

1. Introduction

What do Cirrus Logic, the semiconductor company, Lycos, the Internet search engine, and Genentech, the biotechnology firm, have in common? All were firms founded to exploit technological inventions made by faculty, staff or students of American universities. Throughout the history of the modern university, but particularly in the United States since the passage of the Bayh–Dole Act in 1980, these types of firms, called university spinoffs, have become important parts of the economic landscape.

Moreover, university spinoffs are becoming a significant global phenomenon. In the United Kingdom, university technology commercialization activities accelerated in the late 1990s, a period when many UK institutions established university technology transfer offices (Wright *et al.*, 2002). Charles and Conway (2001) report that United Kingdom universities have generated 338 spinoffs over the past five years. In fact, in the United Kingdom, 175 spinoff companies were incorporated in 2001, a figure equal to approximately 31 percent of the 554 university spinoffs formed in the 1996 to 2001 period (Wright *et al.*, 2002).

Other countries are also seeing significant growth and interest in spinoff activity. Governments in continental Europe are devoting increasing amounts of money to universities, with the goal of turning them into engines of economic growth through spinoff company formation. Asian universities are increasing their production of university spinoffs by adopting new policies that favor the formation of these companies. For instance, the Japanese government recently changed its intellectual property laws to favor spinoff company formation, and universities in other Asian countries are reporting significant increases in the formation of these entities.

University spinoffs are an important class of firms because they are an economically powerful subset of high technology start-ups. Although only 3376 university spinoffs were founded in the United States between 1980 and 2000 (Pressman, 2001), on average, these companies are extremely successful firms. Not only can we count several billion dollar public companies among them, but research also shows that they are significantly more likely than the average firm to go public. For example, Shane and Stuart (2002) report that, from 1980 to 1986, 18 percent of all spinoffs from the Massachusetts Institute of Technology (MIT) went public, a rate of initial public offering over 25%

times higher than that of the average firm. Moreover, in some industries, like biotechnology, university spinoffs are the dominant form of technology start-up, with as many, if not more, biotechnology start-ups emerging from university research laboratories than out of corporate research laboratories.

Perhaps because of the economic importance of university spinoffs, many university administrators, policy makers, and would-be entrepreneurs both inside and outside academia have become very interested in these firms. As a result of this interest, many universities have begun to invest significant resources in their development. Many, if not all, the major research universities in the United States, Canada and the United Kingdom have technology transfer operations with professionals who track faculty, staff and student inventions, seek intellectual property protection for those inventions and then license those inventions to private sector firms that commercialize them. Not only has the number of US universities with these offices grown rapidly over the past 20 years, but also the volume of patenting and licensing of university inventions and the employment levels of university licensing offices have grown dramatically over the same time period.

Moreover, many of these institutions focus significant attention on the spin-off company licensees of university intellectual property by establishing incubators, venture capital funds, business plan competitions and support systems to help entrepreneurs to start new companies to commercialize university inventions. Policy makers, seeing the positive effect of these new companies on local economic development, have been supportive of these efforts, particularly at US state universities, which are viewed as having a mission to promote local economic development. As a result of this interest in spinoffs, many US state universities have made their creation a central activity, with some universities, like Iowa State University, even putting the creation of spinoff companies into their strategic plans.

In parallel with this growth in interest in spinoff companies, there has been a significant growth in the creation of these companies in the United States over the past 20 years. The Association of University Technology Managers (Pressman, 2002) reports that the proportion of university technology in the United States that is licensed to spin off companies has grown every year since 1980, with the proportion of spinoff company licenses reaching a high of 14 percent in 2002.

Given the level of interest in university spinoffs among university administrators, policy makers, and would-be entrepreneurs both on and off academic campuses, one would expect that the topic would be the subject of significant academic inquiry. However, scholarly investigation of this phenomenon is virtually non-existent. Only a handful of books and scholarly articles that discuss any aspect of university spinoffs have ever been written. Moreover, the focus of these books and articles has often been on a particular dimension of

spinoff activity, such as the specific case of biotechnology, or the effect of spinoff companies on the academic mission of universities, leaving the general topic of spinoffs largely unexplored.

As a result, 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, the process of spinoff creation and development, the factors that influence the performance of university spinoffs or the effect of spinoffs on the universities that create them. Simply put, we have very little information about many aspects of spinoff activity, and no systematic effort has been made to assemble in one place the pieces of knowledge that we do have. Our knowledge of spinoff companies and their links to universities and society at large is fragmentary and quite limited.

THE PURPOSE OF THE BOOK

The purpose of this book is to describe and explain the formation of university spinoff companies and account for their role in the commercialization of university technology and wealth creation in the United States and elsewhere. Specifically the book has six goals. First, it seeks to explain why university spinoff activity is an important subject of scholarly investigation. Second, it traces the historical development of university spinoff activity. Third, the book aims to describe how four major factors – the university and societal environment, the nature of technology, the industries in which spinoffs operate, and the people involved in the spinoff process – jointly influence spinoff activity. Fourth, the book seeks to explain the process of spinoff company creation, focusing on the development of university technology into new products and services, the identification and exploitation of markets for these new products and services, and the acquisition of financial resources for the new organizations that exploit university technologies. Fifth, the book aims to examine the factors that enhance the performance of university spinoffs, hoping to differentiate successful and unsuccessful companies. Sixth, it seeks to discuss the effect that university spinoffs have on the institutions that spawn them.

To achieve these goals, this book provides conceptual arguments, reviews existing work by academic researchers and informed observers, and offers new primary data collected from my studies of spinoffs from a range of US academic institutions, and my in-depth investigation of spinoffs from the Massachusetts Institute of Technology founded between 1980 and 1996. For each topic presented, the book provides both conceptual arguments and either primary or secondary empirical evidence. Some of this evidence is based on large sample, quantitative studies, while the rest is based on small sample,

qualitative evidence. Some of this evidence comes from my own primary empirical research (which will be described in more detail below), while the remainder comes from the work of other scholars.

To develop a systematic explanation for university spinoffs, the book weaves the explanations for the different aspects of university spinoffs into a general framework. In doing so, it adheres to the same definition of a university spinoff (to be explained below) when discussing all dimensions of spinoff activity, and seeks to adhere to the same basic assumptions about spinoffs throughout the chapters. The book also outlines the relationships between the different parts of the university spinoff story so that readers can see the phenomenon as a related whole, rather than as unrelated fragments of information.

THE DEFINITION OF A UNIVERSITY SPINOFF

To investigate a topic, researchers must first define it. This book defines a university spinoff as a new company founded to exploit a piece of intellectual property created in an academic institution. 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 definition of a spinoff employed here. Thus university spinoffs are a subset of all start-up companies created by the students and employees of academic institutions.

Sometimes patents, copyrights and other legal mechanisms are used to protect the intellectual property that leads to spinoffs, while at other times the intellectual property that leads to spinoff company formation takes the form of knowhow or trade secrets. Moreover, sometimes entrepreneurs create university spinoffs by licensing university inventions, while at other times the spinoffs are created without the intellectual property being formally licensed from the institution in which it was created.

These distinctions are important for two reasons. First, it is far harder for researchers to measure the formation of spinoff companies created to exploit intellectual property that is not protected by legal mechanisms or that has not been disclosed by inventors to university administrators. As a result, this book likely underestimates the spinoff activity that occurs to exploit inventions that are neither patented nor protected by copyrights. This book also underestimates the spinoff activity that occurs ‘through the back door’: that is, companies founded to exploit technologies that inventors fail to disclose to university administrators.

Second, universities are much more likely to manage the intellectual property created on their campuses now than they were in earlier periods in their histories. As a result, this book likely underestimates the spinoff activity that

occurred in previous periods, when university inventors were more likely to patent their inventions directly and did not need to license back their inventions to found spinoff companies. Moreover, many of the historical examples of university spinoffs described in this book are companies that successfully exploited university knowhow or trade secrets, rather than licensed inventions.

In the current institutional environment, the faculty, staff and students of most universities in the United States, Canada and the United Kingdom are required to assign to the university where they work or study the rights to any inventions that they make while at the university. However, universities differ as to whether student inventions made in the normal course of their studies are included in this requirement.¹ They also differ as to how much of the university's resources inventors are allowed to use without triggering institutional ownership of the invention. Furthermore, universities differ as to how vigorously they enforce their intellectual property rights, and how much effort they put into enforcing inventor disclosure of potential inventions. Nevertheless, one can say that, on average, when faculty, staff or students invent new technologies in universities in the United States, Canada and the United Kingdom, the institutions in which the inventors are located typically assert their rights to the inventions, and seek to make decisions about their disposition. In some cases, entrepreneurs found new companies to exploit that intellectual property, creating university spinoffs.

It is important to note that the definition of university spinoff used in this book differs from definitions used by other researchers. For example, some authors (such as Roberts, 1991a) have defined spinoffs as companies founded by anyone who has studied or worked at a university. Other researchers view spinoffs as companies where academic scientists serve on scientific advisory boards in return for equity compensation. This book does not employ these alternative definitions, for four reasons. First, to define university spinoffs as companies that are founded by anyone who has ever studied or worked at a university would require the discussion of such a wide range of new companies as to be theoretically meaningless. For example, including the real estate side businesses of university faculty members as university spinoffs would seem to be inconsistent with the idea of understanding the creation of new companies based on intellectual property created in universities. Second, comparing companies founded by people who attended or worked at a university many years earlier means that the factors leading to the formation and development of the new companies are distantly related to the university, at best. Third, it is not clear that focusing on the people who found companies rather than the opportunities that they exploit is the best lens through which to view entrepreneurial activity (Shane and Venkataraman, 2000). Fourth, many of the companies that give equity ownership to faculty members who serve on their scientific advisory boards are not new companies, but instead are small,

established firms. As a result, including companies that offer equity to scientific advisors with new companies founded to exploit university inventions confounds new firm creation with ownership-based definitions of entrepreneurial activity.

Because of the differences between the definition of a university spinoff used in this book and those used in previous books and articles, the findings in this book are not directly comparable to the findings of many prior researchers. As a result, this book discusses in greatest detail the findings of those authors who use the same definition of a university spinoff as this book, and makes more sparing use of the findings of authors who have different definitions. Astute readers of the British literature on university technology transfer will note that this book's definition of spinoffs is most closely related to the definition of 'spinout' companies as discussed in that literature. Therefore British studies of spinout companies are discussed in great detail in this book.

While most university spinoffs exploit patented inventions, not all do. Many software spinoffs also exploit technologies that are protected by copyrights. Other spinoffs exploit university intellectual property that is protected neither by patents nor by copyrights. For example, the Wharton Economic Forecasting Association was a spinoff founded by Nobel Prize-winning University of Pennsylvania economist Lawrence Klein, who contracted with the University of Pennsylvania to license the Wharton name for his financial forecasting firm (Matkin, 1990). Nevertheless, almost all of the academic research on this topic focuses on patented inventions. Therefore most of what will be discussed in subsequent chapters examines the formation of new companies to exploit university-assigned patented inventions.

Faculty, staff or students can found university spinoffs, as all three of these groups develop new technologies on university campuses. While the distribution of inventors who create spinoff technologies across the categories of faculty, staff and students differs by type of technology, on average, university faculty members create most of the intellectual property that leads to university spinoffs.

While the inventors of the technology that leads to university spinoffs are, by definition, faculty, staff and students of academic institutions, the entrepreneurs that lead the efforts to found these companies need not be members of the university community. University spinoffs can be, and often are, created by entrepreneurs who come from outside the academic institution to lead the effort to exploit university technologies to create new firms. Similarly, investors who bring together external entrepreneurs and university technologies to establish new companies are another category of lead founders of university spinoffs. Empirical data on the spinoffs founded to exploit MIT-assigned intellectual property between 1980 and 1996 indicate that university

inventors were the lead entrepreneurs in approximately one-third of the spinoffs, with the other two groups each driving the formation of approximately one-third of the new companies as well.²

AN INTERDISCIPLINARY APPROACH

This book takes a phenomenon-oriented, rather than disciplinary, perspective on university spinoffs. While many scholars in business schools focus on articulating a particular disciplinary perspective, using a phenomenon as a setting in which to test the theories of that discipline, this book focuses on explaining the spinoff phenomenon, using a variety of theoretical frameworks to understand it. As a result, the approach of this book differs from the approach that would be taken by economists, historians, political scientists, psychologists or sociologists who might seek to examine spinoffs through the theoretical lens of their fields.

The present approach is undertaken because understanding university spinoffs seems to require an interdisciplinary investigation. While the fields of economics, law, psychology, public policy and sociology all illuminate some dimensions of spinoff activity, none of these perspectives appears to illuminate all dimensions. Moreover, in the absence of a broad and deep empirical literature on university spinoffs, consideration of disciplinary disagreements about university spinoffs seems premature. Rather, an effort to provide a straightforward and logical explanation for university spinoffs, coupled with an effort to organize the empirical findings on university spinoffs in a coherent manner, seems to be a promising way to advance our understanding of this phenomenon. Furthermore, each of these lenses appears to be a complement to, rather than a substitute for, the alternative perspectives. As a result, the examination of university spinoffs through multiple perspectives provides a much richer understanding of the phenomenon than each of these perspectives provides on its own.

THE STRUCTURE OF THE BOOK

This book has a very simple structure. The first section, encompassing the next two chapters, focuses on explaining why university spinoffs are important economic entities, and on describing the history of university spinoff activity. The second section of the book, incorporating the subsequent five chapters, discusses the set of factors that affect the creation of university spinoffs, including the university environment, the societal context in which the university and the spinoffs operate, the technology that would be exploited by the

new company, the industry in which the spinoff would operate, and the people involved in founding spinoff companies. The third section of the book, including Chapters 9, 10, and 11, discusses the process of creating university spinoffs. The first of these chapters discusses the process by which university technologies are created from scholarly research, resulting in inventions that are sometimes patented and licensed, and sometimes lead to the formation of new firms. The second of these chapters focuses on the transformation of the university invention into a product or service and the development of a market, whereas the third of these chapters focuses on the acquisition of financial capital by the new company. The final section of the book consists of three chapters devoted to discussing the implications of spinoff activity: the first discusses the factors that influence the performance of university spinoffs; the second discusses the downside of spinoff activity for universities; and the third provides general conclusions for the book. Below, I provide a brief introduction to each of the chapters.

Chapter 2 explains why university spinoffs are an important topic of investigation, pointing to their economic impact, and the impact that they have on the universities that spawn them. Specifically, this chapter discusses a variety of ways in which university spinoffs benefit society and universities, including their effects on local economic development, their ability to produce income for universities, their tendency to commercialize technology that otherwise would be undeveloped, and their usefulness in helping universities with their core missions of research and teaching.

Chapter 3 discusses the history of university spinoffs. Starting with a brief description of spinoff companies in 19th-century Germany, where the modern university was born, this chapter traces the involvement of universities in the creation of new technology companies over time. The chapter discusses university spinoff activity in the United States since the passage of the Hatch Act in 1887, which established the land grant university, and introduced the linkage between universities and commercial economic activity in the United States. Chapter 3 also explains how changes generated by the two world wars and the Cold War influenced spinoff activity. The chapter focuses attention on the key watershed event in the history of university spinoffs in the United States: the passage of the Bayh–Dole Act in 1980, which gave universities the property rights to federally funded inventions. In particular, it describes the meteoric rise in the number of university spinoff companies since the passage of the Bayh–Dole Act, from fewer than 90 per year in the 1980s to over 500 in 2000, and explains why four central forces (the birth and growth of biotechnology; changes in university patent rights; changes in patent laws; and changes in the spinoff financing process) have led to this dramatic growth.

Chapter 4 discusses the variance across universities in their tendency to produce spinoff companies. This chapter explains why some universities, like

Arizona State University and Harvard University, produce virtually no new companies, despite generating a large number of technological inventions, whereas other universities, like Carnegie Mellon University and Massachusetts Institute of Technology, produce a much higher number of spinoff companies, given their level of technological invention. This chapter explains why university policies toward exclusive licensing, the distribution of royalties to inventors, holding equity in spinoff companies, faculty leaves of absence, the use of university resources to develop spinoff company technologies and pre-seed stage investment funds all influence the rate of university spinoff activity. Chapter 4 also explains how three characteristics of university technology transfer offices – resource richness, start-up company expertise, and network ties to investors and other spinoff company stakeholders – influence rates of spinoff company formation across academic institutions. Finally, this chapter explains how university cultures that reinforce entrepreneurial activity, the presence of entrepreneurial role models, the tendency of university researchers to obtain industry rather than government funding, and academic prestige also influence the variance in spinoff rates across universities.

Chapter 5 examines the effect of the institutional environment on university spinoff rates. The chapter documents differences in rates of university spinoff activity that exist across different geographic locations. It also explains why and how four environmental factors affect the level of spinoff activity in a particular location: access to capital, locus of property rights, rigidity of the academic labor market and the industrial composition of the area.

Chapter 6 explores the types of technologies that tend to be used to generate spinoff companies. Because established firms have a variety of advantages in commercializing technology, including complementary assets in manufacturing, marketing and distribution, only some university inventions are appropriate for creating spinoffs. This chapter explains why radical, tacit, early stage and general-purpose technologies, which provide significant value to customers, represent major technical advances and have strong intellectual property protection, are more likely than other technologies to provide the basis for spinoffs.

Chapter 7 examines the widespread variation across industries in the creation of university spinoffs. The chapter explains why university spinoffs are most common in biomedical industries, focusing on the effects of the collapsed discovery process in biotechnology, the long commercialization time horizon in the life sciences, the increasing production of biomedical inventions at universities, the locus of life science expertise in universities, the limited cost sensitivity of customers for biomedical products and services, and the discreteness of biomedical inventions. In addition, Chapter 7 identifies specific industry characteristics that prior research has found are associated with spinoff company formation, including the effectiveness of patents, the

importance of complementary assets in manufacturing, marketing and distribution, the age of the industry's technology base, the degree of market segmentation, and average firm size. Finally, this chapter discusses the industry conditions that make university spinoffs more effective than established firms at commercializing university inventions, and explains why industries with a large number of firms, with less value added generated from manufacturing, and smaller markets are more amenable than other industries to spinoff company efforts to commercialize university technology.

Chapter 8 explores the role of people in the process of creating university spinoffs. The chapter discusses the central role that university inventors play in the formation of these companies. In addition, it describes the three types of entrepreneurs that lead the efforts to found university spinoffs: the inventors of the technologies (inventor-led spinoffs), external entrepreneurs who license university inventions (external entrepreneur-led spinoffs) and investors who bring together inventors and entrepreneurs to create new companies (investor-led spinoffs). Chapter 8 also explains the differences in the spinoffs founded by these three types of lead entrepreneurs and discusses the reasons why inventors found spinoffs, focusing on the effect of psychological attributes and career-related factors, the two dominant explanations in the literature to date.

Chapter 9 describes formation of university spinoffs. Beginning with research funding, this chapter traces the creation and disclosure of technological inventions, and the patenting and marketing of those technologies. It also explains the process of spinoff company formation, providing an explanation for how entrepreneurs discover commercial opportunities in university technologies.

Chapter 10 discusses the development of university technologies by spinoff companies. In particular, it explains why and how spinoff company founders transform their technologies into new products and services. Chapter 10 also explains how the founders of spinoff companies evaluate their markets, identify customer needs, gather feedback from customers, choose applications and sell their new products and services.

Chapter 11 discusses the acquisition of financial resources by university spinoffs. The chapter explains why spinoffs require large amounts of external capital and why, outside of biotechnology, this initial capital generally comes from the public sector, rather than from private investors. Chapter 11 also explains how the information asymmetry and uncertainty generated by university spinoffs necessitate two very important processes in private sector financing: the founders' use of information to demonstrate the value of their ventures to potential investors, and the exploitation of social ties between investors and entrepreneurs. Finally, this chapter discusses the matching of spinoff ventures to the right types of investors, such as business angels and venture capitalists.

Chapter 12 describes the performance of university spinoffs and identifies the factors that differentiate more successful spinoffs from less successful ones. The chapter explains how the human capital of founders, the amounts of financial capital raised by the new ventures, the founders' efforts to meet customer needs, the new ventures' technological base, the new firms' strategy and the support provided by the university from which the spinoff emerges all influence the performance of university spinoffs.

Chapter 13 discusses the disadvantages of university spinoffs. First, it explains how university spinoffs create several problems for the traditional model of universities as a source of knowledge creation for the good of society, including exacerbating the conflict between applied and commercially oriented fields, like engineering and business, and less applied and commercially oriented fields like the arts and humanities; reorienting faculty and staff effort toward commercial goals and away from the scholarly goal of knowledge creation; and creating conflicts of interest between the faculty and the institution at large. Second, the chapter explains how spinoff companies generate problems for the management of technology transfer in universities by raising the cost and difficulty of technology transfer and by imposing greater risks on the university than does licensing to established firms.

The final chapter of this book summarizes the key ideas discussed in the other chapters and links them together to create an overall picture of university spinoffs. This chapter also points out additional dimensions of university spinoffs not covered in depth in this book, so that readers may consider them, and highlights those topics most in need of additional scholarly research and policy discussion.

THE RESEARCH UNDERLYING THE BOOK

This book is the result of over seven years of scholarly research on university spinoffs that began when I first started to teach at the Sloan School of Management at the Massachusetts Institute of Technology in the summer of 1996. This research continued during my tenure at the Robert H. Smith School of Business at the University of Maryland and the Weatherhead School of Management at Case Western Reserve University. While this research initially began with in-depth qualitative studies of the technologies and companies that spun out of MIT, it has also included surveys of investors, statistical analyses of MIT inventions, and quantitative comparisons of different universities' technology licensing activities. The arguments and evidence described in the chapters that follow are based on a variety of different research projects conducted with many co-authors.

One of these projects, conducted with Dan Cable of the University of North
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Carolina at Chapel Hill, surveyed 202 seed stage venture capitalists and business angels, and conducted in-depth interviews with the entrepreneurs and financiers of 50 spinoffs from the Massachusetts Institute of Technology. Published in the journal *Management Science*, in 2002, in an article entitled 'Network ties, reputation, and the financing of new ventures', this effort sought to understand the venture finance decisions of early stage investors in new firms.

Another project, conducted alone, examined in-depth case studies of eight new ventures founded to exploit a single invention assigned to the Massachusetts Institute of Technology. Published in the journal, *Organization Science*, in the summer of 2000, this study, entitled 'Prior knowledge and the discovery of entrepreneurial opportunities', sought to understand how entrepreneurs discover business opportunities in new technologies.

A third project, also conducted alone, explored the firm-founding patents among the population of 1397 inventions assigned to the Massachusetts Institute of Technology between 1980 and 1996. The goal of this project, which was published in the journal, *Management Science*, in 2001 under the title 'Technology opportunities and new firm creation', was to identify the dimensions of university technology that make some inventions more likely than other inventions to be exploited by spinoffs.

A fourth project, conducted alone as well, explored the firm-founding patents among the population of 1397 inventions assigned to the Massachusetts Institute of Technology between 1980 and 1996. Also published in the journal, *Management Science*, this project, entitled 'Technology regimes and new firm formation', sought to identify the industry characteristics that encouraged the formation of spinoff companies as a mode of technology exploitation.

A fifth project, conducted with Rakesh Khurana of Harvard University, also explored the firm-founding patents among the population of 1397 inventions assigned to the Massachusetts Institute of Technology between 1980 and 1996. Published in the journal, *Industrial and Corporate Change*, in 2003 under the title 'Bringing individuals back in: The effects of career experience on new firm founding', this study sought to identify the characteristics of university inventors that encourage the formation of spinoff companies as a vehicle for technology commercialization.

A sixth project, conducted with Toby Stuart of Columbia University, examined the life histories of the 134 companies founded to exploit inventions assigned to the Massachusetts Institute of Technology from 1980 to 1997. Published in the journal *Management Science*, under the title 'Organisational endowments and the performance of university start-ups', this study had as its goal the examination of the effect of social relationships and business strategy on new venture finance and development.

A seventh project, conducted with Atul Nerkar of Columbia University,

also examined the life histories of 134 companies founded to exploit inventions assigned to the Massachusetts Institute of Technology from 1980 to 1997. The purpose of this research project, published in the *International Journal of Industrial Organization*, under the title ‘When do startups that exploit academic knowledge survive?’, was to identify the effect of the relationship between industry conditions and technology characteristics on the survival of university spinoffs over time.

An eighth project, conducted with Riitta Katila of Stanford University, examined efforts by new and established firms to commercialize the 966 inventions licensed by the Massachusetts Institute of Technology from 1980 to 1996. The purpose of this study, entitled ‘When are new firms more innovative than established firms?’, was to investigate the effect of industry conditions on the exploitation of commercialization of university inventions by new and established firms.

A ninth project, conducted with Dante DiGregorio of the University of New Mexico, examined the formation of spinoff companies out of the university technology licensing offices of 101 US universities from 1994 to 1998. The purpose of this study, which was published in the journal, *Research Policy*, under the title ‘Why do some universities generate more start-ups than others?’, was to identify the university characteristics that enhance and inhibit spinoff activity.

This book also provides primary data not previously published in scholarly articles. In particular, it includes a great deal of material from field interviews conducted with people involved in the formation and development of MIT spinoffs. These interviews were semi-structured and ranged in length from 30 minutes to two hours. In conducting the interviews, I sought to obtain information from several parties involved with each new venture. Interviewees included inventors, entrepreneurs, investors, licensing officers and other stakeholders of the new ventures. While the data from these interviews are used to support many of the arguments presented throughout the book, this information provides the bulk of the evidence behind the arguments made in Chapters 9 and 10 about the process through which university spinoffs are formed and develop their technologies and markets.

This book also takes advantage of the wealth of data collected by the Association of University Technology Managers on trends in university technology transfer and spinoff activity in the United States over the past 20 plus years. I use these data to document the dramatic increase in spinoff companies from US research universities in recent years.

The book also draws heavily on the work of other scholars who have studied university spinoffs. While the group of scholars investigating this subject is not large, many of them have made important contributions to our understanding of this topic. Because many of my arguments would be incomplete or

unsupported without reference to the contributions of other scholars, I make use of published papers on university spinoffs and technology transfer that I have read in scholarly journals or conference proceedings, as well as unpublished research that I have seen presented at conferences. In particular, I draw heavily upon the research of Sue Birley and Nicos Nicolaou of Imperial College of Science, Technology and Medicine; Maryann Feldman of the University of Toronto; David Hsu of the University of Pennsylvania; Rob Lowe of Carnegie Mellon University; David Mowery of the University of California at Berkeley; Bhaven Sampat and Marie Thursby of Georgia Institute of Technology; Mike Wright of the University of Nottingham; Arvids Ziedonis of the University of Michigan; and Lynne Zucker and Michael Darby of the University of California at Los Angeles.

Lastly, there is no doubt that the ideas in this book were influenced by my discussions with many venture capitalists, business angels, technology transfer officers and entrepreneurs. In many cases, these practitioners provided the core insights into a dimension of university spinoffs that allowed me to formulate and empirically investigate the propositions offered in this book. While these contributions are not directly referenced, they are no doubt important in developing the arguments and evidence presented here.

I now turn to the second chapter of the book, where I begin to explore the puzzle of university spinoffs. In that chapter, I explain why university spinoffs are an important subject of scholarly inquiry.

NOTES

1. Some universities, such as Imperial College of Science, Technology and Medicine (in the United Kingdom) exempt students who are not working on sponsored research projects from the assignment rule.
2. Even when inventors are not the lead entrepreneurs in the formation of spinoff companies, as is the case when the lead entrepreneurs are investors or external entrepreneurs, inventors are usually founders of those companies in a legal sense. Typically, the inventors of university technology that leads to the formation of spinoff companies hold founders' stock, even if they do not assume a management role.