

30 Years After the Bayh-Dole Act:
Rethinking the Australian
Research Commercialisation Experience

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Declaration

I declare that this thesis contains no material that has been accepted for the award of any other degree or diploma in any University, and to the best of my knowledge and belief, contains no material published or written by another person, except where due reference is made in the thesis.

Eleanor Flening

13 July 2010

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My interest in research commercialisation began 10 years ago when I was a molecular genetics student at the University of New South Wales. Under the supervision of Dr Garry King, I was involved in the development of a new genotyping technology that would lead to commercial outcomes. Garry was an incredibly talented researcher and an inspiring educator. He not only taught me how to be critical and innovative, but also gave me my first real exposure to the exciting world of commercialisation. Deeply intrigued by the challenge and complexity involved, a few years later, I decided to undertake this PhD study to better understand the underlying processes and the dynamics between a variety of players and relationships.

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Abstract

By granting universities the rights to assert ownership of intellectual property (IP) resulting from United States (US) federally sponsored research, the Bayh-Dole Act of 1980 has stimulated considerable interest from policymakers around the world. Inspired by the US example, the Australian government has introduced a similar patent policy to encourage the commercialisation of publicly funded research. Research institutions have quickly responded to this policy and established technology transfer offices (TTOs) to manage the identification, protection and exploitation of IP created by their employees. It is often assumed that this IP-based approach accelerates the transfer of new inventions from academia to industry and helps to generate national benefits and social return from public investment in research.

This thesis provides a case study of the commercialisation of publicly funded research in the biotechnology sector in Australia. Following mainly a qualitative approach, the study explores the rise of the research commercialisation phenomenon by tracking its historical origins, key turning points and their present ramifications. It also examines the perceptions, motivation and experiences of various participants such as academic scientists, technology transfer managers, entrepreneurs/CEOs and private investors.

At the individual level, an important finding of this study was that the term *research commercialisation* is understood differently by different participants. Two main views were identified which not only differ semantically, but also in their objectives, time-scales, assumptions and measures of success. The clarification of these views enables the participants to better understand each other and minimise unproductive debates.

At the institutional level, this study revealed that by focusing on the exploitation of IP resulting from publicly funded research, Australia's current TTO-based structural arrangements may interfere with the flow of scientific discoveries from academia to

industry and encourage academic inventors and entrepreneurs to bypass the TTOs. Explanations for these unexpected outcomes are given and suggestions for possible improvement are discussed.

Although this study is based on the biotechnology sector in Australia, the research findings may have important implications for any other sectors and for other countries with similar structural arrangements.

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List of Abbreviations

Acronym	Meaning
AAAS	American Association for the Advancement of Science
ABS	Australian Bureau of Statistics
ACI	Australian Centre for Innovation
AIC	Australian Institute for Commercialisation
ANU	Australian National University
ARC	Australian Research Council
AUTM	Association of University Technology Managers
AVCC	Australian Vice-Chancellors' Committee
BAA	Backing Australia's Ability
BIF	Biotechnology Innovation Fund
BLO	Business Liaison Office
CCST	Coordination Committee on Science and Technology
COMET	Commercialising Emerging Technologies
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DEEWR	Department of Education, Employment and Workplace Relations
DEST	Department of Education, Science and Training
DIISR	Department of Innovation, Industry, Science and Research
FCST	Federal Council of Science and Technology
GDP	Gross Domestic Product
Go8	Group of 8
HECS	Higher Education Contribution Scheme
HEW	Health, Education and Welfare

Acronym	Meaning
IGS	Institutional Grants Scheme
IIF	Innovation Investment Fund
IP	Intellectual Property
IPA	Institutional Patent Agreement
LOA	Licence, Option, Agreement
MRI	Medical Research Institute
NHMRC	National Health and Medical Research Council
NIH	National Institute of Health
OECD	Organisation for Economic Co-operation and Development
PELS	Postgraduate Education Loan Scheme
PFRA	Publicly Funded Research Agency
PMSEIC	Prime Minister Science, Engineering and Innovation Council
PRO	Public Research Organisation
R&D	Research and Development
RMIT	Royal Melbourne Institute of Technology
SEWRSBER	Senate Employment, Workplace Relations, Small Business & Education Reference
TLO	Technology Licensing Office
TTO	Technology Transfer Office
UNSW	University of New South Wales
UWA	University of Western Australia
UQ	University of Queensland
UTS	University of Technology Sydney
VC	Venture Capital
WARF	Wisconsin Alumni Research Foundation

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Introduction

Man cannot discover new oceans unless he has the courage to lose sight of the shore.

André P. G. Gide
(1947 Nobel Laureate in Literature)

1.1 Background

Over the last few decades, universities and public research organisations around the world have greatly expanded their involvement in patenting, licensing and spin-off¹ activities. A new term, *research commercialisation*, has recently been introduced to describe this phenomenon (Markman, Siegel, & Wright, 2008; Rothaermel, Agung, & Jiang, 2007). The meaning of the term *research commercialisation* is often explicitly assumed in literature. For the scope of this thesis, it is defined as the transfer of a new scientific discovery from academia to industry.

Many observers have attributed the recent rise of research commercialisation to the passage of the Bayh-Dole Act of 1980 and subsequent similar legislations and policies in other OECD countries (Mowery, Nelson, Sampat, & Ziedonis, 2004). The Bayh-Dole Act is a US federal government patent policy which makes it easier for universities to retain ownership of intellectual property (IP) resulting from government sponsored research. It has frequently been portrayed as a policy success for facilitating the transfer of university inventions to industry. For example, OECD (2002) argued that

¹A university spin-off is a company founded to exploit intellectual property created in an academic institution (Shane, 2004, p. 4)

such legislation “provides greater legal certainty, lowers the transaction costs, and fosters more and efficient channels for technology transfer” (p. 3).

Inspired by the US example, the Australian government has introduced the *National Principles of Intellectual Property Management for Publicly Funded Research* (ARC et al., 2001). Although these principles are not formal legislations, they encourage public research organisations and universities to assert ownership of IP created by their employees in the course of their research work.

Apart from the introduction of the national principles, the Australian government has implemented various instruments to promote the commercialisation of publicly funded research, particularly in the biotechnology sector (Zhao, 2004). Over 200 programs have recently been launched to support research commercialisation. The average annual expenditure on these programs is approximately \$3.7 billion (Cutler, Cutler & Company, & DIISR, 2008). With this tremendous amount of investment, the government expects that “the exploitation of research will need to become an integral part of the research process” (ARC, 2000, p. 33) and “universities must introduce strategies to stimulate and facilitate increased transfer of knowledge to business and society” (Batterham, 2000, p. 88).

In response to government expectations, Australian universities and public research organisations have developed policies and systems to manage and support research commercialisation. Technology transfer offices (TTOs) have been established on most campuses to facilitate the transfer of scientific discoveries from academia to industry. Under the current structural arrangements, TTOs are primarily concerned with IP-based channels. Most of their efforts are focused on the identification, protection and exploitation of IP generated within their research institutions (Allen Consulting Group, 2004; ACI, Howard Partners & Carisgold, 2002).

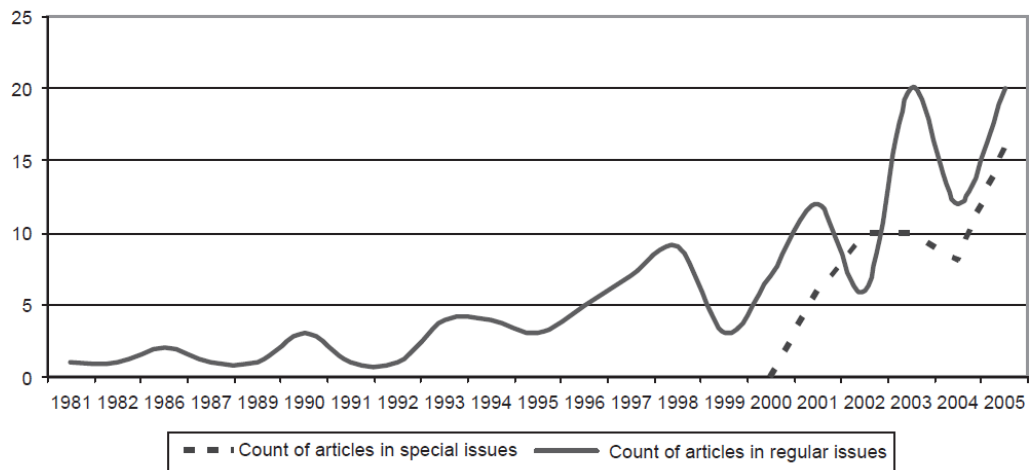


Figure 1.1 Articles published on research commercialisation, 1981–2005.
Source: Rothaermel et al. (2007, p. 6).

1.2 Classification of Existing Studies

The rise of the research commercialisation phenomenon has attracted considerable interest from scholars (Figure 1.1). Between 1981 and 2005 at least 173 journal articles have been published on this topic. Based on a comprehensive review of these articles, Rothaermel et al. (2007) divided existing research into four main areas: (a) entrepreneurial university, (b) productivity of TTOs, (c) new firm creation, and (d) environmental context.

Studies from the *entrepreneurial university* area are concerned with organisational designs that enhance or hamper research commercialisation. These studies typically revolve around incentive systems, university status, location and culture (Argyres & Liebeskind, 1998; Etzkowitz, 2003; Owen-Smith, 2003, 2005).

Research from the *productivity of TTOs* area is concerned with the identification of factors that drive the performance of TTOs. Most measures of productivity are focused on the numbers of invention disclosures, patents and licences, royalties and equity positions. Based on these performance measures, several factors have been shown to

be linked to the productivity of TTOs. These factors include university environment, structure and staffing of the TTO, mechanisms of technology transfer, and nature and stage of technology (Debackere & Veugelers, 2005; Siegel, Veugelers, & Wright, 2007; Siegel, Waldman, & Link, 2003a).

Studies from the *new firm creation* research area are focused on the spin-off route for commercialising university research. These studies have described a number of factors that affect the creation of university spin-offs, e.g. TTOs, university policy, investors, founding teams, underlying technology and external conditions (Di Gregorio & Shane, 2003; Lerner, 2005; Lockett & Wright, 2005).

Research from the *environmental context* area places research commercialisation in the context of innovation networks. These studies are generally focused on science parks, incubators and differences in geographic location (Phan, Siegel, & Wright, 2005; Zucker & Darby, 1996).

A common characteristic of the current literature on research commercialisation is that most studies are concerned with the US and European settings. A few scholars pointed out that experience drawn from Stanford, MIT or a few other successful cases in the US, cannot be directly applied to other nations due to their different economical, cultural and institutional contexts (Goldfarb & Henrekson, 2003; Klofsten & Jones-Evans, 2000; Mowery & Sampat, 2005).

A review of the research commercialisation literature shows that there is only a handful of scholarly investigations that are focused on the Australian context. These Australian-based studies are primarily concerned with specific issues or particular experience in research commercialisation. For example, Yencken (2005) examined the role of spin-off companies in the commercialisation of university and other public research agency research outcomes. Both Thorburn (2000a) and Upstill and Symington (2002) analysed the commercialisation experience of Commonwealth Scientific and Industrial

Research Organisation (CSIRO), Australia's largest R&D organisation. Harman and Stone (2006) investigated the characteristics and experience of university technology transfer managers. Zhao (2004) reviewed recent government policy changes affecting the commercialisation of university research.

Building upon the work of these scholars, Collier (2008) recently conducted a PhD study on university commercialisation in Australia. The objectives of his study were to find out why some universities apparently exhibited superior performance in research commercialisation and to identify the characteristics they possessed. Using a case study methodology which involved 8 Australian universities, 5 overseas universities and 5 small-and-medium enterprises, this study found that factors such as institutional and senior executive support, superior TTO management, world-class research and size of university all influence the performance of universities. His research findings were in agreement with a report commissioned by the Australian government (Allen Consulting Group, 2004). Both provided a rich description of specific issues that are relevant to the Australian context.

Although many important variables have been identified, existing studies on research commercialisation are fragmented. They often fall into a number of disjoint disciplines such as innovation, sociology, management, economics, education and history. There is no connected structure that ties together the current separate subfields of study of research commercialisation. This makes review, much less integration, of what is known rather difficult.

1.3 Purpose of the Study

As described in the previous section, despite the burgeoning literature on research commercialisation, very few studies are focused on the Australian setting. Our current understanding of the phenomenon is limited to a number of semi-isolated research

streams and disciplinary perspectives. There is a need for interdisciplinary efforts to systemically reflect upon Australia's experience and draw some important lessons that are specific to this country's institutional context. Achieving a broader integrated perspective can be helpful for thinking about research commercialisation and guiding future research and policy.

Typically social science research is carried out within a certain tradition. According to Jacob (1989), "the concept of tradition focuses our attention on assumptions that researchers make about the nature of the universe, theory, legitimate questions and problems, and appropriate methodologies" (pp. 229–230). This concept has been useful for guiding research and making sense of the diversity of research in a field.

However, we must be careful not to allow it to cloud our vision or restrict our horizon (Atkinson, Delamont, & Hammersley, 1988). There are specific circumstances where researchers do not share the assumptions of existing traditions or find existing traditions inadequate (e.g. Nelson & Winter, 1977). Under these circumstances, scholars may need to take holistic perspective and draw upon multiple traditions or disciplines to offer new viewpoints, raise new questions, provide ways of answering these questions and suggest new explanations (Stember, 1991).

This study adopts a holistic and interdisciplinary perspective. The overarching purpose is to develop an interconnected intellectual structure that brings various elements of the research commercialisation process within the Australian context into harmonious relationships. To achieve this purpose, the following guiding research questions were formulated at the beginning of the study:

1. How is research commercialisation perceived by Australian participants?
2. How do Australia's current TTO-based structural arrangements facilitate the transfer of new scientific discoveries from academia to industry?

The first research question is concerned with describing and interpreting the meaning, motivation, attitudes and views of various participants towards the commercialisation of publicly funded research.

The second research question is concerned with Australia's structural implementation of research commercialisation. Our current TTO-based structural arrangements have been developed based on the US best known practice. Driven by the desire to maximise economic and social return from public investment in research, much of our effort is focused on the transfer and exploitation of IP created by universities and public research organisation. This research question seeks to explore how such structural arrangements facilitate the research commercialisation process.

Following mainly a qualitative approach with inductive logic, this study proceeded without having pre-conceived frameworks to maximise the probability of discovering new insights. The two research questions provided a useful guide for the empirical exploration of the phenomenon within the Australian setting. However, the study was not limited to answering these two questions and aimed to go beyond them. The final outcome was the development of conceptual frameworks and models that integrate various pieces of knowledge about the research commercialisation process in Australia.

1.4 Structure of the Thesis

This thesis explores the research commercialisation phenomenon in the Australian local setting. The structure of the thesis is organised as follows:

Chapter 2 describes the exploratory case study methodology employed in this study and explains why the biotechnology sector was purposely chosen as an extreme case. Research design issues of validity, generalisability and ethical consideration are also

discussed in this chapter.

The subsequent two chapters establish the context of research commercialisation through reviewing its historical development.

Chapter 3 tracks the origins of university patenting and licensing activities, describes the early technology transfer practice and the key turning points. It also explains how research commercialisation evolved and came to the university agenda in Australia.

Chapter 4 reviews the general environment created by the Australian government to promote research commercialisation, and the support and management structures that have been implemented by the research institutions.

The next three chapters provide a rich description of the empirical data obtained from semi-structured interviews and participant observation. Relevant documents and other available data from secondary sources were also used to provide additional support.

Chapter 5 addresses the first research question of this study and describes how research commercialisation is perceived by different participants.

Chapter 6 investigates the second research question of this study from two different angles. The first part describes the participants' research commercialisation experience through the TTOs. The second part of this chapter examines the performance of the TTOs mainly using secondary data.

Chapter 7 presents some interesting findings that emerged from this exploratory study and explains why some participants went around the TTOs to commercialise their research results.

Chapter 8 provides further analysis of the empirical data of this study and clarifies the confusion and contradiction that are often associated with our current TTO-based

structural arrangements. Several conceptual frameworks and models for thinking about research commercialisation were introduced.

Chapter 9 summarises the research findings, presents the main contributions and the limitations of this study, and provides directions for future research.