

COLLABORATIVE R&D AND
THE NATIONAL RESEARCH
JOINT VENTURE DATABASE

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COLLABORATIVE R&D AND THE NATIONAL RESEARCH JOINT VENTURE DATABASE

A Statistical Analysis

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for Carol

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PROLOGUE

Plato wrote in *The Republic* the following, “The beginning is the most important part of the work.” Being so motivated, I am using this Prologue to explain briefly my entrance into the research field of collaborative R&D or more specifically into the study of research joint ventures (RJVs).

My research journey began in 1985 with a research grant from the National Science Foundation (NSF). The project, titled “An Economic Analysis of Cooperative R&D Programs,” had the objective of creating a national database on formal RJVs based on public filings in the *Federal Register* in the aftermath of the National Cooperative Research Act (NCRA) of 1984. The unit of observation in the database that I created, which I named the COoperative REsearch (CORE) Database, and which I discuss in some detail in Chapter 1 of this book, was the RJV itself. Since then, I have continued to write about cooperative research and RJVs both in terms of legislative initiatives and in terms of informal firm-with-firm, firm-with-university, and firm-with-public sector research cooperation.

This book represents, to some extent, a stopping point in my research journey. In early 2014, I developed a survey instrument to collect detailed information about RJVs. My effort of testing the instrument and soliciting RJV-active firms to respond to it resulted in what I call the National RJV database (NRJVD). I had the privilege of unveiling aspects of this database at the Organisation for Economic Co-operation and Development (OECD) in Paris in 2014. Since that time, relevant data were collected and analyzed. I have published a few papers based on the NRJVD and a 2020 book titled *Collaborative Research in the United States* in which information from the NRJVD is described in some detail. This book is my swan song, so to speak, on collaborative R&D and RJVs. Emerald Publishing was kind enough to make pages available to me to explore the NRJVD descriptively and economically, and herein I am pleased to present my findings.

While I began this personalized Prologue with a quotation from Plato, I end it with a quotation from William Blake: “You never know what is enough unless you know what is more than enough.”

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LIST OF ABBREVIATIONS

| | |
|-------|--|
| ATP | Advanced Technology Program |
| CORE | COoperative REsearch |
| DOJ | Department of Justice |
| NCRA | National Cooperative Research Act |
| NCRPA | National Cooperative Research and Production Act |
| NIST | National Institute of Standards and Technology |
| NRJV | National Research Joint Venture |
| NRJVD | National Research Joint Venture Database |
| NSF | National Science Foundation |
| OECD | Organisation for Economic Co-operation and Development |
| OPEC | Organization of the Petroleum Exporting Countries |
| R&D | Research and Development |
| RJV | Research Joint Venture |
| SDOAA | Standards Development Organization Advancement Act |
| SRPs | Strategic Research Partnerships |
| SRS | Science Resources Studies |
| TFP | Total Factor Productivity |

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ABOUT THE AUTHOR

Albert N. Link, PhD, is the Virginia Batte Phillips Distinguished Professor at the University of North Carolina at Greensboro (UNCG). He received a BS degree in Mathematics from the University of Richmond (Phi Beta Kappa) and the PhD degree in Economics from Tulane University. After receiving his PhD, he joined the economics faculty at Auburn University, was later Scholar-in-Residence at Syracuse University, and then he joined the economics faculty at UNCG in 1982. In 2019, he was awarded the title and honorary position of Visiting Professor at the University of Northumbria, United Kingdom.

His research focuses on entrepreneurship, technology and innovation policy, the economics of R&D, and policy/program evaluation. He is currently the Editor-in-Chief of the *Journal of Technology Transfer*. He is also co-editor of *Foundations and Trends in Entrepreneurship* and founder/editor of *Annals of Science and Technology Policy*.

Among his more than 60 books, some of the more recent ones are: *Technology Transfer and U.S. Public Sector Innovation* (Edward Elgar, 2020), *Collaborative Research in the United States: Policies and Institutions for Cooperation Among Firms* (Routledge, 2020), *Sources of Knowledge and Entrepreneurial Behavior* (University of Toronto Press, 2019), *Handbook for University Technology Transfer* (University of Chicago Press, 2015), *Public Sector Entrepreneurship: U.S. Technology and Innovation Policy* (Oxford University Press, 2015), *Bending the Arc of Innovation: Public Support of R&D in Small, Entrepreneurial Firms* (Palgrave Macmillan, 2013), *Valuing an Entrepreneurial Enterprise* (Oxford University Press, 2012), *Public Goods, Public Gains: Calculating the Social Benefits of Public R&D* (Oxford University Press, 2011), *Employment Growth From Public Support of Innovation in Small Firms* (W.E. Upjohn Institute for Employment Research, 2011), and *Government as Entrepreneur* (Oxford University Press, 2009).

His other research consists of more than 200 peer-reviewed journal articles and book chapters, as well as numerous government reports. His scholarship has appeared in journals such as the *American Economic Review*, the *Journal of Political Economy*, the *Review of Economics and Statistics*, *Economica*, *Research Policy*, *Economics of Innovation and New Technology*, the *European*

Economic Review, Small Business Economics, ISSUES in Science and Technology, Scientometrics, and the Journal of Technology Transfer.

Based on citations to his published works, he ranks in the top 10 of all global scholars registered in RePEc in a number of different fields of study in economics.

His public service includes being a member of the National Research Council's research team that conducted the 2010 evaluation of the US Small Business Innovation Research (SBIR) program. Based on that assignment, he later testified before Congress in April 2011 on the economic benefits associated with the SBIR program. He also served from 2007 to 2012 as the US Representative to the United Nations (Geneva) in the capacity of Co-vice Chairperson of the Team of Specialists on Innovation and Competitiveness Policies Initiative for the Economic Commission for Europe. In October 2018, he delivered the European Distinguished Scholar Lecture at the Commission's Joint Research Centre (Seville).

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There are a number of individuals who assisted on my research joint venture (RJV) journey which is capstoned by this book. As the readers will learn, the first person to thank is Laura Bauer (now Lauer Bauer Beecy). As a graduate student in economics at the University of North Carolina at Greensboro, she provided invaluable research assistance on my genesis research into collaborative research (see Link & Bauer, 1989). Second, I thank John Jankowski and Francisco Morris, both from the National Science Foundation, for their continued support of the COoperative REsearch database and the workshops on RJVs that followed.

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INTRODUCTION

1.1. LEGISLATIVE BACKGROUND

The US productivity slowdown is generally known to refer to the period of time when total factor productivity (TFP) growth in the private business sector in the United States was declining. The decline came in two waves. The first was in the early 1970s and the second wave was in the late 1970s and early 1980s. By most accounts, those in the US Congress dismissed the slowdown in the early 1970s as being little more than an industrial reaction to the global energy shortage and the Organization of the Petroleum Exporting Countries (OPEC) embargo.¹ When the productivity slowdown reared its head again in the late 1970s and early 1980s, the US Congress was more diligent in terms of the timing and scope of its responses.

The structure of the Congressional responses might be dated formally to the 1978 Domestic Policy Review on Industrial Innovation that was initiated by President Jimmy Carter. The Domestic Policy Review was embargoed from the Office of the White House Secretary to Congress on October 31, 1978. Therein (Carter, 1979):

I am today announcing measures which will ensure our country's continued role as a world leader in industrial innovation. These initiatives address nine critical areas [one of which is] clarifying anti-trust policy. ... By spurring competition, anti-trust policies can provide a stimulant to the development of innovation. In some cases, however, such as in research, industrial cooperation may have clear social and economic benefits for the country. Unfortunately, our anti-trust laws are often mistakenly viewed as preventing all cooperative activity. The Department of Justice, at my direction, will issue a guide clearly explaining its position on collaboration

among firms in research, as part of a broader program of improved communication with industry by the Justice Department and the Federal Trade Commission. This statement will provide the first uniform anti-trust guidance to industrial firms in the area of cooperation in research.

Within a relatively short period of time for new legislative action to occur (November 1980), the Department of Justice (DOJ) issued *Antitrust Guide Concerning Research Joint Ventures*. DOJ's position about joint research could not have been made clearer (DOJ, 1980, pp. 1–3):

Research itself presents a broad spectrum of activity, from “pure” basic research into fundamental principles, on the one hand, to development research focusing on promotional differentiation of a product or marketing issue on the other extreme. In general, basic research is undertaken with less predictability of outcome, and thus more risk, than developmental research. Moreover, the outcomes of basic research are less likely to be appropriable and thus more likely to be widely diffused in the economy, with the possibility of there being the basis of future advance and competitive opportunity for all.

The intensity of antitrust concerns about joint research will vary along the research spectrum: less intense about “pure” basic research, undertaken without ancillary restraints on use of the results, to more intense at the developmental end of the research spectrum, particularly if ancillary restraints has never been challenged by the Antitrust Division. ... Nevertheless ... concern has been expressed that valuable joint research efforts, particularly in basic research, might be deterred by fear, possibly unwarranted, of exposure to antitrust attack.

In general, the closer the joint activity is to the basic end of the research spectrum – i.e., the further removed it is from substantial market effect and developmental issues – the more likely it is to be acceptable under the antitrust laws [my emphasis].

After a series of bills introduced during the 98th session of Congress, the National Cooperative Research Act (NCRA) of 1984, Public Law 98-462, was passed in October of that year. The stated purpose of the NCRA was:

To promote research and development, encourage innovation, stimulate trade, and make necessary and appropriate modifications in the operation of the antitrust laws.

This is an important purpose statement. I revisit the purpose of the NCRA in Chapters 4 and 7 when I consider whether the NCRA has been successful or not. To bound the Act, the following definition of what joint research entails was stated:

Any group of activities ... by two or more persons for the purpose of—

- (A) theoretical analysis, experimentation, or systematic study of phenomena or observable facts,*
- (B) the development or testing of basic engineering techniques,*
- (C) the extension of investigative findings or theory of a scientific or technical nature into practical application for experimental and demonstration purposes, including the experimental production and testing of models, prototypes, equipment, materials, and processes,*
- (D) the collection, exchange, and analysis of research information, or*
- (E) any combination of the purposes specified in subparagraphs (A), (B), (C), and (D), and may include the establishment and operation of facilities for the conducting of research, the conducting of such venture on a protected and proprietary basis, and the prosecuting of applications for patents and the granting of licenses for the results of such venture*

Indemnification of the organizations in a research joint venture (RJV) required more than the members being engaged in basic research. The RJV was required to file a disclosure notice with the DOJ (and this is generally done by the lead organization in the RJV, and the notice must state the purpose of the joint research (in practice this is little more than a sentence) and the names of the members of the RJV). Disclosure notices are then published in the *Federal Register*. When the scope of the nature of the collaborative research changes, and/or the membership of the RJV changes, a new disclosure form must be filed with the DOJ, and it too is published in the *Federal Register*.

Like many legislative initiatives, amendments to the enabling legislation are frequently considered. The first amendment to the NCRA came in 1993. The National Cooperative Research and Production Act (NCRPA) of 1993, Public Law 103-42, amended the NCRA by expanding so-called allowable activities. Simply put, joint production activity was protected from antitrust violation by the 1993 amendment. In 2004, the NCRA was yet amended again. The Standards Development Organization Advancement Act (SDOAA), Public Law 108-237, protected joint research that led to the development of voluntary consensus standards.²

1.2. THE COOPERATIVE RESEARCH DATABASE

In 1985, the year following the passage of the NCRA, the National Science Foundation (NSF) initiated an effort to document collaborations in innovation that were based on NCRA *Federal Register* filings.³ Then, in 1993, NSF initiated the development of what became known both in academic and policy circles as the COoperative REsearch (CORE) database, and the NSF continued to support its construction and distribution through 2007.⁴

In 2000, the NSF sponsored a workshop in Arlington, Virginia, to discuss how the Science Resources Studies (SRS) Division of the NSF should think about developing data on US strategic research partnerships (SRPs). It was pointed out at the workshop that the United States does not collect, informally or systematically, data on research collaborations much less on RJVs. The United States is an outlier in that regard relative to the other Organisation for Economic Co-operation and Development (OECD) countries. Eminent scholars who attended the workshop were invited to make recommendations to the NSF about this fact. One of their recommendations was to initiate a study of the feasibility of including survey questions on NSF's RD-1 Survey of Industrial Research and Development instrument (Jankowski, Link, & Vonortas, 2001). However, nothing permanent came from this recommendation.

The unit of observation in the CORE database is the RJV itself as defined by its initial filing of its joint research intentions with the DOJ and that filing later being published in the *Federal Register*. An annual count of the 1,046 RJVs filed under the NCRA of 1984 and the NCRPA of 1993 by the calendar year that the notice of the RJV was made public in the *Federal Register* is in [Table 1.1](#).⁵

To me, the obvious question to ask about the trend in RJV filings, or in the formation of new RJVs, implicit in [Table 1.1](#) is: Why did the number of new RJVs filed under the NCRPA of 1993 start to decline beginning in 1996? To answer this question with some degree of authority, one might have to engage in interview case studies of firms and organizations that thought about forming an RJV but did not. Clearly, my answer to my own question is rhetorical. However, absent such counterfactual information one might conclude that we, meaning the policy and academic research community at large, do not know much about the RJVs formed under the NCRA and the NCRPA. I obviously agreed then (and still do now), and in 2014, I began an effort to collect detailed information from the RJVs already filed. This effort led to the construction of the National Research Joint Venture Database (NRJVD), and that database is explored throughout this book.

Table 1.1. Number of RJVs in the CORE Database ($n = 1,046$) and in the NRJVD ($n = 117$) by Calendar Year of *Federal Register* Filing, 1985–2012.

| Calendar Year | Number of RJVs in the CORE Database ($n = 1,046$) | Number of RJVs in the NRJVD ($n = 117$) |
|---------------|---|---|
| 1985 | 50 | 3 |
| 1986 | 17 | 0 |
| 1987 | 26 | 1 |
| 1988 | 31 | 2 |
| 1989 | 27 | 3 |
| 1990 | 45 | 2 |
| 1991 | 61 | 5 |
| 1992 | 59 | 4 |
| 1993 | 73 | 5 |
| 1994 | 63 | 6 |
| 1995 | 115 | 5 |
| 1996 | 97 | 8 |
| 1997 | 45 | 3 |
| 1998 | 31 | 3 |
| 1999 | 50 | 4 |
| 2000 | 45 | 4 |
| 2001 | 26 | 1 |
| 2002 | 30 | 4 |
| 2003 | 22 | 5 |
| 2004 | 22 | 7 |
| 2005 | 15 | 6 |
| 2006 | 12 | 2 |
| 2007 | 13 | 4 |
| 2008 | 16 | 6 |
| 2009 | 15 | 8 |
| 2010 | 17 | 8 |
| 2011 | 12 | 3 |
| 2012 | 11 | 5 |

Source: CORE database and NRJVD.

1.3. OUTLINE OF THIS BOOK

The remainder of this book is outlined as follows: In Chapter 2, I very briefly summarize the academic literature on RJVs. I offer this review in an effort to provide academic context for the analysis in the following chapters.⁶

I describe the NRJVD in Chapter 3. The name of the database, in particular the use of the adjective *National* in the name of the database,

is not intended to reflect presumptuousness on my part. To the best of my knowledge, my data collection effort is the most inclusive of all such efforts related to formal US RJVs undertaken to date.⁷ It is more encompassing than the CORE database because the unit of observation is the firm that formed the RJV (i.e., the lead firm). The responses recorded in the NRJVD relate to the RJV formed by the lead firm.

In Chapter 4, I offer an initial assessment of the NCRA of 1984 and its 1993 amendment. Therein, I reflect on Fig. 4.1 to infer that the stated purpose of the Act has been met:

To promote research and development, encourage innovation, stimulate trade, and make necessary and appropriate modifications in the operation of the antitrust laws.

I also reflect on firm responses to specific survey questions from the NRJVD discussed in Chapter 7 to support my conclusion that the Act has fulfilled its intended purpose.

In Chapter 5, I describe a number of characteristics of US RJVs as reflected through the NRJVD. These characteristics include motivations to form the RJV, lead firm characteristics, evaluation metrics for the RJV projects, the technology focus of the RJV projects, member characteristics, outputs from the RJVs, and outcomes from the RJVs. I present descriptive statistics in this chapter based on the RJV lead firm's responses to all of the questions on the National Research Joint Venture (NRJV) survey.⁸

Preliminary research patterns from the NRJVD are presented in Chapter 6. Therein, I focus primarily on correlates with outputs and outcomes from the RJV projects.

In Chapter 7, I revisit a theme from Chapter 4. I offer in this chapter suggestive evidence about the successfulness of the NCRA.

This book concludes in Chapter 8 with summary remarks and a roadmap for additional research.

NOTES

1. Link and Siegel (2003) discuss the US Congress's reaction to their early wave of slowdown of productivity growth.
2. See Leyden and Link (2015) for a more detailed discussion of the NCRA and its amendments.
3. This initial effort by NSF resulted in Link and Bauer (1989).

4. The CORE database was established and maintained by Link at the University of North Carolina at Greensboro during the period of NSF support. See Hagedoorn, Link, and Vonortas (2000) for a detailed discussion.
5. Re-filings of RJVs due to changes in research scope or changes in membership are not included in [Table 1.1](#). Only initial filings are counted in the CORE database. To emphasize, the calendar year associated with an RJV in the CORE database corresponds to the date of publication in the *Federal Register*, not to the date that the RJV was disclosed to and filed with the DOJ.
6. A detailed literature review is in Caloghirou, Ioannides, and Vonortas (2003). My context-orientated literature review in Chapter 2 benefitted from comments and suggestions from Nick Vonortas.
7. The popular press documents many collaborative efforts that are not included in the DOJ's filings published in the *Federal Register*. I refer to these collaborative efforts as informal RJVs.
8. Some of my descriptive analysis of the data in the NRJVD in Chapter 5 is complemented by my earlier discussion of the NRJVD in Link (2020). There are only so many ways to present data and their attendant description. Some duplication of themes and points of emphasis are inevitable.