianka, 1994). The formation and maintenance of strong reciprocal links between two populations is important because it can guarantee continuous supply of resources from one to the other. Organizational theorists have routinely studied these kinds of links using network theories (Baker and Faulkner, 2006; Granovetter, 1985). Networks focus predominantly on contractual agreements and alliances between organizations (Gualti, 1998). They are therefore bound to end at some point in time, eventually ending the effects of networking on the participants. In contrast, we believe that reciprocal transactions based on a commitment to sharing slack resources and

reputation between industries can be potentially endless. In the particular example of academic spinoffs, it has been documented that both universities and spinoffs begin donating to each other early in their industries' life cycles; they continue to do so even *after* spinoffs are completely independent companies, residing outside the university.

To be fair, just as network theorists, community ecologists have often conceived of collective strategies as joint agreements for lobbying based on contracts and designated industrial leadership (Astley and Fombrun, 1983). However, they have found that contractual interconnections increase disturbance among populations and reduce the capacity of the community to adapt to its environment. In contrast to this, social exchange theory suggests that reciprocal actions promote the development of trust in social relationships, because reciprocity allows the demonstration of trust and intentions through gifts (Blau, 1964). We believe that the imprinting effect of reciprocity among early industry members can foster great networking patterns with other industry members in the future. Over time, reciprocity can become institutionalized, as actors can develop common behavioral patterns and routines that harmonize these behaviors. In the long-run, the self-reinforcing process of giving in sequential transactions can be an indication of the duration and sustainability of the exchanges within the community (Molm *et al*, 2007). These exchanges can guarantee critical tangible and intangible resource supply far in the future, unlike temporary strategic alliances. We propose:

Proposition 4: Reciprocal exchanges between organizational populations increase the sustainability of the network between them, thus securing the continuous future exchange of resources within the community.

Biologists argue that symbiotic relationships at the community level can help populations protect each other from predators (Boucher *et al*, 1982; Pianka, 1994). One of the ways this happens is through the provision of housing by one partner to another. In the example of academic entrepreneurship, the provision of office space by Technology Transfer Offices to newly established spinoff firms is a standard practice. To discover analogies between protection from predators in biology and those in organizational settings, we need consider the competitors of universities (e.g. science parks) and spinoffs (e.g. other startup companies) within a country. Exchanges based on reciprocity can protect both universities and spinoffs from these competitors due to price advantages. First, because exchanges based on sharing are cheap and are not based on contracts, they do not incur transaction costs to the parties involved (Williamson, 1975). Second, because they are acquired for free, the receiving partner can develop further production- or cost-advantages relative to competitors. Third, utilizing slack resources in a reciprocal exchange network maintains low costs even for the donor. For example, research has shown that spending slack resources on organizational projects to enhance innovation is not always fruitful, thus wasting slack resources that could be donated to a partner. It has also been argued that preserving idle slack resources may increase relaxation of discipline within organizations (Nohria and Gulati, 1996).

By utilizing shared communication, transportation and technological links early in their lifecycles, industries can develop another valuable advantage: common competencies. Competencies are necessary for their constant adaptation to the environment and to competitors' moves. In the organizational ecology literature, these kinds of competencies are often termed "comps" (McKelvey, 1982). Comps are the dominant competencies that distinguish organizational species and are formulated

through incremental organizational changes over time[13]. Comps play the same role as genes do in human beings: they possess and transmit the managerial and technical know-how from one generation to the other (McKelvey, 1982; Pianka, 1994), thus ensuring continuity and specialization among populations in a community. As we argued above, common comps between two industries are cheaper and quicker to acquire when exchanges between these industries are based on gifts than on contracts. Comps are usually inherently inimitable or costly to copy – competing populations can only reproduce high quality tacit knowledge through similar long-standing networks or better technologies. We believe that reciprocal transactions can therefore protect industrial collectivities from their competition by providing them with a relative competitive advantage based on both cost benefits and unique competencies developed within a community system (Boucher *et al*, 1982; Gouldner, 1960; McKelvey, 1982; Pianka, 1994). We propose:

Proposition 5: Reciprocal exchanges between organizational populations develop cost advantages and inimitable comps that help the entire community protect its members from competitors.

In biology, a corollary of protection from predators is the species' proliferation in environmental safety. Safe locations are critical for the survival of animal populations because residing in safe areas helps them reproduce without interference. This kind of rapid proliferation is known as "escalation" (Vermeij, 1994). Escalation is based on the assumption that predators are unable to reverse the proliferation process due to their unfavorable location relative to the prey. Parallel processes can take place in organizational settings. Specifically, reproducing in safe

[13] Janzen (1980) and Pianka (1984: 329) argue that the coevolution of populations starts by evolutionary changes in the traits of a population in response to trait changes of a second population.

environments is something that organizational populations can easily do if they hold advantages against competing populations. A consequence of having weak competitors is the ability of a population to increase its size by adding new members that wish to exploit these advantages (cf. Bresser and Harl, 1986). Because the community has acquired these advantages through reciprocal donations among its member populations when they most need them, the populations can somehow control the introduction of new members into them. Obviously, a key prerequisite for joining an industry such as this would be the commitment of newcomers to the existing ideology of reciprocity (Cropanzano and Mitchell, 2005; Gouldner, 1960). In the case of academic entrepreneurship, ties between spinoffs and Technology Transfer Offices would prohibit the admittance of new spinoffs or TTOs to their respective populations, unless they had embraced reciprocity as a standard behavioral pattern.

The control of a population's increasing size is crucial for another reason. Population ecologists argue that high density in an industry makes the resources more and more scarce, thus increasing competitive pressures from within (Hannan and Freeman, 1977; Carroll and Hannan, 1989). Controlling density to a certain degree could therefore limit frictions among individual organizations and preserve cooperative ideologies of practice. In general, if populations can increase their size at a controlled rate, the utilization of resources within the capacity of the larger community can achieve its highest quality (Hawley, 1986).

Given the impact of residing in safe areas (weak competition) in controlling population density, the question is how can the escalation process stop? Biologists argue that the rapid proliferation of populations in safe nests can only be stopped by external, uncontrollable environmental shocks (Vermeij, 1994). In organization

studies, external shocks can be critical events such as radical technological discontinuities (Anderson and Tushman, 1990), unexpected government legislation (Aldrich and Ruef, 2006) or natural disasters. The existence of such destabilizing shocks in the literature serves as another proof of why stability in the relationship among populations is necessary, thus reinforcing the argument in favor of strong reciprocal bonds. We propose:

Proposition 6: Reciprocal exchanges between organizational populations can help the entire community proliferate safely and at a controlled rate.

7.5.5. Reciprocal legitimacy at work

One of the negative aspects of symbiosis through reciprocal donations in pairs of organizational populations is the fact that overreliance on each other eventually risks transforming the entire community into a closed system. Astley (1985: 235) warned that too much interdependence based on exchange of resources makes populations shut themselves off from outside influences. An easy way to overcome this disadvantage is for the populations to begin exchanging resources with their environment. In this paper, we do not deny the potentially negative effects of too much interdependence between populations due to reciprocity (Gouldner, 1960). We emphasize the fact that early exchanges between illegitimate populations solidify their mutual networking and produce competitive advantages and controlled population growth that ultimately help the community gain legitimacy in its entirety. Further, because legitimacy is associated with resource acquisition (Deephouse and Suchman, 2008; Suchman, 1995), the exchange of resources between the community and its external environment is dependent on how the environment assesses the legitimacy of the populations involved.

Organizational ecology and institutional theorists (Meyer and Rowan, 1977; DiMaggio and Powell, 1983) argue that environments form opinions about what is acceptable organizational behavior based on several criteria. Two of these are signals of performance (Rao, 1994; Rindova *et al*, 2005) and increased population density (Hannan and Freeman, 1977). High cost advantages and inimitable comps developed in cheap reciprocal transactions certainly help populations increase their performance (Barney, 1991). As we argued, they also help populations attract new organizations thus increasing their density at a controlled rate (Hawley, 1986). Combined, signals and density increase the visibility of the two emerging population to their environment. As a consequence, information on the usefulness and appropriateness of the two industries also increases, helping convey a sense of respectability and legitimacy of the entire community to the outside environment (Hannan and Freeman, 1977; Meyer and Rowan, 1977; Spence, 1973). At this stage, the environment may start supplying the community with further resources, thus kick-starting a process of community-environment exchanges. The norms of reciprocity therefore do not constrain organizational populations to their mutual interdependence (Atley, 1985). Instead, they help them acquire legitimacy and, as a consequence, resources from their environments, thus cancelling the possibility that they remain isolated. We propose:

Proposition 7: Sustainable networks, cost advantages, inimitable combs and safe proliferation resulting from reciprocal exchanges within a community increase the size and visibility of its populations to the external environment, thus generating legitimacy to the community.

7.7 Discussion

Drawing analogies between biology and management studies, this paper has proposed a new theory of organizational "reciprocal legitimacy" at the community level of analysis. First, we have argued about the resources that can be exchanged between pairs of early-stage, illegitimate organizational populations: slack resources and status. The quality of these exchanges is moderated (antecedents) by the political balance between the two populations, the information that is being transmitted in relation to these exchanges and the technology available for them. Successful reciprocal transactions may lead to three types of advantages for participating populations: network sustainability, cost advantages and comps, controlled density. These processes enhance the size and visibility of the entire community to its external environment, thus granting legitimacy to the populations.

The idea proposed here is testable to the extent that data collection limitations can be overcome. As for most ecological studies, techniques and methods of analysis have been proposed by leading scholars in the field such as Carroll and Hannan (2000). To examine how resources are exchanged through gifts, one may look into young industries or federations of organizations (D'Aunno and Zuckerman, 1987; Provan, 1983; 1984) where these can be common. To examine the consequences of reciprocal transactions, one would have to compare the evolution of two pairs of industries, perhaps one that is regulated by contractual agreements and another that is not. The three proposed consequences of community legitimacy can be treated as dependent variables in regression analyses.

Developing a reciprocal legitimation theory is important for many reasons. First, population ecology and institutional theories have both been criticized for neglecting to explain how legitimacy is practically generated in a population.

Criticism of population ecology has focused on the use of organizational density as a measure of population legitimacy in itself (Young, 1988; Zucker, 1989), without delving deeper into the process of legitimacy generation at higher levels of abstraction (Astley, 1985). Criticism of institutional theory has focused on the fact that legitimacy is the outcome of a process, and using that process to explain its emergence is a tautological fallacy (Greenwood, Oliver, Sahlin, Suddaby, 2008:18; Deephouse and Suchman, 2008). And despite DiMaggio and Powell's (1983) introduction of the construct of "organizational fields", institutional theorists have focused almost exclusively on explaining individual organizations' legitimacy, not fields or communities.

Second, as Astley (1985:533) has pointed out, organizational theorists need to relax from the "obsessions of competitive survival" and "predatory practices". Recent scholars in the organization studies and strategy literature have looked once again at competitive models such as the Red Queen hypothesis (Van Valen, 1973) or game theory (Dollinger, 1990) to provide explanations for industry-based legitimation and evolution. Unlike these studies, our work on reciprocal legitimacy emphasizes the relational character of organizational populations through cooperation and mutualism in social exchanges (Blau, 1964; Cropanzano and Mitchell, 2005). We therefore contribute to the legitimacy debate by proposing a conceptually rich theoretical perspective based on organizational cooperation, rather than competition. We specifically examine the antecedents and consequences of reciprocal exchanges between populations at the community level of analysis (Astley, 1985; Astley and Fombrun, 1983). We conceive interorganizational relationships as cooperative, not competitive and as based on the belief of reciprocity through donations, rather than contracts and formal agreements (Gouldner, 1960).

Reciprocal exchanges are important for the legitimation and growth of organizational populations, when the latter are co-emerging and suffering from a liability of newness. Theoretically, this is crucial because organization scholars have emphasized the emergence of one population at a time, neglecting the effects of symbiotic interdependences on the emergence and legitimation of entire communities (Romanelli, 1991). Similarly, coevolution theorists have dealt with populations that are already in some "developed" stage in their life cycles (Aldrich and Ruef, 2006) and lack of legitimacy is not core to these theoretical explanations. In fact, community ecologists have emphasized the importance of collective strategizing in established communities as an outcome of legitimacy, without examining how legitimacy is actually acquired by a population (Astley, 1985).

Our work is different from networks and strategic alliances is many respects. Networks of organizations predominantly refer to the structural equivalence and colocation of individual organizational members in the network (e.g. Wiewel and Hunter, 1985). Instead, reciprocal transactions are based on the nature (e.g. resources, sequence) of exchanges, not on location or functional complementarity (Scott, 2006). Unlike cheap reciprocal transactions, strategic alliances (Gulati, 1998) are ex-ante agreements of limited duration aiming at increasing organizational performance and can incur severe transaction costs[14] to their participants (Williamson, 1975). Finally, alliances are unable to capture the dynamics of entire organizational populations and have thus been operationalized between individual organizations, despite recent efforts by community ecologists towards that direction (Astley, 1985).

[14] Transaction costs refer to monetary or other resources (e.g. time) that are needed to enforce or monitor carrying out agreed transactions. In this paper, we do not argue that reciprocal exchanges are transaction cost-free, in fact, we argued about the importance in information to study these exchanges.

8. CONCLUSION

University spinoffs have grown in numbers and size over the past two decades. This study has dealt with three relevant research questions. The first had to do with why they spread so quickly; the second with their potential benefits on universities, and the third with the coevolution of spinoffs and universities within the wider academic entrepreneurship community. The research questions were framed to fill specific gaps in the spinoff literature, as leading authors in the field have previously called (Djokovic and Souitaris, 2008; Shane, 2004a). I approached these questions using theories from the economic sociology and the sociology of organizations literature, specifically, institutional, ecological and evolutionary perspectives (Aldrich and Ruef, 2006; Astley, 1985; DiMaggio and Powell, 1983; Hannan and Freeman, 1977; Meyer and Rowan, 1977). The results of the study largely supported the hypotheses that were crafted based on a careful qualitative and quantitative research design. I have presented in detail the phenomenological, theoretical and managerial implications of the two empirical projects and the one conceptual in separate chapters. I have also proposed specific directions for future research throughout chapters 5-7.

Overall, the results of the study highlight the importance of environmental, institutional factors in shaping the education market. While this is in accordance with prior research on public organizations and universities (Scott, 1981; Tolbert, 1985; Tolbert and Zucker, 1983; Zajac and Kraatz, 1993), the implications of the study's findings are far reaching. In particular, they demonstrate the expanding role of social construction mechanisms such as media and fashion mechanisms in educational institutions' decision making processes. Chapter 5 argued about the role of these forces in pressuring universities to engage in spinoff activities, despite the lack of

resources, incentives and managerial commitment within these organizations. The project linked these processes with low levels of intervention from governmental and other public agencies with regards to the monitoring and regulation of public education markets. One important corollary of this observation had to do with how public organizations can "decouple" formal structures from substance. Specifically, low level government intervention was associated with decoupling by providing public universities with the opportunity to "deceive" the authorities in spite of pressures for compliance to state demands for restructuring. Yet, the results reiterated the importance of institutional compliance among public organizations in their decision-making models, as legitimacy in times of environmental turbulence forced institutions towards isomorphic, mimetic behavioral patterns. These findings have clear managerial implications as to how public entities should be regulated.

Chapter 6 provided similar findings with regards to how public organizations are rewarded within the UK's nation innovation policy framework. Unlike previous assumptions among researchers, the study's novelty lies in its ability to uncovered non-efficiency explanations of public management initiatives (Lockett and Wright, 2005; Shane, 2004a), including the role of social construction mechanisms in rewarding public institutions for their actions. It also highlighted the importance of the gradual legitimation of university actions before the latter can acquire resources from private and public financial providers. The results have direct implications as to how school managers should manage the legitimacy of their organizations within their changing environments. For example, it has been shown that media coverage is a significant tool that universities can exploit in their favor.

The robustness and reliability of the study were tested in multiple cases. Several alternative explanations were proposed, for example, by conducting

robustness checks using different dependent variables. A multitude of control variables were also introduced in the empirical models to increase the explanatory power of the results beyond the predicted assumptions of the core independent variables. This study used longitudinal, panel data on the entire population of UK universities and spinoffs over a period of 15 years. For this, I spent extensive amount of time and effort in trying to ensure the reliability of the measurements used in both empirical studies. Consequently, I was able to uncover the precise trajectory of spinoff diffusion and the appropriation of resources by universities better than other empirical research designs in the academic entrepreneurship literature.

While I have examined limitations and directions for future research earlier, I wish to outline here some of the projects I have already started working on in relation to this body of work. One of the findings in ch. 5 was the role of association membership (UNICO) in the universities' spinoff formation efforts. The chapter argued about the role of the association in legitimizing spinoffs as appropriate university functions, as well as in setting norms and best practice among educational institutions. The data used for this project revealed significant variance in the timing that universities joined the association. My next immediate concern is therefore to assess the reasons for this variability. How do universities differ in their search for legitimacy? Are prior reputation and performance levels good predictors of their behavior relative to industry norms and associations? The legitimating role of professional associations has been examined in the organization studies literature on several occasions (e.g. Casile and Davis-Blake, 2002; D'Aunno and Zuckerman, 1987; Greenwood Suddaby and Hinings, 2002; Swan and Newell, 1995).

The second future study will deal with the population density effects of spinoff generation on their death rates. The population data I obtained on spinoffs

may be pointing to the role of resource constrains in the spinoff industry's growth, as is evidenced in the collapse of births and the increased mortality post-2001 (Hannan and Freeman, 1977). In ch. 5, I demonstrated the role of environmental factors in predicting the evolution of the industry over time, yet the availability of the data are ideal for the exploration of pure population ecology effects.

Finally, an important note on the implications of ch. 7 for theory and future research. The novelty of this study is embedded in the combined operationalization of biological and social exchange (reciprocity norms) constructs for the study of evolutionary processes. Interestingly, these processes were further examined at the population ecology level. My literature review on community ecology and organizational evolution indicate that very few theoretical formulations in the current literature are testable in empirical settings. Acclaimed authors in the fields have argued convincingly in favor of this observation (e.g. Astley, 1985; Carroll, 1984; Freeman and Audia, 2006). I believe that the context of academic entrepreneurship from which I drew inspiration is exceptionally unique in its availability for the empirical examination of reciprocal legitimation processes that ch.7 proposed. In particular, the database that was used elsewhere in this study has the breadth to carry out measurements and analyses at the community ecology level, using the populations of spinoffs and universities as the exchange parties in reciprocal transactions. But more data would certainly be required for this objective.

9. REFERENCES

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10. APPENDICES

Appendix 10.1: Institutional and diffusion theory literature review

Journal papers				
No	**Authors**	**Theoretical model and variables**	**Data, findings and contributions**	**Method and sample**
1	Abrahamson, 1991	Four theoretical perspective are examined: 1. Efficient-choice 2. Fad 3. Fashion 4. Forced-selection When and how are technically inefficient innovations adopted and when and how are technically efficient innovations rejected?	Defines perspectives based on power, networks, politics, mimicry and performance level of firms. Processes outside and inside the organization are examined. Effectively looks at efficiency vs. fads in adoption of innovations.	Conceptual paper
2	Abrahamson and Rosenkopf, 1993	Proposes a mathematical model of bandwagons to determine: 1. whether a bandwagon will occur 2. how many organizations jump on it 3. how many retain the innovation it diffuses	Data are based on "collectivities" and the idea of ambiguity in the usefulness of the innovation.	Testing a bandwagon model
3	Ahmadjian and Robinson, 2001	Spread of downsizing as a practice: Resistant organizations are old, large, domestically owned, with high reputation and high human capital. As more organizations downsized thought, individual choices became less influential and, in a bandwagon process, resistant organizations imitated the majority that had adopted downsizing as a practice.	Demonstrates the safety-in-numbers effect in adoption studies. Examines the interaction between social and economic effects over time.	Defines downsizing as laying off 5% or more of a firm's labour. Event history analysis

4	Attewell, 1992	Adoption depends on a sequence of variables related to learning e.g.: Computer bureaus, manufacturers' knowledge, consultants influence, troubleshooting expertise, dynamics within the user firm (e.g. centralization etc) etc.	Contrary to dominant diffusion models of information flaws (media) and influence, the paper focuses on the role of know-how and organizational learning for the adoption of innovations. Offers critique of current diffusion theory and proposes alternatives (in literature review)	Case studies and interviews
5	Bothner, 2003	Adoption of 6th generation processor depends on: 1) Competition, but in relation to... 2) Size in a dynamic way, i.e. certain companies will adopt quicker or slower depending on their size as other competitors adopt the innovation.	Provides a dynamic model with regards to competition and size of adopting firms.	Event history analysis based on a Log-normal model
6	Burns and Wholey, 1993	Information processing theory and diffusion 1. Org. diversity and scale 2. Org. size 3. Org. slack resources Inter-organizational networks and diffusion: 1. Network embeddedness (centre-periphery) 2. Org. visibility and prestige 3. Prior transmission of information on adoption via professional media 4. Cumulative prior adoption (within region) Previous studies have assumed diffusion via: 1. Rational choice to solve problems 2. Mimicry (fads) 3. Media influences 4. Normative pressures (local networks)	Investigates the impact of organizational and network factors on the adoption and abandonment of matrix management in a panel of organizations over a 17-year period. Another key question is: Is programme adoption and abandonment processes symmetrical or based on different factors?	Logistic regression
7	Burt, 1987	Social contagion: 1. Cohesion (communication through media,	Early theorizing and operationalization of those two central concepts in diffusion.	MLE regression

		physical proximity between ego and alter) 2. Structural equivalence (competition between ego and alter)		
8	Chang *et al*, 2006	Firm innovation spreads with: -Institutional infrastructure of a country -Affiliations (networks) within the countries' infrastructure -Profitability of other affiliates in same group	Dynamic model where groups across countries are compared. Weak and strong infrastructure are also mixed with those groups to explain contagion.	Zero-inflated Poisson and Zero-inflated negative binomial regression
9	Clark, 1968	Institutionalization of innovations in Higher Education: 1) Organic growth model (development of professional activities formation of new institutions, definition of status associated with innovation) 2) Differentiation model (based on institutionalized patterns within universities) 3) Diffusion model (knowledge, information collection, evaluation, trial, adoption) 4) Combined-process model (institutionalization occurs externally and internally)	The essential dynamic element is the growth in complexity, systematization and strength of the basic ideas on which the innovation is founded. Results are generalizable to government, military, and other forms of organizations.	Conceptual paper
10	Clark and Soulsby, 1999	Spread of MDF in the Czech Republic: 1. Survival not growth is the aim (motives) 2. Individual behaviours important (politics)	Examines the economic, political and institutional factors that affect the adoption of the MD form in a post-communist, rather than western capitalist society.	Case studies, interviews
11	Cole, 1985	Spread of small-group activities based on: 1. Incentives to national labour markets for innovation (politics) 2. Establishment of well-funded organizations to communicate and support change (ideology) 3. Disposition of organized labour towards these changes and its ability to enforce its preferences.	*Unit of analysis*: Entire industries within national political communities Level of analysis: Cross-national Contributions: 1) impact of power on org. forms (macro-politics as opposed to micro-politics) and 2) impact of environment on org. change	Case studies, interviews

12	Colyvas, 2002	Diffusion of university inventions to the market: 1) Role of intellectual property rights in bringing inventions to practice 2) Role of university TTOs	Contributes by applying institutional/diffusion theory to the specific context of academic entrepreneurship.	Case studies, interviews
13	Conell and Cohn, 1995	General propositions: 1. Firms often fail to respond to changes in their environment due to lack of awareness/ information (consciousness) 2. Significant events serve to bring environmental changes to the attention of management 3. Firms respond to limited information by imitating other successful firms	Hypotheses tested: H1: Strikes stimulate other strikes by raising consciousness, and setting "starting dates" H2: Successful strikes produce more imitation than failed strikes H3: Unionization stimulates other strikes	Event history analysis
14	Cool *et al*, 1997	Research question is: -How do supply and demand factors affect the rate of diffusion of an innovation within an organization?	Examines how the intra-organizational adoption of an innovation in individual organizations affects the overall diffusion of that innovation among all organizations.	Defines a "critical mass" of 25% in order to locate the point of adoption.
15	D'Aunno *et al*, 1991	The role of external audiences in legitimacy: Conflicting requirements and pressures from various environmental actors lead to conflicting actions from organizations that change. Organizations try to offer value to the most important forces in their environments, leaving less important ones with limited information or resources.	Choosing which environmental demands (elements) to respond to is crucial in organizational survival. Accordingly, organizations are likely to adopt practices that are mostly aligned with influential social actors.	Probit regression
16	Davis, 1991	Hypotheses on what affects diffusion: 1. Ownership structure of the firm (including interlock network of Boards) 2. Previous existence will prevent further diffusion 3. Interlocks with other firms (contagion) 4. Prevalence in an industry	Control variables: 1. Size and previous performance of firm 2. Whether they have adopted other take-over defence mechanisms (can be positive or negative impact, so dummy variable) 3. Whether they are institution-owned 4. Location of incorporation (US state)	Cox event-history analysis

17	Davis and Greve, 1997	"Spatial heterogeneity" model of adoption: Four vectors: 1. Intrinsic rate of adoption 2. Susceptibility to influences by others 3. Infectiousness of previous adopters 4. Social proximity to previous adopters	Changes in corporate governance practices can be analysed by linking the adaptations of individual firms to the structures of the networks in which firms' decision makers are embedded.	MLE regressions
18	Fiss and Zajac, 2004	Old views: 1. Competition market pressures 2. Product market pressures New views: 1. Diversity of shareholders' views 2. Diversity of managers' views 3. Symbolic management of shareholders (language and appearance)	Owners' (banks, families, political parties) and managers' (education, age) power affect diffusion and implementation of the innovation. The authors propose that adoption and non-adoption are not sufficient tests; we also need to assess implementation after adoption to check for decoupling.	Pooled cross-sectional regression and negative binomial regression
19	Fliegstein, 1985	The ability of key actors to alter structure under three circumstances: 1. When the firm has a product-related or – unrelated strategy 2. When corporate presidents have a background in sales or finance 3. When other firms in the industry alter their structures	Briefly examines five major theories to assess spread of the MD form: a) Strategy-structure; b) Transaction costs; c) Population ecology; d) Control theory-power; e) Institutional theory. Examines diversification strategies (related/ unrelated) and why they spread.	Binary logit regression
20	Galaskiewicz and Burt, 1991	Two contagion models: Cohesion vs. Structural equivalence	Describes corporate contributions officers' evaluations of non-profit organizations seeking philanthropic donations	Standard network autocorrelation models
21	Green, 2004	Diffusion of managerial practices: 1. The discursive justifications used to rationalize it. When such justifications are accepted and taken for granted, the practice reaches a state of	Examines the impact of pathos, ethos and logos justifications in managerial discourse on the adoption of innovations Rhetorical theories used to explain diffusion are a) discourse analysis and	Conceptual paper

		institutionalization. 2. Changes in justifications and diffusion provide a basis for explaining institutionalization as both a process and a state.	b) social construction.	
22	Greve, 1995	Org. change may occur due to: 1. Problem solving (Cyert &March, 1963) 2. Learning (Burgelman, 1994) 3. Conflict (Ocasio, 1994) 4. Regeneration (Starbuck & Hedberg, 1977) 5. Contagion (Burns & Wholey, 1983) The authors examine: Contagion = sensemaking of managers Competition = resource scarcity	Defines as key determinants: size of the organization, intensity of competition, corporate and market contacts (networking) with other organizations	Event history analysis: heterogeneous diffusion model as described by Tuma & Hannan (1984)
23	Greve, 1996	Hypotheses/model on diffusion: 1. Mimicry of other industry organizations 2. Change of ownership 3. Possession of knowledge	-Herd behaviour theory (rationality within mimicry) -Properties to define org. forms -Great literature review on diffusion	Event-history analysis: heterogeneous diffusion model as described by Tuma & Hannan (1984)
24	Guler *et al*, 2002	Diffusion of ISO 9000 certificates: Social network theory using location in different countries to assess adoption of ISO through: -cohesion and -structural equivalence.	Key findings: 1) States and foreign multinational firms are key actors responsible for coercive isomorphism. 2) Cohesive trade relationships between countries generate coercive and normative effects. 3) Role-equivalent trade relationships result in learning-based and competitive imitation.	Negative binomial regression
25	Haveman and Rao, 2007	Diffusion of a practice depends on: -Social movements and -Political movements	The main contribution lies in uncovering the influence of social movements in the institutionalization of org. forms	Cox event history
26	Hedström, 1994	Mathematical model predicting the actors' choices to join a movement based on: 1. Individual factors to join	Contagion through networks or cohesion	Logistic regression

		2. Other actors actually joining the movement (contagion) based on the two actors' proximity		
27	Henisz and Delios, 2001	Decision on firms' location depends on: -Same business group's firms decision to locate there (mimicry) -Low level of political hazards in the location These effects are moderated by how much experience a focal firm has in a particular country/location	The use of prior experience as a moderator of the decision-making process is seen as crucial, given the market and political uncertainty.	Discrete-time logit regression
28	Holden, 1986	Mathematical model estimating: -Previous successful hijacking attempts -Previous unsuccessful hijacking attempts -Reported hijacking attempts -Reported unsuccessful hijacking attempts	The authors' estimates translate to: -Location of hijackings -Type of prior hijackings -Outcome of previous hijackings -Media coverage of previous hijackings	Discrete-time linear excitation model proposed by Hawkes (1971)
29	Kalev *et al*, 2008	Diffusion based on: 1. The role of the state (state autonomy) 2. Efficiency 3. Labour control 4. Professionalisation 5. Discourse	Brings insights from political sociology and framing theories to organizational studies research.	Quantitative and qualitative analysis
30	Kimberley and Evanisko, 1981	The following are positive on adoption: 1. Leadership a) tenure, b) cosmopolitanism and c) education 2. Organizational a) centralization, b) specialization, c) size, d) functional differentiation, e) external integration 3. Environmental a) competition, b) city size	Tests a series of hypotheses on 3 main areas (leadership, organization, environment)	Linear regressions

31	Knoke, 1982	Municipal reforms adopted based on: 1. Cultural clash (religion, race) 2. Hierarchical diffusion (city population log) 3. Modernization (city age, population growth) 4. Class conflict (wages, education) 5. Neighbourhood effect (geography)	Results do not support hypotheses	Event history models
32	Kostova and Roth, 2002	Three main pillars in diffusion: 1. Institutional profile of country (regulatory, cognitive, normative) 2. Relational context of MNC (power dependence, trust, identification, ceremonial adoption) 3. Decoupling (ceremonial adoption when regulatory environment is strong but there are less strong cognitive and normative pressures; or when dependence is high but recipient unit has low trust and identification with parent firm)	The paper contributes by specifying institutional duality (double pressure from 2 environments: internal market and market abroad) may lead to decoupling: subsidiaries will not implement changes proposed by mother firm. The authors also distinguish among: -Pre-institutionalization, -Semi-institutionalization (some acceptance but short history means more like a fad) and -Full institutionalization	Hierarchical regression and ANOVA
33	Kraatz and Zajac, 1996	US school adaptation: Strong institutional pressures would predict structural and functional adaptation in US colleges, but the opposite has been true: they changed their structure and goals according to their own interests in defiance of norms. Most hypotheses were rejected and this is seen as a limitation to the applicability of IT.	The authors unpack the limits of neo-institutional theory by finding results that contrast its major assumptions	Event history analysis
34	Lee and Pennings, 2002	Two institutionalization processes: 1. Competitive; includes "market feedback", the process of spread of the superiority of a new environmentally selected form (due to better performance etc) 2. Institutional; includes resources, influences, sensemaking, abilities, power, individual network	Uses population ecology and institutional theory to argue that there are two processes that affect adoption: institutional and competitive: 4 forces: -Market feedback, -Network embeddedness,	Event history analysis

		embeddedness etc.	-Size similarity, -Location proximity	
35	Meyer *et al*, 1992	Variables that affected diffusion: -Urbanization -Religion -Political independence -Rule of compulsory national education -Race -Ethnolinguistic fractionalization	Political organization into nation-states was the main driving force behind the variables examined and the most important factor.	Event-history using a log-linear model
36	Myers, 2000	*Adds media coverage (communication*) to Strang and Tuma's (1993) general framework on riot diffusion.	Summarizes the 4 tenets of Strang and Tuma's (1993) spatial and temporal heterogeneity diffusion	Cox regression
37	Nelson *et al*, 2004	Four models of innovation adoption: a. Rational choice adoption b. Quasi-rational choice c. Social construction d. Fad/fashion The two driving forces behind this categorization are the absence/presence of dynamic increasing returns and the ability/inability of the organization to get sharp persuasive feedback	Proposes four generic diffusion models, similar to Abrahamson's (1991, 1996) and Rogers's (2003) theories	Conceptual model
38	O'Neil *et al*, 1998	Speed and persistence in strategy adoption depends on: Environmental factors: -Environmental uncertainty, -Macrocultures *within* and *across* Organizational factors: -Past success/performance -Size of performance difference between first	Links diffusion theories to organizational strategies. Applies a multilevel theoretical model to contrast previously proposed efficiency explanations of strategy adoption (e.g. mergers, privatizations, diversification, downsizing etc.)	Conceptual paper

		adopter and competing organizations -Adoption failures -Organizational "memory"		
39	Orton and Weick, 1990	Decoupling of adopted activities: Fragmented external environments and conflicting requirements stimulate decoupling of activities. Organizations will either pretend to be implementing changes/innovations or create formal structures without adherence to the technical requirements	Reviews the theory on loose-coupling based on the concepts of its: a) Causation, b) typology, c) effects, compensations, and outcomes.	Conceptual paper
40	Palmer *et al*, 1993	Five main factors: 1. Economic (strategy and size, tactics, performance) 2. Politics (intra-organizational and inter-organizational) 3. Institutional (tradition, mimicry, coercion, normative pressure) 4. "Non-financial dependence" (competition, power of customers etc) 5. Firm age (old are inert, will not change)	Economic and political factors affect diffusion at the beginning but later on institutional factors are more important (after the new form has gained legitimacy)	Event-history models
41	Pennings and Harianto, 1992	Adoption of technological innovations: 1. Accumulated knowledge skills (know-how) and experience in previous technologies 2. External networking and linkages with technology firms. 3. High previous capital investments in technological systems and equipment	Application in the US commercial banking industry	Event history model
42	Rao, 1994	Exit (death) rates of automobile manufacturers are based on: 1. Cumulative victories in product certification contests within their industry	Deals with the social construction of reputation and its impact in the survival and performance of organizations.	Cox regression

		2. Cumulative victories decrease the exit rate of start-ups more than that of lateral entries. Reputation is the mediating variable in the relationship between certification contests and exits.		
43	Ruef, 2000	Where do organizational forms come from? How do they spread? Community ecology approach: a) the residual sociopolitical legitimation enjoyed by an emerging form due to prior collective action on the part of a predecessor form and… b) the residual cognitive legitimation enjoyed by an emerging form resulting from its ability to draw on the more highly crystallized identity of a predecessor form. c) A third dimension of the symbiotic relationship taps into benefits that are not tied to legitimacy per se, but rather to resource spillovers.	This conceptualization captures the intuition that the probability of form emergence… a) increases with carrying capacity and the legitimacy/resource spillover effect of having existing organizations with a similar identity but b) decreases when competition among existing organizations consumes much of the resources available to the potential form. Thus, in the emergence (legitimization) of new organizational forms, there is an interplay between symbiosis/mutualism and population ecologists' density assumption.	Poisson regression
44	Sanders and Tuschke, 2007	Three main constructs: 1. Organizational learning [exposure to other environments, perhaps in other countries] through: a) affiliations with partners which have already adopted, b) executives with high education 2. Second order learning: previous adoption of institutionally contested practices 3. Diffusion forces: cohesion and structural equivalence 4. Regulatory legitimacy: legal changes remove barriers to adoption	The authors find that the first four (4) elements have stronger effect on pioneers than late adopters. Timings: -Pioneer adopter (before legislation permitted the adoption) -Momentum adopter (after legislation) -Non-adopter	Event history models

45	Sherer and Lee, 2002	Adoption of workforce changes: -Prior human resource scarcity negatively affects adoption -Prior prestige of principal office likely to lead to early adoption	Merges institutional theory with resource dependence theory to construct a theory on institutional change.	Event history analysis
46	Spell and Blum, 2005	Two perspectives on adoption: 1. Strategic choice perspective (org. Size, union presence, turnover) 2. Institutional perspective (others have adopted in the industry, discourse through media coverage)	Timing: The strategic approach is stronger at the beginning and the institutional gets stronger thereafter Moderator: Moderating effect of discourse on density vs. adoption	Cox event history model
47	Strang and Macy, 2001	Diffusion is not necessarily dependent on rational or mimetic processes: In general, mimetic, under-rationalized processes lead to fads and the spread of ineffective innovations, while rational, over-rationalized choices lead to the spread of effective innovations. The authors propose a single model that applies to both the above scenarios: Within their bounded-rationality, firms learn from each other and pay attention particularly to their successful peers before deciding on what to adopt.	The paper explains how bandwagons collapse, thus amending DiMaggio and Powell's arguments on mimicry: Mimetic behaviours that lead to unsuccessful outcomes push certain players to defect from common practices and towards uncommon innovations, so that mimicry eventually increases population diversity (not isomorphism) and promotes temporal instability (not stability).	Econometric models and experiments/simulation
48	Strang and Meyer, 1993	Institutional factors of diffusion: 1) Cultural linkages: categorization into same industry or cultural groups; competitive emulation; isomorphism 2a) Theorization by the adopters: e.g. organizational communication or control processes that are theorized help the spread of reforms in these areas. Marxist theorizations helps socialist revolutions	2a and 2b happen jointly: this has the powerful effect of matching the adopter to the practice and the practice to the adopter. Theorization acts as a "social construction" mechanisms that affects the content and form of diffusion.	Conceptual paper

		spread. When theorization is shared among all adopters, the actors involved will be considered homogenized. 2b) Theorization of the diffusion practice: the practice speaks out for its benefits thereby making it more appealing for adaptation by others. 3) Modernity: the ideas of progress and justice that shape the environment of organizations. Same technologies and same legitimate accounts of organizing bring them together.	Analytic strategies: -better specify relational model -specify theoretical linkages -examine variations among populations -examine variation among diffusion practices (more or less *modern* etc) -examine the content of diffusion	
49	Strang and Soule, 1998	*Diffusion* is often used to denote "increasing incidence" but that makes it uninteresting: "causal process" is the best way to look at diffusion. External vs. Internal diffusion: 1)External elements are the mass media and the various change agents. 2) Internal includes a) cohesion through strong ties (networks), b) news through weak ties, c) structural equivalence and competition, d) prestige, e) spatial proximity, f) cultural categories	Distinguishes between the diffusion practice (mimicry) or the diffusion outcome (social learning)	Conceptual paper but offers review of econometric models used in diffusion studies
50	Strang and Tuma, 1993	Spatial and temporal heterogeneity in diffusion: Network centrality and local structures of influence based on coherence and structural equivalence enhance diffusion speed.	In contrast to previously proposed population-level models, the authors develop individual-level models of adoption that allow heterogeneity both within the population and across time.	Spatial and temporal heterogeneous diffusion models
51	Swan and Newell, 1995	Previous literature: 1. General strategy regarding innovation 2. Firm size Contributions: 1. Membership profile of a professional association	Examines relationships between the involvement of individuals in a professional association (seminars and conferences, meetings, social events), the level to which they network with others within their firms and the level of technological innovation in their firms	Qualitative and quantitative analysis

		and its channels to disseminate knowledge 2. The importance of the association in promoting innovation among its members	(boundary spanning activities)	
52	Teece, 1980	Administrative innovations: 1. Have no protection by patenting them, hence can diffuse easily. 2. They involve significant costs and org. disruption. 3. They cannot be adopted partially or on a step-by-step basis, therefore timing and speed of diffusion are crucial.	Corporate acquisitions could be an economic factor worth investigating regarding diffusion of administrative innovations	Logistic regression
53	Tolbert and Zucker, 1983	City characteristics-predictors: 1. Number of foreign-born immigrants 2. Socioeconomic bases (education etc) 3. Scope of functions performed by city 4. City age (negative effect) 5. City size	Internal organizational characteristics proved more important for adoption at the beginning, but later when the reforms where institutionalized, external environmental characteristics were found to be more important than internal.	Cox regression model
54	Van de Bulte and Lilien, 2001	Medicine adoption is affected by potential adopters' perceptions of 5 critical product characteristics: 1. Complexity, 2. Compatibility with existing values, 3. Trivialability, 4. Observability of results, 5. Relative advantage over alternatives	Social contagion: 1. Information transfer, 2. Normative pressures, 3. Competitive pressures, 4. Performance network effect	Cox regression model
55	Weber and Davis, 2000	Stock exchange diffusion: Local processes: -Size of economy (overall and relative to the country's population) -Legacy of colonialism -Recent transition to multiparty democracy Global processes: -Multinational prior investments	The paper integrates globalization dynamics into institutional theory to explain the spread of stock exchanges in the 1980s-90s. Results contrast dependence theory assumptions and the role of legal tradition or religion (protestantism) in the diffusion process	Cox regression model

		-IMF aid -Centrality in trade flows -Regional "contagion"		
56	Wejnert, 2002	Diffusion of innovations based on: 1. Characteristics of the innovation (public vs. private consequences; benefits vs. costs) 2. Characteristics of innovators (societal entity; familiarity with the innovation; status characteristics; socioeconomic characteristics; position in social networks; personal characteristics) 3. Environmental context (geographical settings; societal culture; political conditions; global uniformity)	Great conceptualization and full literature review of these three key factors.	Conceptual paper
57	Westphal and Zajac, 1997	Major assumptions: -CEOs who have experienced a similar increase in board independence at their companies will export that to the firm in whose board they also sit. -The greater the proportion of CEOs on a board, the lower the likelihood of an increase in demographic distance between the CEO and the board -The greater the proportion of CEOs on a board, the lower the likelihood of a decrease in unrelated diversification	Brings in the norm of reciprocity and social exchange theory	Event history analysis. Entropy measure on diversification used
58	Zuckerman, 1999	Legitimacy and resources: The candidate-audience interface includes all actors, intra-organizational and external. Appeal to the most powerful secures legitimacy and, thus, longevity and performance.	Highlights the importance of mediators such as product critics in a market.	Fixed-effects regression analysis

Book s and Book Chapters			
No	**Authors**	**Theoretical model and variables**	**Data, findings and contributions**
1	DiMaggio, 1991	Diffusion of art museums: Social elites supported the creation and professionalization of museums for their own purposes, but the interests of the museums' management institutionalized the form by appealing to wider audiences.	The author participates in the debate over whether the diffusion/institutionalization of a practice is due to systemic change (org. interests and purposes) vs. conventional change (compliance)
2	Lynch, 1996	Thought contagion ("memes"): The new science of memes deals with the evolution of ideas that program for their own retransmission (cf. Richard Dawkins) through mass belief systems. Retransmission happens through 7 general patterns, called "modes": -Quantity effect -Efficiency effect -Proselytizing -Belief preservation -Sabotaging competition -Cognitive advantage -Motivational advantage	Lynch introduces the core elements of the theory of memes, linking it to the social sciences (sociology, anthropology, economics, psychology, game theories). Apart from the recreation and proliferation of existing ideas through its core modes, thought contagion can recombine or even generate new ideas in a field/society
3	Rogers, 2003	Elements of diffusion: 1. An innovation/technology 2. Communicated through certain channels 3.Over time 4. Among members of a social system Types of innovation decisions: 1. Optional 2. Collective 3. Authority Consequences:	Some other elements: -Diffusion can be planned or spontaneous. -Heterophily (or structural equivalence) can explain variation. -Social norms, structure or leadership can explain variation.

		1. Intended vs. unintended 2. Direct vs. indirect 3. Desirable vs. undesirable	
4	Strang and Sine, 2002	Interorganizational institutions Key concepts: -Naturalistic vs. force/choice-based emergence of new institutional arrangements -The role of institutional performers at the top (e.g. the state, legislation) -The role of "triggers of change" and "challengers" as institutional innovators -Legitimacy through illegitimate actions -Links with ecological perspectives	Proposes the following topics for future research: -Establishing a clear IT paradigm -Deinstitutionalization paradigm -Distinguish between legitimacy and status (how does status affect institution building/decline?) -Move towards internal/endogenous sources of organizational change -Exploring a top-down as well as bottom-up (specific actors) research approaches

Appendix 10.2: Organizational Ecology theory literature review

Journal papers				
No	**Authors**	**Theoretical model and variables**	**Findings and contributions**	**Method and sample**
1	Anderson and Tushman, 1990	Technology cycle: Technological discontinuity > (Era of ferment) > Dominant design > (Era of incremental change) > Technological discontinuity 2. Discontinuities underline either products (product forms that command a decisive cost, performance or quality advantage) or processes (superb ways of making a product). Sales of the new technology will peak after the emergence of a dominant design, not during the era of ferment.	Literature review of theoretical models that explain technological change, including anthropology, sociology etc.	Case studies
2	Astley, 1985	Population vs. Community ecology A) Population ecology focuses on established populations, emphasizing factors that homogenize organizational forms and preserve population stability. B) Community ecology overcomes these limitations: it focuses on the rise and fall of populations as basic units of evolutionary change, simultaneously explaining homogeneity and heterogeneity between them. What links the population and community ecologies is technology: Interdependencies between the technologies of different populations fuse those populations together and only those populations that are able to function as constituent members of such higher level communities will survive.	The core argument of the paper is that: Community ecology can better capture the evolution of fields compared to simply population ecology (PE). PE says that failing organizations are replaced by new entries that gradually change the population composition (*phyletic gradualism*). Thus, PE focuses on the regulation of established populations (that are prone to stability), not their origins or extinction. In contrast, CE supports an episodic not gradual tempo of population change based on radical technological changes governed by "historical happenstance" and "blind decision", not technical necessity. Technological change ≈ "biological mutation". Also, innovation comes in the form of technological "clusters"	Conceptual Paper

3	Astley and Fombrun, 1983	Adaptation takes two forms: 1) Individual and 2) Communal Individual adaptation is subdivided to: 1) Somatic (bodily form) which is temporary and reversible in the lifetime of an organism. It is particular to the life of the organism and is not passed on to successors. 2) Genetic (morphology of a whole species) represents a long-term adaptation of the species. Communal adaptation is subdivided to: 1) Commensalistic (organizations-members of the same species make similar demands on their environment) 2) Symbiotic (organizations-members of different species make dissimilar demands on their environment: they supplement each other's efforts and are thus mutually interdependent) Individual adaptation in organizations (individual strategies): 1) Business strategy is like somatic/morphological adaptation (how to meet variation in an organization's environment) 2) Corporate strategy is like genetic adaptation (defining the businesses that that organizations should be in through long-term changes in its structure to accommodate itself to new environmental niches)	The authors suggest the following framework regarding strategy: Interorg. env. > Collect. Str. > Commun. ad. Gener. env. > Corpor. str. > Genetic adapt. Task env. > Business str. > Somatic adapt. The paper's contribution lies in defining the communal adaptation/strategy. Thus, coordination among members of the organizational population depends on 1) the number of entities in the population and 2) the type of relationship between them. Finally, the authors classify collective strategies into 4 categories: -Confederate -Agglomerate -Conjugate -Organic The challenge for organizations is to balance their individualistic goals within such communities and the interests of the other members or the wider society within which they participate. Firms must fulfill social and political as well as economic functions	Conceptual paper
4	Astley and Van de Ven, 1983	Examines 6 core questions that remain unanswered in the Org. Studies literature. 1) Organizations: functionally rational or socially constructed embodiments of individual action? *2)* Organizational change: Internal adaptation or environmental selection?	The authors use 2 core dimensions: 1) Micro vs. Macro levels of analysis 2) Deterministic vs. Voluntaristic (free will) assumptions of human nature	Conceptual paper

		3) Organizational life: determined by environmental constraints or by strategic managerial choices? 4) Organ. environment: simple aggregation of externally-controlled organizations or an integrated collectivity governed by its own internal social and political forces? 5) Organizational behavior: is it principally concerned with individual or collective action? 6) Organizations: neutral technical instruments engineered to achieve goals or institutionalized manifestations of the vested interests and power structure of the wider society?	The authors distinguish 4 generic views of organization studies: 1) Natural selection view 2) Collective-action view 3) System-structural view 4) Strategic choice view	
5	Barnett, 2006	Some interesting propositions: 1) The strength of collective actions declines immediately after an industry establishes legitimacy 2) The strength of collective action in a mature industry declines immediately after legitimacy is re-established. 3) Over the life of an industry, member firms focus on individual activities unless disrupted by a legitimacy challenge 4) Industries in decline are less likely to mobilize in the face of a legitimacy threat than industries in emergency or maturity.	The paper examines the role of collective action and competition during the lifecycle of an industry	Conceptual paper
6	Barnett and Burgelman, 1996	Evolutionary perspectives of strategy	Introduction to SMJ special issue	Conceptual paper
7	Barnett and Carroll, 1987	Competition vs. Mutualism 1) Competition: “direct” or “diffuse” 2) Mutualism: “direct” or “diffuse”. Diffuse mutualism is when organizations with similar characteristics enhance each other’s institutional legitimacy. Mutualism 1) Commensalism (positive interdependence based on supplementary similarities) and 2) symbiosis (positive interdependence based on complementary differences)	Examines whether any of these patterns of interdependence really existed in the Telephone Industry	Event history models

8	Barnett and Hansen, 1996	Red Queen: Self-reinforcing process of change through constant learning: one organization's learning triggers competition, the competitors in turn "learn", and so on. Organizations co-evolve through these reciprocal interactions	Explores the conditions under which learning can be "adaptive" or "maladaptive". In specific, it deals with the duration of an organization's relationships a) recently and b) in the distant past.	Event history models
9	Beard and Dess, 1988	Input-Output analysis (from economics) a) Industrial organizational classification b) Organizational species' technology c) Organizational species' interdependence Species/population/form Organizational species are polythetic groups of competence-sharing populations isolated from each other because their dominant competencies are not easily learned or transmitted (McKelvey, 1982). An organizational population designates all members of an organizational species or industrial classification at any time and the term organizational form designates the typical organization in terms of a specified set of defining characteristics of that population	Organization task environment ≈ Organ. niche	Conceptual paper
10	Boucher *et al*, 1982	Competition vs. Mutualism vs. Predation Interactions effects for two species or two populations: Mutualism: +/+ Competition: -/- Predation: -/+ Commensalism: +/0 Two types of mutualism: Direct mutualism = physical contact Indirect mutualism = no physical contact Direct mutualism benefits: -Nutrition, -Supply of energy, -Protection from enemies, -Transport to safer places	Mutualism ≈ symbiosis, obligacy, commensalism, cooperation, protocooperation, mutual aid, facilitation, reciprocal altruism, and entraide. How many partners in a mutualism? One (monophily), few or up to 5 (oligophily) or many (polyphily)? Oligophily is the compromise between the risks of specialization and the inefficiency of generalist interactions.	Conceptual paper

		The evolution from commensalism to mutualism can take these forms: 1) Evolution to symbiotic mutualism is thought to begin a) through proximity of the organisms involved. Then, b) one of the two provides the other with a benefit that greatly enhances its chances for survival. Finally, c) as more needs of the association are met by the combined abilities of the mutualists, the intensity of the competition on those partners from ecologically similar species will diminish. 2) Evolution to nonsymbiotic mutualism is that in which the two species are physically unconnected. The formation of mutualistic communities may take place from a) coevolution of the species or b) accidentally, e.g. due to developments in prior archetypes or more distant populations that eventually result in bringing the focal mutualistic populations together.		
11	Bresser, 1988	Collective strategies that might result in impairment of secrecy and information disclosure: 1) Regulative legislation: regulators collect and distribute information to competitors 2) Contracting (mergers/JVs): defecting employees, ineffective communication links between participant organizations 3) Trade associations: distribution of trade statistics/data The authors propose different levels of feasibility between collective/competitive strategies based on various combinations of: a) competition/regulation/trade associations and contracting with b) pricing, advertising and promotion, product innovation dimensions	The paper discusses possible combination of collective and competitive strategies in an industry. Such combinations can be dangerous due to the need to share and, at the same time, conceal information from other market participants.	Conceptual paper
12	Bresser and Harl, 1986	Environmental interdependence can be analyzed by: 1) Rate of movement among environ. elements (movement= environ. variation that increases when there is a higher frequency of change and if change becomes less predictable. Increased movement aggravates stress	Coordination forms of collective strategy: -Regulative legislation -Contracting (mergers, JV) -Coopting and interlocking directories	Conceptual paper

		and decision-making uncertainty increases) 2) Strength of interconnectedness between environ. elements [Interconnectedness is determined by the extent to which rules or formal/informal agreements exist to regulate the interactions among environmental elements. Interconnectedness increases as rules create linkages and therefore govern more interactions among environmental units. There is competitive (based on market rules) and contractual (based on contracts) interconnectedness]	-Trade and professional associations -Collusion and industry leadership Impact of collective strategies: -reduce strategic flexibility -increase the impact of external disturbances -low organizational adaptability -attract new industry entrants	
13	Bruderer and Singh, 1996	Evolution: central concepts are… 1. Birth = variation 2. Org. learning = adaptation 3. Death = selection (fitness) 4. Proliferation = retention	The authors provide a literature review of the adaptation vs. selection debate among evolutionary theorists	Simulation
14	Campbell, 1975	Differences between social and biological VSR evolution: -Social variation is, of course, identical to biological -Social selection is similar to biological -Social retention/duplication is more problematic than biological. Social retention mechanisms include: child socialization, reward and punishment, identification, imitation, indoctrination into tribal ideologies, language and linguistic meaning systems etc. But majority opinions/behaviors are perhaps the most important such mechanisms.	Core contributions: 1) Too much variation through discontinuities can be harmful. Biological mutations are 99% of maladaptive or neutral, not positive effects. 2) Too strong a retention mechanism jeopardizes the production of variations, thus also further evolution – we need some balance.	Conceptual paper
15	Cropanzano and Mitchell, 2005	Social Exchange Theory (SET): Examines the following areas for additional research: a) Roots of conceptual ambiguities b) Norms and rules of exchange c) Nature of resources being exchanged d) Social exchange relationships	The paper provides a review of the literature on SET. It highlights conceptual and other deficiencies in the current arguments and methodological paradigm of SET.	Conceptual paper

16	Derfus *et al*, 2008	Red Queen revisited: a) Firm actions increase performance b) Firm actions increase and so do rival actions and speed of rival actions c) Firm actions stay constant, rival actions increase, hence focal firm's performance decreases	Additions to the baseline model: RQ is moderated by: a) Industry concentration b) Industry demand c) Market position of firm	Negative binomial regression
17	Dollinger, 1990	Collective strategy # interorganizational strategy: Interorganizational interaction takes form as pairwise activity. When that activity is repeated over large numbers of loosely linked organizations, then we have collective action. A) Collective strategy comes from Hawley's sociobiology and exchange theory (Blau, 1964; Cook, 1977) which evolved into RBV (Pfeffer & Salancik, 1978) B1) Development process: Firm-level interactions > repetition > clustered strategies(cooperation becomes self-sustainable) > population-level collective strategy B2) Evolutionary process: Pairwise cooperation > mimetic adaptation, competitive isomorphism, institutional isomorphism > critical mass established > colonization C) Environmental context: Munificence, complexity and dynamism in the environment foster collective actions at the intermediate level. When they are too high or too low, collective action will not take place. D) Efficacy/performance: As colonization spreads, the individual firm gains become smaller - the gains only become larger for the entire population relative to other populations.	The authors answer four questions: 1. How common/frequent are collective strategies? 2. How are they developed? 3. What are the environmental and industry influences on collective actions in fragmented settings? 4. What is the efficacy of collective strategy?	Conceptual paper
18	Doz, 1996	Explores the impact of: a) Learning, b) Reevaluation, c) Readjustment	Explores the evolution of strategic alliances	Case studies

19	Fatas-Villafranca *et al*, 2007	Coevolution of national industries and institutions: -Role of well-trained scientists and engineers -Role of universities as supporting institutions that coevolve with national industries -Existence of techno-scientific radical changes -Role of price/performance competition worldwide -Existence of local (dis)advantages in the access to key production inputs depending on national conditions	*Block 1*: production, growth, demand and market dynamics *Block 2*:Innovation *Block 3*: Evolution of national university systems *Block 4*: Specific coevolution mechanism	Simulation
20	Freeman and Audia, 2006	Two criteria to distinguish Organizational communities a) Spatial differentiation b) Functional complementarity Based on these, there are 4 types of communities: 1. Organizational demography (NO, NO) 2. Interorganizational relations (NO, YES) 3. Concentration and agglomeration (YES, NO) 4. Residential communities (YES, YES)	*2. Interorganizational relationships*: are based on ideologies, identities, technological space, market concentration (generalists vs. specialists) and participant's socio-demographic space (e.g. size). *3. Concentration*: the main argument here is between local density vs. country density. 4. Residential communities ≈ social networks	Conceptual paper
21	Garud and Rappa, 1994	Technology is conceived of as: -the researchers' initial Beliefs -the Artifacts they create and -the Evaluation Routines There are reciprocal relationships between pairs of these elements. For example, beliefs define the standards (routines), and the desired standards also shape existing beliefs.	Provides a socio-cognitive model of technology evolution (adoption)	Case study
22	Goes and Park, 1997	Key inter-organizational links that foster innovation: -Structural -Administrative -Institutional (trade associations) -Resource-based	Organizations form linkages to foster innovation, adapt to environmental demands and prosper. Specifically, institutional links among organizations in a field are stronger and more frequent when the market is in turbulence.	MLE regression

23	Gouldner, 1960	The norm of reciprocity: The stability of the relationship between A, B requires the investigation of a) mutually contingent benefits rendered and b) the manner (relative power) that this is sustained. Malinowski: Reciprocity refers to the interlocking status duties which people owe one another. People believe that, in the long-run, the mutual exchange of goods and services will balance out. Reciprocity is a "starting mechanism", in that it fosters social interaction. Unlike existing social arrangements, reciprocity enables the beginning of a social system, because one is obliged to respond to somebody else's favor. Thus, the norm breaks off from the past status quo.	Conditions to diagnose reciprocity: -The resources available in order to reciprocate -The intensity of the recipient's need when the benefit was bestowed -The motives of the donor -The status of the participants -The time it takes to perform an obligation	Conceptual paper
24	Greve, 2002	When and where are new organizational populations established? The paper draws a distinction between temporal and (for the first time) spatial evolution of organizational forms. It argues that the density dependence (legitimacy vs. competition) argument does not hold in general but only in specifically delineated geographical neighborhoods of organizations. Organizations within neighborhoods (communities) interact with varying degrees of legitimation and competition effects, other than the classic ecological assumptions of a single, central population…	The paper introduces the following theoretical terms: -Spatial contagion -Spatial competition -Spatial density dependence	Negative binomial regression
25	Hannan *et al*, 1995	Legitimation processes operate more broadly than competition: Legitimation= pan-European Competition= by country	In population ecology, evolution is measured as the entry of new organizations in a population/country	Quasi-likelihood estimators (McCullagh, 1983)
26	Hannan and Carroll, 1992	Measuring population legitimacy: In population ecology, only cognitive legitimacy is measured and this through density accounts. The first order density measures legitimacy, and the second order density measures competition.	The population ecology legitimacy has been criticised heavily, for example by Zucker, 1989; Delacroix and Rao, 1994; Baum and Powell, 1995; Young, 1988.	Conceptual paper

27	Homans, 1958	Social behaviour as exchange: Homans introduced the research paradigm of exchange among social actors. He drew from the example of the "hungry pigeon" who develops an exchange relationship with the man that feeds it.	This is one of the first pieces to propose that exchanges are not limited to material goods but also include symbolic values (e.g. social approval, prestige)	Conceptual paper
28	Janzen, 1980	Coevolution is: An evolutionary change in a trait of the individuals in one population in response to a trait of the individuals of a second population, followed by an evolutionary response by the second population to the change in the first.	Coevolution is different from: -interaction, -symbiosis -mutualism	Conceptual paper
29	Kieser, 1989	Societal evolution: Genesis of organizations not only due to intentional action but also due to the preservation of accidentally formed practices that were initially intended for other purposes (Hayek, 1973) There are reciprocal selection processes at the world//institution/group/individual human behavior levels. However, it is inappropriate to characterize any of these as the prime mover of societal evolution: they all evolve simultaneously!! But asynchronic developments on these levels lead to societal crises, legitimation crises and ultimately the emergence of new organizational forms.	The adaptability of societies is dependent on the speed (tempo) of evolutionary processes at the above three levels. Adaptability of the current organizational form is crucial in its selection as the dominant form. When the system cannot adapt as fast and efficiently as required by environmental and competitive forces it will eventually collapse, and other forms will replace it.	Case study
30	Koza and Lewin, 1998	Coevolution of strategic alliances: -Mimetic behaviors dictate entry to strategic alliances for the first time by new firms -Successful experience in strategic alliances dictates more of these -Alliances due to mimetic behaviors will dissolve quicker than alliances based on firm-specific needs. -Exploitation intentions mean alliances will be organized to produce performance outcomes -Exploration intentions mean alliances will be organized to produce learning objectives	The paper proposes a framework which views strategic alliances in the context of the adaptation choices of a firm. The morphology of an alliance (absorptive capacity, control, identification) may drive the evolution of alliances at the population level.	Conceptual paper

31	Lewin *et al*, 1999	Proposes a more integrated framework of how firm strategic and organization adaptations co-evolve with changes in the environment and organization population and forms.	Builds on March's (1991) model of organizational adaptation.	Conceptual paper
32	Lewin and Volberda, 1999	Coevolution is: The joint outcome of managerial intentionality, environment, and institutional effects. It takes place through direct interactions or feedback from the rest of the system. Properties: -Multilevel: within (micro) and between (macro) organizations. Macro includes communities. -Multidirectional causalities -Nonlinearity: counterintuitive results may occur due to strange links and feedback paths. -Positive feedback -Path/history dependence = Adaptation in time	Suggests that we need large longitudinal datasets of org. populations that somehow coevolve	Conceptual paper
33	McKelvey and Aldrich, 1983	Examines the following in Org. Studies: -Classifiability -Generalizability -Predictability	The authors propose the "theory of natural selection" perspective in population ecology.	Conceptual paper
34	Meeker, 1971	Social Exchange: Meeker amended the classic SET rules of exchange (reciprocity) by proposing that exchanges among individuals make take one of the following additional rules: -Rationality, -Altruism, -Group gain -Status consistency or rank equilibration -Competition	Meeker's model refers to individual social action among people	Conceptual paper

35	Molm *et al*, 1999	Negotiation vs. reciprocity Discusses how the form of social exchange (negotiated vs. reciprocal) affects the distribution of power among the participants in the exchange network. In general, the reciprocal exchange produces *lower power use* than the negotiated.	Contributes to the debate about whether social exchange based on the norm of reciprocity is any better than social exchange based on pre-agreed, negotiated terms.	Experiment
36	Molm *et al*, 2007	Theory of reciprocity and solidarity in exchange: 1) Direct exchange: 2) Indirect exchange: Each actor gives to another but receives benefits back from another. The indirect exchange involves more than two actors (in contrast to indirect) and is seen as generating *stronger bonds of solidarity than pair-wise exchange.* These exchanges are embedded in wider networks, and power of actors within these networks is important.	Distinguishes between reciprocal vs. negotiated exchange. Solidarity based on these exchanges develops through 3 mechanisms: a) the risk of non-reciprocity, b) expressive value of reciprocity, c) salience of cooperative elements of the exchange	Experiment
37	Nielsen, 1988	Cooperative strategies: 1. Pool strategy 2. Exchange strategy 3. De-escalate strategy 4. Contingency strategy These can be found in a) negative-sum game/ declining markets, b) zero-sum game/ mature markets, c) positive-sum game/ growth markets and in order to d) change the game/market to a positive-sum/ growth one.	Makes the case for cooperative rather than competitive strategies. It then offers examples of cooperative strategies (e.g. distribution agreements, transfer pricing, joint ventures etc).	Conceptual paper
38	Oliver, 1990	Determinants of interorganizational relationships The authors examine the following types of relationships: -Trade associations -Voluntary agency federations -Joint ventures -Joint programs -Corporate-financial interlocks	Critical contingencies in all relationship formation: -Necessity (e.g. regulatory pressures) -Asymmetry (to exercise power over other players' resources) -Reciprocity (mutual cooperation/ collaboration, not competition)	Conceptual paper

		-Agency-sponsor linkages	-Efficiency -Stability (predictability) -Legitimacy	
39	Romanelli, 1991	Three views are examined: a) Org. genetics view: focus on characteristic traits of organizations b) Environmental conditioning view: environments help forms grow c) Social systems view: forms are the product of embedded social-organizational interactions	Develops the concept of "organization-creating organizations" as first defined by Stinchcombe (1965). These firms: 1. Operate in a variable environment that fosters innovation; 2. Have the resources to create other organizations and 3. Some of these resources would be explicitly free from vested interests.	Conceptual paper
40	Ruef, 2000	Where do organizational forms come from? Symbiosis and mutualism can help answer the above question. In particular, symbiotic relationships help new forms acquire legitimacy in three ways: a) the residual sociopolitical legitimation enjoyed by an emerging form due to prior collective action on the part of a predecessor form b) the residual cognitive legitimation enjoyed by an emerging form resulting from its ability to draw on the more highly crystallized identity of a predecessor form. c) a third dimension of the symbiotic relationship taps into benefits that are not tied to legitimacy per se, but rather to resource spillovers.	This conceptualization captures the intuition that the probability of form emergence… a) increases with carrying capacity and the legitimacy/resource spillover effect of having existing organizations with a similar identity but b) decreases when competition among existing organizations consumes much of the resources available to the potential form.	Poisson regression
41	Schopler, 1987	Inter-organizational groups as collectivities: Two dimensions are proposed for classifying such groups: a) Group origin (mandatory or voluntary) and b) Degree of externally imposed task structure (high or low)	Expected development and outcomes of inter-organizational groups: 1. Reliable compliance 2. Frustrated vs. responsive 3. Directed vs. inner conflict	Conceptual paper

		The paper further draws from the following literatures: -Open systems theory -Exchange theory -Small group theory	4. Creative commitment	
42	Terreberry, 1968	Two hypotheses discussed: 1. Org. change is increasingly externally induced and 2. Org. adaptability is a function of the ability to learn and to perform according to changes in the environment.	Links to other concepts such as "symbiotic marketing" that relate to co-evolution, co-existence.	Conceptual paper
43	Van Valen, 1973	Red Queen hypothesis's origins	Red Queen introduced for the first time in this biology paper	Conceptual paper
44	Vermeij, 1994	*Summarizes 3 main evolutionary theories:* a) Escalation, b) Coevolution, c) Red Queen *Escalation*: refers to the increase in species numbers due to their residence in relatively safe areas, away from enemies. Population movements therefore have positive effects, and selection occurs based only on *external events* such as climate change, tectonic movements etc. Escalation accepts that species might go extinct due to enemy's killings too. *Coevolution*: strict or diffuse. Participants in coevolution can be competitors, mutual beneficiaries, predator and prey, or host and guest. The survival and reproduction of the two parties depends largely on interaction between them, than on other potential sources of selection outside the dyad. *Red Queen*: the environment constantly deteriorates, thus, the species has to constantly evolve only to avoid extinction. A more likely outcome of the model is to achieve a mutual adaptation stalemate, i.e. a situation where the only way to stimulate further evolution among the interacting species is through the introduction of changes in the rules that govern adaptive compromise.		Conceptual paper
45	Westphal and Zajac, 1997	Major assumptions: -CEOs who have experienced a similar increase in board independence at their companies will export that to the firm in whose board they also sit. -The greater the proportion of CEOs on a board, the lower the likelihood of an increase in demographic distance between the CEO and the board -The greater the proportion of CEOs on a board, the lower the likelihood of a decrease in unrelated diversification	Brings in the norm of reciprocity and social exchange theory to explain diffusion	Event history analysis. Entropy measures on diversification used

Books and Book Chapters			
No	**Authors**	**Theoretical model and variables**	**Data, findings and contributions**
1	Aldrich and Ruef, 2006	Variation: -Intentional or blind Selection: -Externally or internally Retention: -Within or between organizations Units of analysis: -Routines and competencies (behavioral, cognitive regularities/properties) -Organizations -Populations/communities Community ecology definition: "A set of coevolving organizational populations joined by ties of commensalism and symbiosis through their orientation to a common technology, normative order or regulatory regime". Thus, the historical period or place of their emergence is up to the researcher to define and are not part of the community official definition. Commensalism: full competition (-,-), partial competition (-,0), predatory competition (+,-) Neutrality (0,0), partial mutualism (+,0), full mutualism (+,+) Symbiosis (+,+) *Dominance* (through power and influence that emerge after the formation/ establishment of the community and its populations)	Six theoretical perspectives related to evolutionary theory's VSR: -Ecological, Institutional, Interpretive, Organizational Learning, Resource dependence, Transaction cost economics. The organizations and populations we observe at a given moment are not the "most fit" in any absolute sense. Rather, their forms reflect the historical path laid down by a meandering drift of accumulated and selectively retained variations How do communities emerge? 1) Norms and values 2) Laws and regulations 3) Technological change Formation process: 1) The role of entrepreneurs 2) Funding sources 3) Ecological nestedness "Supra-organizational legitimacy" 1) Organizational efforts 2) Cross-population actions (e.g. associations, media,) 3) Laws and regulations (e.g. state-sponsored unions)
2	Baum and Singh, 1994	Coevolution: An organization that stimulates the evolution of another organization is, in turn, itself responsive to that evolution, and the response is predictable.	Coevolution is linked to the Red Queen hypothesis, "especially in the early stages of a population's growth when the legitimacy of the population itself is being established"

		2 types: There is direct (between two populations) and diffuse (among many populations in a broader ecological community) coevolution.	
3	Hawley, 1986	Individual and ecosystem: Every human being requires access to environment Interdependence with other human beings is imperative Human beings are time-bound in a finite world Humans possess an inherent tendency to preserve and expand life to the maximum given prevailing conditions The intrinsic limitation on the human being's behavioral variability is indeterminate.	Human ecology paradigm: Adaptation proceeds through the formation of interdependences among members of a population System development continues to the maximum size and complexity afforded by transportation and communication New information increases the capacity for the movement of materials, people, messages until the enlarged capacity is used.
4	Pianka, 1994	Coevolution refers to the joint evolution of two (or more) taxa that have close ecological relationships but do not exchange genes and in which reciprocal selective pressures operate to make the evolution of either taxon partially dependent on the evolution of the other. Thus, coevolution includes most of the various forms of population interaction, from competition to predation to mutualism. Coevolution can help organisms become strongly specialized on a single species or a few closely related species of plants. Interactions between populations: Competition (-,-) Predation (+,-) Neutralism (0,0) Mutualism/mimicry (+,+) Commensalism (+,0) Amensalism (-,0) Ecological equivalence: Organisms evolving independently of one another under similar environmental conditions that respond to similar selective pressures with identical adaptations, that end up occupying the same niches in different communities.	Key concepts examined: -Resource acquisition and allocation -Evolution, natural selection and speciation -Vital statistics of populations: demography -Population growth and regulation -Interactions between populations (mutualism, commensalism) -Predation and parasitism (and coevolution) -Community and ecosystem ecology (ecological equivalence, pseudocommunities)

5	Rao, 2006	Define communities: We have core and peripheral organizational features (Hannan & Freeman, 1984) a) Core: stated goals, authority relations, core technology, market strategy. b) Peripheral: number and size of subunits, number of levels in authority structures, span of control, interlocking directories, patterns of communication, strategic alliances) Generally repeats the definitions and the characteristics of community formation that Aldrich & Ruef (2006) have used. Symbiosis vs. Commensalism and their subcategories are the main types of communities exactly, as Aldrich again. Connections in hierarchical levels: Downward causation (all processes at the lower level depend on higher levels), and upward causation (upper levels depend on lower levels)	Neutrality: Neutrality is not a absence of interactions but an evolved set of interactions that eliminates competitive effects that might otherwise occur between populations of organizations. Coevolution: The joint evolution of two or more populations that have close ecological relationships but do not exchange genes and in which reciprocal selective pressures operate to make the evolution of either partially dependent on the evolution of the other. Reciprocal coevolution ≠ mutual causation. "Rapid coevolution" can alter the nature of the ecological interactions in favor of both populations
6	Rosenkopf and Tushman, 1994	Technological Communities dynamics: 1. Actors e.g., research labs, paten agencies, professional societies, trade associations, regulatory bodies. These act and interact spurring the evolution of technological systems. 2. Linkages, i.e. interdependence among actors. 3. Power, because actors differ in their abilities to shape and influence the paths of technological change.	Technology and organization coevolve and this process of coevolution is characterized by periods of social construction and periods of technological determinism
7	Scott, 2008	Critique on Astley & Van de Ven's (1983) community ecology: "In contrast to population ecologists who emphasized competitive processes among similar organizations, community ecologists pointed out that communities of organizations could develop structures that were mutually beneficial". Sees as a limitation of Astley's work its tendency to focus more on colocation than on functional interdependence, with the effect that	Colocation ≠ Functional interdependence within communities

		important connections and exchanges among organizations outside the spatial boundaries of the community were ignored.	
8	Van de Ven and Garud, 1994	Why and how are technological innovations developed and commercialized? 1. VRS as a continuous and gradual process, 2. Punctuated equilibrium (Anderson & Tushman, 1990) "Technological discontinuity" is also a factor that renews the novelty-creation cycle.	The authors believe that these perspectives do not capture well the origins of novelty (≈variation). Therefore, they argue that evolutionary, VRS processes are better viewed as a cumulative progression of numerous interrelated acts of variation, selection and retention over an extended period of time. A better understanding of the process of novelty can be obtained when the evolutionary concepts of VRS are defined as micro-events or individual events, rather than as macro-stages of evolution.

Appendix 10.3: Quantitative Data Coding: all variables 1993-2007

No	Variable name	Description
Panel variables		
1	uniid	ID number of university used in the panel
2	year	Time period in the panel
University and spinoff variables		
3	public	Number of university publications
4	avpublic	Average number of publications per 1,000 full-time students
5	rank	Position in the Sunday Times university guide rankings (reputation)
6	nobel	Cumulative number of university Nobel Prizes (status)
7	med	Number of articles in the UK press that refer to both the university and the name of a spinoff
8	cummed	Cumulative number of articles in the UK press for each university and its spinoffs as above
9	avmed	Average number of articles in the UK press (by number of spinoffs) in a university's portfolio
10	allmed	Cumulative number of articles in the UK press of all other universities in the population (excluding the focal one) and their spinoff firms yearly
11	ipo	Cumulative number of spinoffs that have experienced an IPO by university
12	outs	Cumulative number of outsourcing agreements with private companies to exploit a university's IP
13	unico	Year of joining UNICO and years of experience with them thereafter. Used decreasing ratio of 0,8 for each year that passes after an exit from UNICO to denote decreasing importance of experience
14	age	Number of years since university founding (or conversion to university status for former polytechnics)
15	lnage	The natural logarithm of "age"
16	size	The number of university full time students
17	lnsize	The natural logarithm of "size"
18	neta	Membership in the Russell Group university network. Dummy variable
19	netb	Membership in the 1994 Group university network. Dummy variable
20	netc	Membership in the Million+ university network. Dummy variable
21	netd	Membership in the University Alliance university network. Dummy variable
22	netaexp	Cumulative years of experience in the Russell Group university network
23	netbexp	Cumulative years of experience in the 1994 Group university network
24	netcexp	Cumulative years of experience in the Million+ university network
25	netdexp	Cumulative years of experience in the University Alliance university network
26	ttoexp	TTO office age expressed in cumulative years
27	ttoa	TTO structure as a wholly-owned limited company. Dummy variable
28	ttob	TTO structure as a department within the university. Dummy variable
29	ttoc	TTO structure as department within a university. Dummy variable
30	ttod	TTO structure as Public Limited Company. Dummy variable
31	spfirst	Dummy variable measuring the year that a university created its first spinoff company
32	spno	Number of spinoffs formed each year
33	spbio	Number of spinoffs in: biotechnology, dental, chemistry, chemicals, food sciences, agriculture
34	speng	Number of spinoffs in: engineering, architecture, computing, construction, electronics and electrical engineering, automotive, energy, manufacturing, forestry and logging, fuel cells, healthcare equipment, material sciences, nanotechnology, physics, software, technology, telecommunications, testing devices, other technology
35	spserv	Number of spinoffs in: consulting, educational services, environmental services, financial services, lifestyle, market research, media, psychology, publishing, transportation, catering, archaeology, other services, other business activities

36	spjoint	Number of joint spinoffs formed based on IP from more than one universities
37	splive	Cumulative number of university spinoffs alive at any year
38	spdead	Cumulative number of spinoffs that have stopped operating at any year
39	spasset	Total assets of all spinoffs by a university
40	lnspasset	The natural logarithm of spasset
41	sprev	Total revenues of all spinoffs by a university
42	lnsprev	The natural logarithm of sprev
43	fukind	University funding from the UK industry
44	avfukind	Average UK industry funding per university full-time student (divided by university size)
45	ffees	University funding from student fees
46	avffees	Average fees funding per university full-time student (divided by university size)
47	fendow	University funding from endowments
48	avfendow	Average endowment funding per university full-time student (divided by university size)
49	rgtotal	UK government recurrent grants, total figure
50	avrgtotal	Average UK government recurrent grants (total figure) per university full-time student (divided by university size)
51	rgres	UK government recurrent grants for research and technology transfer
52	avrgres	Average UK government recurrent grants for research and technology transfer per university full-time student (divided by university size)
53	rgteach	UK government recurrent grants for teaching
54	avrgteach	Average UK government recurrent grants for teaching per university full-time student (divided by university size)
55	nmrc	Number of Medical Research Council awards
56	fmrc	Total funding from Medical Research Council
57	nbbsrc	Number of BBSRC awards
58	fbbsrc	Total funding from BBSRC
59	nepsrc	Number of EPSRC awards
60	fepsrc	Total funding from EPSRC
61	nesrc	Number of ESRC awards
62	fesrc	Total funding from ESRC
63	ncouncil	Number of awards from all four UK research councils
64	fcouncil	Total funding from all four UK research councils
65	avfcouncil	Average total funding from all four UK research councils per university full-time student (divided by university size)
66	nnesta	Number of NESTA awards
67	fnesta	Total funding from NESTA
Institutional variables		
68	gdp	Gross Domestic Product by region
69	rd	R&D investment from private industry by region
Interactions		
70	coh1	Cohort 1 refers to years 1993-1999. Dummy variable
71	coh2	Cohort 2 refers to years 2000-2004. Dummy variable
72	coh3	Cohort 3 refers to years 2005-2008. Dummy variable
73	unitop	Universities where ranking<30. Dummy variable
74	unibot	Universities where ranking>30. Dummy variable
75	geogdp	Regional development in terms of GDP combined with the size of the university that is located in an area
76	geord	Regional development in terms of R&D combined with the size of the university that is located in an area

Appendix 10.4: Qualitative Data Coding

	ID	Codes	Interview 1 London South Bank University	Interview 2 University College London	Interview 3 Oxford University	Interview 4 Surrey University	Interview 5 Strathclyde University	Interview 6 Edinburgh University
Demographics	D1	No of spinoffs	14	76	68	31	55	59
	D2	First spinoff	1999	1984	1963	1981	1977	1967
	D3	TTO staff	10	42 (inc. 15 business managers)	52	9	40	70 (+3 part-time)
	D4	Location	London	London	England	England	Scotland	Scotland
	D5	Specializa-tion	KTPs	Licensing/Spinoff	Licensing/Spinoff	Licensing/Spinoff/ KTPs	Licensing/Spinoff/ KTPs	Spinoffs
	D6	Research budget, 2007	£3.41m	£94.34m	£119.60m	£48.11m	£33.80m	£68.28m

	D7	TTO structure	The other thing with this office is that it's complicated: there is research, enterprise and spinoffs...	...we are one of the few TTOs that is completely independent from the university in terms of funding... ...we fund ourselves from the profits we make and we are in a point now where we can carry on indefinitely...	ISIS is structured into three main business units: One technology transfer, the other consulting which is helping academics consult the third parties, and the third business unit is ISIS Enterprise which is selling consultancy services.		...one is getting new spinoffs formed and funded, and that can involve the business planning, the funding, putting commercial management in place, mentoring the academics... The other half is to manage the university's relationship as a shareholder... Some universities will set up a new company to do that activity, wholly owned or a subsidiary, whereas ours is part of the university structure, we are part of the university...	No data available
Domain 1	101	Accidental emergence	So if we didn't have a strategy back in the 90s, we do have a strategy now!	...[in] a lot of UK universities... there isn't anyone in specific recruited to do tech-transfer but if you are in research and administration you might be asked to do it as part of your job... I don't think it was a		...once it is embedded within the university, the universities learned there were spinoff benefits to that particular activity and were then prepared to back it without being pushed...		

				conscious decision from the part of the university to follow, I think it happened because of the circumstances at the time... ...they had a small group run my Mr X pretty much on his own that did spinoffs and all the licensing was done within the Contracts Research Office...				
	102	Income shortages	But it coincided with reducing funds for universities as well. They had started looking around for money to support their research or try to do something else. So it must have stemmed from the 1980's...		...all universities are cash-strapped themselves...			
	103	Research capacity and prior exposure to commercial activities (*naturalistic emergence*)	It also depends on what they do within a university obviously, and it's all driven by the academics (what their expertise is, what research they do) because a lot of what we do stems from original research so if the			Originally the TTO was much more focused on IP than on commercialisation and then it gradually evolved... it's a continuous process – it didn't start and stop, it was continuous.	...this office now has nearly 40 people, whereas when we started (1984) it had only 2 or 3. It helps to know that ours grew organically, whereas others had almost 40-50 people almost overnight...	In the first instance, most company formation support was provided through what we used to call our Business Development teams... Basically, we had

			university is good at winning research grants then it has more people, it can generate more business ideas etc. ...we are much lower in the RAE scores than Imperial or UCL simply because we don't have the research capacity...			...they had more research base to commercialise - Cambridge has a huge number of people and connections around the world and their name...	...the emphasis in Strathclyde has always been on applied research... One thing is that we started sooner than others. It's also the culture of commercialisation here at Strathclyde, I mean the original Principle of the university, Sir Graham Hill...	commercial people and they did licensing, they did commercial research contracts, and an academic who wanted to set up a company they did their best. There was a lot of ad-hoc company formation...
	104	Government incentives	Since 2000 along came funds form HEIF and so all these offices have expanded. It was a government initiative to generate more tech-transfer from universities and to enable universities develop an income based on their expertise. What we do is not about money. What we do is all in order to support tech-transfer because it is driven by government and the need for business.	...as the government got more and more involved in pushing commercialisation as an activity that universities should do (I think partly to get themselves into funding) then there was more and more money available to do it... ...there was HEIF money, the London Development Agency and the regional development agencies, then we had more funding to actually set up large Technology Transfer Offices...	...what Margaret Thatcher did back in the late 1980s which didn't allow BTG then to have the monopoly on technology... HEIF actually came later. There were things before like the biotechnology exploitation, there were business incubation schemes to help spinoffs, there was the University Challenge Funds in the late 90s.	...on the one hand you have the government through the various funding supporting the RAE saying this is how you judge academics and you have another piece of the government saying that we actually want to promote commercialization ...a lot of this in the past was driven by government policy and of course there was money attached to it, so people bid for the money in ways that attract the money.	We do get proposals from academics saying, "oh, look how many sources of funding I can get" like the Smart Awards... and we would say "No, you won't, you'll get some commercial value to your proposal as well – there's got to be a proper business plan, there's got to be evidence of commercial need..." But a lot of our spinoffs still come from the Proof of Concept scheme and in some cases we get	Our incubation business is not very much affected by the Scottish Executive (SE)... But... the Proof of Concept is potentially a substantial research award into the schools to pursue commercial deals... Now, none of that money has come from the SE as of yet.

			...even before HEIF, the funding schemes were made to support the community not just to make money... ...the 1988 Patents Act that states that an IP generated by a full-time employee belongs to the employer...			When we first started, the aim was to follow the government's ideas – third leg funding, let's get as much income as we can... The HEIF funds (we are going into round 4) have been instrumental in helping set up the TT offices and commercialisation I think it was more of an evolution that legislative. You know, the government created the climate, the climate said we'll become more independent and so we are further on the road than most other Europeans.	a couple of hundred thousands from that source. ...we have received help from the University Challenge Fund and the Synergy Fund...	
	105	Industry reasons	I think a lot of it came from big industries which began to cut costs and close their R&D and started using universities'. They were looking for new, original					

			research...					
	106	U.S.A. influence		...I think the UK and Europe have seen more what the US have done...	Obviously the university has some links to some US universities and schools but I don't think that impacts us. ...we do speak with other big TTOs in the US but nothing more than really personal relationships.	Would we be influenced by roles models? Yes but mostly from the US, not Europe. We probably in those days are looking to the US or the Oxbridges and those that are further along the path...	Most of what we hear about them is second hand. ...most of the things they tell us are things we already know, so I don't think it's rocket-science as they say...	We pinched that strategy from, I think it was Stanford or MIT, where we insisted on a non-dilutable equity stake...
	107	University reputation	...there may be competition but the less research-intensive could never catch up with Imperial.	...we have top-class research, RAE 5* departments (the majority of them), we've got Nobel Prize winners, leaders in all sorts of research fields and obviously that helps...				
	108	Regional development policies	it's all about the impact of regional strategies on technology transfer and business development... There's four proof-of-concept funds in London for university pre-commercial funding so that impacts on spinoffs...		The regional development agencies care about whether we create jobs for the local economy but do the project managers think "Gosh, I've got to spin this company out instead of licensing it because it will create jobs"? No they don't!			

			It's all about how universities can improve and bring London together in terms of "this is what London has"		...if you compare the Oxford cluster vs. the Cambridge cluster in areas, the Oxford cluster is very much home-grown...			
Domain 2	201	Revenue/ income	But I mean we have centres in the university, one of them is the food centre, which is supported by income from commercial activities... ...one of our earliest [spinoffs] is still going and making money – not astronomical amounts of money but making to pay back dividends for the university... This universities brings in more money from KTPs which you could argue are much more useful in the generation of business and GDP than spinoffs have. What we do is not about money.	...we are trying to get most of the equity at the beginning because we invest our own money... ...in terms of income, we probably got more income from licensing than we got from spinoffs... ...I think we sell one of our spinoffs every three years and we normally expect an income of about £10m for each sale... ...what we are trying to do with spinoffs is get the money from the equity sale but we also have licenses to sell so we have an ongoing revenue stream... ...it's maybe 50-60% licensing and the rest is spinoffs...	...what happens is revenues that comes to ISIS, ISIS takes 30% and the rest is sent down to the university and they divide it according to their structure... So we don't make a profit – everything we get we send straight down to the university.	...the university isn't so much bothered about the income generation, not any more... ...even the best universities in the world like MIT do not earn more than 3% of their entire budget from their commercialisation activities... ...if you really look at Surrey, to contribute 1% of the budget here and there, isn't in commercial terms material to the survival of the university... ...you get a nice spinoff then you sell it every 2-3 years, you can't run it for an annual budget though. We try to look upon these windfall gains as	The commercialization office here is not for the purpose of generating income for the university - we regard that some kind of a bonus, rather than the reason we are here.	...excluding sort of two or three star players, that doesn't create an awful lot of return for the university. ...appearing in a "field" publication for venture capitalists or angels is even more important. It is practically more important! It's important that people know that, to attract entrepreneurs, management teams, investors...

						useful for doing things that you wouldn't normally be able to do... The benefits in cash terms are always much less that the headline figures because of sharing it with the academics. It's not so much a government thing, it's a Research Council thing. The government gives money to Research Councils and these are then responsible for giving out the money.		
	202	Risks		...a spinoff, is a higher-risk, higher-return investment... ...if it goes down then we lose a lot of money and we're still in control if we still hold the majority of the equity so we'll then have to sort it out... bring a receiver or an administrator...				
	203	Outsourcing agreements	...we don't have enough IP but yeah	Organisations such as IP Group that have	IP Group put in £20m to make a new	...you ended up creating spinoffs	We felt that they would put pressure to	We don't like the IP Group and we

			we would talk to people, we would consider [outsourcing] if we thought it was beneficial.	gone in and done deals with the universities have helped (whether it's a good thing for the universities is another question) but it has made more companies spun out or get listed so they are much more in the public eye...	chemistry building... The other one we have is with Technikos which is very similar to the IP Group deal. So it doesn't affect how we commercialise things.	perhaps but they were a little bit unready and most of them tended to be undercapitalised and with the wrong management team but when IP Group came on board we now have a different character within the TTO... They have a whole range of contacts in the marketplace for creating a high-quality spinoff with the right management team, the right level of capitalisation to take it to the next stage. ...they help us with due diligence, even with what might end up being a licensing opportunity because in order to determine whether they want to use it as a spinoff, they do all the due diligence. ...so six and a half months with a market capitalisation of	focus on winners and the day to day input and reliance on the funds is something we weren't comfortable with...	refused it. We wanted to put in place a fund similar to the IP group but it would have the first right to look, not the first right to refuse. There may be perfectly good reasons for IP Group to decline to invest in a particular proposition because they are exposed already to a particular sector and they don't want more exposure...

						£70m and they raised £30m in cash. And there is absolutely no way that this university (and I would argue any university) would have done this without someone like the IP Group.		
	204	Negatives		I think it's increasingly hard if you are an academic to teach, to raise money, to get grants, to be involved in reviewing other people's papers, to make sure you keep a publications record and then, on top of that, for us to ask them help us write patents, to help with doing contract research... Some are ambivalent, some just think it's wrong to commercialise basic academic research and some are very pro-doing research...		Negative effects? To be honest I don't know. I don't think so. Did we lose anything that I can point to? Not really...	...there was an academic who left to manage a spinoff company and as a result... research teams can break up in the relevant department of faculty... Some spinoffs had to be set up and occupy space within the university and they needed particularly lab space etc. Some conflicts of interest have to be carefully managed and sometimes they cause friction.	
	205	Metrics	...universities were measured by number of patents they apply for and the number of	...it's the long-term growth of the spinoffs rather than just the number...	Back in the late 90s the measurements were very numerical so "how many	Number of spinoffs, no! So the long-term growth... our only involvement is that is	We would highlight the level of licensing particularly to the pharmaceuticals and	So, I think a volume approach to company formation is not

			spinoffs, not whether the patents went anywhere or were licensed or whether the spinoffs were good at all!	...there was pressure from the government and they wanted to see how many spinoffs you've set up - the fact is you can set up a spinoff in a week if you want it...	academics have you met", "how many patents have you filed"...	has the right base to start with... but the long-term growth has nothing to do with us... So fewer numbers, better capitalised, better quality, better management, yes!	the 40+ spinoff companies we have formed and the jobs that they have created.	dissimilar to portfolio approach over shares...
	206	Networking with other universities	...competition right now is less important... and instead they [we] look more to collaboration.			...we get involved in the incubation of companies through the partnership between Surrey, Southampton, Bath and Bristol for the furtherance of the incubation... ...those four universities decided that they would be able to attract more funds by putting together a collaborative bid where we needed some momentum, some critical mass...		So there is a [cross-university] collaboration there; it's a top-down collaboration in many respects... But the collaboration in the truer sense isn't really there as much as it was in the past!
	207	Holding equity in spinoffs	It used to be 25% but now we keep it under 24%... ...in a spinoff the academic will initially be able to		Oxford also cares about the fact that it has stakes in those companies and often quite big equity stakes - we have people looking after	The university is not in the business of being a shareholder in external companies. So the university will exit when it feels it to be	It's our policy that where the initial value is entirely based on university IP we would seek 20% after seed funding.	...the university is always inclined to own an equity stake, and that equity stake is essentially differed royalty.

			take the majority of the equity...		companies where we have a stake in.	appropriate. The university's objective is to hold the shareholding for a realistic, reasonable amount of time to allow the company to become stable, profitable and then generally speaking probably to take an exit and concentrate on something else...	We never look for a majority shareholding but we always seek a significant minority shareholding. Our view is that we are entitled to a stake given all the support that we provide... If we go about it in the right way, investors will see it as a positive sign. Some are a bit nervous about it...	There is typically an equity stake in a newco of about 15%...
	208	Role models	...the real model of what should be done in the pathways is King's College. ...if you look at the reports on commercial activities you know... Oxford, Cambridge, Imperial are top of the scale. ...there is a lot that we can learn from all the universities...			Would we be influenced by roles models? Yes but mostly from the US, not Europe. We probably in those days are looking to the US or the Oxbridges and those that are further along the path...	Probably the ones who have the best track records are Edinburgh (it has the biggest research base)... In England you hear about Oxford and Cambridge and, obviously, Imperial... I think it's fair to say that other schools have come to us, to learn from us. I mean, there are offices that are run by people who started their careers here...	
	209	Further			We also help attract			one of the

		research funding			further research funding for the university... A lot of it is from the industry.			problems is if we have shares in the company that has spun out of engineering and sell the shares and reinvest the money in the informatics, then what happens when we sell the company from informatics?
	210	Strategy	...it's not only one person, the academic or the person sitting here (and supporting it with IP or thinking of ways to take it), it's also the support from the rest of the university, the finance, so the learning and the willingness which can come right from the top, the Vice Chancellor. ...we have a very good course here called engineering and product design.		...we are structured into three main business units: One technology transfer, the other consulting and the third business unit is ISIS Enterprise... ...the university now has a solid commitment which without doubt has been one of the things that has allowed ISIS to grow compared to other tech-transfers.		Well, we've always taken the view that we should set the bar very high and we try to ensure that our spinoffs have the necessary cash for at least 18 months and that they have a strong management team.	...there is an inevitable synergy between the companies formed and the university, because they come from here, and that's the important thing. And that's why we are not particularly focused on spinoffs. That's what started creating growth in the sector and it became apparent that universities had a great opportunity.., an untapped resource...

Domain 3	301	Public awareness	...media coverage is good, we have a bulletin that goes out to all the staff – we put our things on our internal web pages and people can read them if they want to...	...[media] has increased awareness I think with the public that we do commercial deals and that is something good... It used to be accepted that universities were publicly-funded and now it has become more and more obvious that that was never fully the case...	... in the late 90s or early 2000's it was probably still regarded as, well, the oddballs go to tech-transfer, they don't really know what they want to do – don't quite want to be an academic but don't want to be in the industry...	...the early criticism as I said was about the use of public funds. I think the climate has changed, nobody raises that in a serious public forum anymore...	...the public recognises that we are not Ivory Towers who are kind of cut-off from the communities within which they are based. So star companies tried to advertise themselves.., it would certainly add value to the university.	I think there's always been an interest although it never went to the front pages. So it is forming public opinion, yes.
	302	Recruitment of students/staff or research collaboration		...if you are a student and you want to apply to a particular applied area in science or business and you go to a university where they do commercial activities then it is more likely to want to go there than to a university that doesn't... ...students are probably much more aware now of what UCL does and might want to come to UCL over and above other universities... ...and when the	...because they also use it to attract research and researchers who have perhaps been thinking of coming to the UK to take up a post will come and see me first. I've had some lectures who come here, I had one a couple of months ago and he came here first to talk through what we do in tech-transfer. They've all got PhDs [at the TTO]	People who want to work in space come to Surrey because it has a good space centre and a big spinoff company that comes with it and within that part of the academic fraternity we are well known for that...	I'd like to think that it figures at the perception of Strathclyde as a university, and maybe some postgraduates do take that into account when they decide to come here.	I think often researchers are focused on what they are doing and... I mean there are examples of joint research but... but that's very occasional...

				students get better then the better post-docs you get... the better teachers you get because they like the calibre students that you have. The whole thing snowballs and you end up with a much better university that is more profitable, has more students, can charge more and you get more industry contracts... We have had people who came to work here because of the commercial opportunities and professors who have moved their whole group from their universities...			
	303	Reputation	And if we never make any money from our entrepreneurial students they have brought us so much positive media coverage that is is fantastic. I don't think it necessarily impacts (I	...there was a press release about that company and we always try to get them to put down the fact that it was a UCL company...	...are we going to spin-out something that we would see as a totally unethical company? No! We care deeply about the university's reputation... I don't really think [media] has had much of an effect	...commercialisa-tion if used correctly and marketed correctly can be a wonderful incentive for attracting good quality undergraduate students, postgraduate students and it gives the university a certain profile within the	I do my best to make sure we still get credit for them (the "glory") because if a company is turning over several billion pounds and is employing 60-70-80 people then you still want the world to know that you started it...	Six-seven years ago they got caught up in the politics of what people did discussing whether universities were being too greedy... So all these things get press interest and the university tries to make the

			think it's good) on the rest of the university – it impacts us as a department because it raises our profile as an important entity within the university... About Time Design was the guy that went on the Dragon's Den and he was offered money and he turned it down. And the following weeks the phone didn't stop ringing with people wanting to invest.		because if you look at it a lot of the media coverage on tech-transfer is negative. One thing this does is it raises the profile of Oxford, then, for example we've just done a big deal on T.V. which means... there hasn't been a new TB vaccine since 1921, so you know...	marketplace... And good commercialisation or doing things for the community or simply selling a company is something that can turn into a public relation story.	...depending on how much is going on, the local newspapers will report it. At the moment there is no shortage of business stories but we have done even better at other times....	most of that... In terms of day-to-day stuff, it tends to go to the business pages, and gets reported in a very factual way...

Notes:
Domain 1= Rationale behind decision to engage in spinoff formation
Domain 2= Measuring success/benefits of spinoffs
Domain 3= Media coverage of spinoffs