

Innovation Policy in Search of an Economic Foundation: The Case of Research Partnerships in the United States

By: Kathryn Combs and [Albert Link](#)

“Innovation Policy in Search of an Economic Foundation: The Case of Research Partnerships in the United States,” *Technology Analysis & Strategic Management*, 2003, 15: 177-187.

<https://doi.org/10.1080/0953732032000051091>

This is an Accepted Manuscript of an article published by Taylor & Francis in *Technology Analysis & Strategic Management* on 25 August 2010, available online:

<http://www.tandfonline.com/10.1080/0953732032000051091>. It is deposited under the terms of the Creative Commons Attribution-NonCommercial License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits non-commercial re-use, distribution, and reproduction in any medium, provided the original work is properly cited.

Abstract:

Research partnerships are not a new organizational form, but since the mid 1980s the US government, like other national governments, has provided a favorable environment for them to flourish. The purpose of this paper is to address the question: What is the economic foundation upon which public support of research partnerships in the USA is based? In addition, given that foundation: What additional information is needed to increase the efficacy of the current policy environment? We summarize the relevant literature and find that as a whole, the theoretical literature makes clear that research partnerships are a socially beneficial organizational form once formed. However, more empirical research is needed of a different type that has occupied the journals to date. We offer an agenda for such research that will complement the policy process.

Keywords: research partnerships | research and development | innovation | strategic management

Article:

1. Introduction

Research partnerships, meaning formal or informal collaboration among firms in the conduct of research, are an organizational form that may overcome elements of market failure by reducing technical risk to the R&D-conducting firms by enlarging the underlying knowledge base. These partnerships may also limit market risk by helping to ensure that particular elements of the technology are standardized and thus interoperate in a system. As well, to the extent that collaboration reduces redundant research, there may be cost savings to each partner, reduced time to market, and greater appropriability of R&D results.

Research partnerships assume many forms in practice. Partners may aim to develop or refine a new product, improve production processes, set standards, or develop technology to meet

environmental regulations. The collaboration may take place between partners that compete in the marketplace, or between partners that produce complementary products. Some partnerships include government or university partners as well.

Research partnerships are certainly not a new organizational form, but since the mid 1980s the US government, like other national governments, has provided a favorable environment for them to flourish. The purpose of this paper is to raise a related question:

What is the economic foundation upon which public support of research partnerships in the USA is based? Given that foundation: What additional information is needed to increase the efficacy of the current policy environment?

2. Brief History of Research Partnerships in the USA

One of the first formal research partnerships or collaborations in the USA was the Semiconductor Research Corporation (SRC). In the late 1950s, an integrated circuit (IC) industry emerged in the USA. The fledgling industry took form in the 1960s and experienced rapid growth throughout the 1970s. In 1979, when Japanese companies captured 42% of the US market for 16-kbit DRAMs (memory devices) and converted Japan's integrated circuit trade balance with the USA from a negative US \$122 million in 1979 to a positive US \$40 million in 1980, the US industry became painfully aware that its dominance of the IC industry was being seriously challenged. It was clear to all in the industry that it was in their collective best interest to invest in an organizational structure that would strengthen the industry's position in the global semiconductor marketplace.

The Semiconductor Industry Association (SIA) was formed in 1977 to collect and assemble reliable information about the industry and to develop mechanisms for addressing industry issues with the federal government. In a presentation at an SIA Board Meeting in June 1981, Erich Bloch of IBM described to the industry the nature of the growing competition with Japan and proposed the creation of a 'semi-conductor research cooperative' to assure continued US technology leadership. This event witnessed the birth of the SRC. In December 1981, Robert Noyce, then SIA chairman and vice-chairman of Intel, announced the establishment of the SRC for the purpose of stimulating joint research in advanced semiconductor technology by industry and US universities and to reverse the declining trend in semiconductor research investments. The SRC was formally incorporated in February 1982 with a stated purpose to:¹

- Provide clearer view of technology needs
- Fund research to address technology needs
- Focus attention on competition
- Reduce research redundancy.

Policy makers soon noticed the virtues of cooperative research in part because such organizational structures had worked well in Japan and in part because the organizational success

¹ The eleven founding members were Advanced Micro Devices, Control Data Corporation, Digital Equipment Corporation, General Instrument, Honeywell, Hewlett-Packard, IBM, Intel, Monolithic Memories, Motorola, National Semiconductor and Silicon Systems.

of the SRC demonstrated that cooperation among competitive firms at the fundamental research level was feasible.

To place the activities surrounding the SRC's formation in a broader perspective, recall that in the early 1980s there was growing concern about the persistent slowdown in productivity growth that first began to plague the US industrial sector in the mid 1970s. In addition, US industry seemed to be losing its competitive advantage in world markets, especially firms in the semiconductor industry.²

Such concerns about US industrial performance prompted legislative action to support research partnerships. As noted in a US House of Representatives report of 18 November 1983 about the proposed Research and Development Joint Ventures Act of 1983:

A number of indicators strongly suggest that the position of world technology leadership once firmly held by the United States is declining. The United States, only a decade ago, with only 5% of the world's population was generating about 75% of the world's technology. Now, the US share has declined to about 50% and in another ten years, without fundamental changes in our Nation's technological policy . . . the past trend would suggest that it may be down to only 30%. [In hearings,] many distinguished scientific and industry panels had recommended the need for some relaxation of current antitrust laws to encourage the formation of R&D joint ventures. . . . The encouragement and fostering of joint research and development ventures are needed responses to the problem of declining US productivity and international competitiveness. According to the testimony received during the Committee hearings, this legislation will provide for a significant increase in the efficiency associated with firms doing similar research and development and will also provide for more effective use of scarce technically trained personnel in the United States.

In a House report (6 April 1984) on competing legislation, the Joint Research and Development Act of 1984, the supposed benefits—and recall that at this time it was still too soon for there to be visible benefits coming from the SRC's activities on behalf of the IC industry—of joint research and development were for the first time clearly articulated:

Joint research and development, as our foreign competitors have learned, can be procompetitive. It can reduce duplication, promote the efficient use of scarce technical personnel, and help to achieve desirable economies of scale. . . . [W]e must ensure to our US industries the same economic opportunities as our competitors, to engage in joint research and development, if we are to compete in the world market and retain jobs in this country.

² The declining US position in the semiconductor industry was well known and in other industries there was widespread concern although the empirical evidence about the competitive position of the United States in international markets was incomplete. However, when the US Department of Commerce released its 1990 report on emerging technologies, it was apparent to all that the concerns expressed in the early 1980s were quite valid.

The National Cooperative Research Act (NCRA) of 1984, after additional revisions in the initiating legislation, was passed on 11 October 1984:³

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

The NCRA created a registration process, later expanded by the National Cooperative Research and Production Act (NCRPA) of 1993, under which research joint ventures (RJVs) can disclose their research intentions to the Department of Justice.⁴ RJVs gain two significant benefits from such voluntary filings: if subjected to criminal or civil action they are evaluated under a rule of reason that determines whether the venture improves social welfare; and if found to fail a rule-of-reason analysis they are subject to actual rather than treble damages.

One of the more notable RJVs formed and made public through the NCRA disclosure process was SEMATECH (SEmiconductor MANufacturing TECHnology). It was established in 1987 as a not-for-profit research consortium with an original mission to provide a pilot manufacturing facility where member companies could improve their semiconductor manufacturing process technology. Its establishment came after the Defense Science Board recommended direct government subsidy to the industry in a 1986 report commissioned by the Department of Defense. It was thought that SEMATECH would be the US semiconductor industry's/US government's response to the Japanese government's targeting of their semiconductor industry for global domination. Since its inception, SEMATECH's stated mission has evolved and become more general. The consortium currently defines its mission around solving the technical challenges presented in order to sustain a leadership position for the USA in the global semiconductor industry.

To date, there have been over 800 formal RJVs filed under the NCRA. Certainly, this number is a lower bound on the total number of research partnerships in the USA, even since 1984. Not all are as publicly visible as SEMATECH. Some are quite small, with only two or three members, and others are quite large with hundreds of members. On average, a joint venture has 14 members.⁵

While informal cooperation in research may have been prevalent in the USA for decades, formal RJV relationships are still relatively new compared to other aspects of our national innovation system. Surprisingly, only a few scholars have examined or even hypothesized about the meaning of trends.

³ This purpose is stated as a preamble to the Act.

⁴ The Semiconductor Research Corporation filed under the NCRA on 30 January 1995.

⁵ As an illustration of the research activity that can successfully occur through a small, less visible research partnership, consider the Southwest Research Institute Clean Heavy Diesel Engine II joint venture, noticed in the *Federal Register* in early-1996. The eleven member companies, from six countries including the USA, joined together to solve a common set of technical problems. Diesel engine manufacturers were having difficulties, on their own, meeting desired emission control levels. The eleven companies were coordinated by Southwest Research Institute, an independent, nonprofit contract research organization in San Antonio, Texas, to collaborate on the reduction of exhaust emissions. The joint research was successful, and each member company took with it fundamental process technology to use in their individual manufacturing facilities to meet desired emission control levels. The joint venture was formally disbanded in mid 1999.

Research partnerships are of growing policy interest. In the USA, for example, the National Science Foundation (NSF) sponsored a workshop in 2000. The purpose of this policy workshop on Strategic Research Partnerships (SRPs) was to evaluate policy needs for indicators related to the formation, activities, and economic consequences of alliances and SRPs, and to advise the Science Resources Studies Division of NSF on how to proceed to develop SRP indicators.⁶

Then, in 2002, NSF co-sponsored with Statistics Canada a second workshop. Its purpose was to examine the influence of alliances, networks and partnerships on the innovation process, in order to help statisticians measure activities associated with these linkages, to inform policy makers and to promote discussion in the research community.

3. Toward an Economic Foundation for Research Partnerships

Surprisingly, as the brief history of events leading to the passage of the NCRA points out, policy directions, much less policy conclusions, were never explicitly (and we have no information about implicit derivations) based on an economic foundation. Empirical observations did have a role to the extent that US legislators looked at the seeming success of other countries, Japan in particular, and extrapolated from their environment to that of the USA. However, as we argue in this paper, a rich theoretical foundation has emerged upon which one can, after the fact, justify the historic and current policy interest in research partnerships. What is still lacking, in our opinion, are counterpart empirical analyses to validate the assumptions as hence conclusions of the theory.

A. Findings from Theoretical Research

Three important questions have been addressed and answered in the theoretical literature related broadly to research partnerships and the collaborations that they create. These questions are:

- Do research partnerships improve efficiency?
- Do research partnerships increase competition in the marketplace?
- Do research partnerships increase consumer surplus through improved products or faster introduction?

In general, the answer to each question is, ‘yes’. A summary of the theoretical literature related to each question is in Table 1. We segment the literature in the table and below into three economic framework categories—transactions costs, strategic management and industrial organization.

The *transactions costs literature* asserts that partnerships, or alliances as they are generally called, can under certain circumstances offer the most efficient organizational form for R&D. Research partnerships offer advantages not necessarily present in arms-length contract R&D or in full vertical integration. Two types of transactions efficiencies may arise; if these are strong enough then research partnerships should prevail:

⁶ See J. Jankowski, A.N. Link & N. Vonortas, ‘Strategic Research Partnerships: Proceedings from an NSF Workshop’, National Science Foundation edited report NSF 01–336, 1991.

- If there is unified control (e.g. RJV) over the R&D activities, then resources of both parties are committed. It is more difficult for one party to take advantage of another that has invested in assets specific to the relationship.
- Tacit knowledge could be more easily transferred.⁷

The *strategic management literature* suggests that alliances can be used to create and sustain competitive advantage. In particular, alliances may be an efficient way to quickly and uniquely configure research-related resources. Alliances may also give rise to strong interfirm relationships that develop within strategic networks. The thrust is to increase long-term profitability relative to the industry.

Profitability may increase because of:

- Cost efficiencies
With alliances, firms do not need to develop all their expertise in house. Members of the alliance may specialize in their comparative advantage, yielding economies of scale in R&D and reducing duplication of R&D efforts.
Synergies between alliance partners may give rise to economies of scope and learning, as well. Economies of scope may occur if the alliance output aids in production of goods across partners. Economies of learning may occur if production experience is transferred from member to member.
The strategic network literature treats the relationships between companies as a specific asset that facilitates R&D transactions within the network. In other words, the network may lower transactions costs.
- Market power
Well-structured alliances may be able to offer unique products, allowing the opportunity to price above marginal cost. Also, alliances may hasten introduction of a new product. The result may be some degree of monopoly power—either transitory, or sustainable if a first-mover advantage is exploited.
Aspects of this effect, however, may also benefit consumers who value the faster introduction of new products or features.
Whether the market power effect promotes or reduces competition is subject to interpretation. That is, broadly speaking, the lure of a first-mover advantage or even transitory monopoly power may increase competition to reach the product market.
- Strategic options
Alliances may reduce the risk inherent in the uncertainty of expanding into technological development and new markets. Joint ventures give a company an option for acquisition of the venture that could be exercised as information about technology and markets improves over time.

Using a game theoretic framework to evaluate equilibrium results, the *industrial organization (IO) literature* has somewhat differing conclusions depending on the specific assumptions of the

⁷ Kogut interprets the easing of tacit knowledge transfer as facilitating ‘organizational learning’ rather than lowering transactions costs. See B. Kogut, ‘Joint Ventures: Theoretical and Empirical Perspectives’, *Strategic Management Journal*, 9, 1998, pp. 319–332.

models. According to Nicholas Vonortas, ‘It is improbable that the one-fits-all theoretical exercise will be built anytime soon’.⁸ Nevertheless, some common findings have emerged.⁹

- **Cost efficiencies**
Most models in the IO literature assume that a firm’s research efforts benefit (‘spillover’ to) other firms. In this scenario, firms typically under-invest in research. Research partnerships can internalize the spillovers, which motivates greater research investment if spillovers are high enough. In turn, the cost of producing the final products drops¹⁰ and unnecessary duplicative research is eliminated.
Research partnerships may also create other cost efficiencies. Some models show that research partnerships form to create economies of scale in the R&D process. Economies of scale can arise if the research partnership configures a larger stock of human, physical, or knowledge capital. Others show that research partners step up output production and share the resulting gains in knowledge, magnifying economies of learning among research partners.
- **Improvements in consumer welfare**
In general, the IO literature predicts that the public is well served by research partnerships. When research partnerships successfully lower production costs, consumer product prices fall. In addition, some models predict that efficiencies in research partnerships increase the number of product market competitors and/or improve product quality. However, to the detriment of consumers, research collaboration is predicted to encourage collusion in product pricing under certain circumstances.

As a whole, the theoretical literature summarized in Table 1 and elaborated upon above makes clear that research partnerships are a socially beneficial organizational form once formed. It is, in our opinion, an irrelevant point to argue that such partnerships would or would not exist in the USA or elsewhere in the absence of research partnership policy because none of the models are constructed in such a way so as to evaluate the probability of research partnership formation with and without a policy incentive, a point we revisit in the next section.

Table 1. Summary of the theoretical literature findings on research partnerships

Policy questions	Literature findings	Citations
Do research partnerships improve efficiency?	Yes—can lower transactions costs	<i>Transactions cost:</i> Kogut ^a Williamson ^{b,c} <i>Strategic amangement:</i> Jarillo ^d Mowery et al. ^e Gomez-Casseres ^f

⁸ See N.S. Vonortas, *Cooperation in Research and Development* (Boston, Kluwer, 1997), p. 77.

⁹ Many of the models are reviewed in J. Hagedoorn, A.N. Link & N.S. Vonortas, ‘Research Partnerships’, *Research Policy*, 29, 2000, pp. 567–586. We examine theories of research-only partnerships, omitting discussion of partnerships that also jointly sell a product.

¹⁰ Most of the spillover models also assume that any innovations are ‘process’ innovations rather than new products. ‘Process’ innovations lower the cost of producing an existing product.

Policy questions	Literature findings	Citations
	Yes—Reduces unnecessary duplicative R&D Expenditures	<i>IO:</i> Combs ^g Katz ^h
	<i>Via knowledge sharing in endogenous research partnerships</i>	<i>Kamien et al.</i> ⁱ Kamien & Zang ^j <i>Strategic Management:</i> Prahalad & Hamel ^k
	Yes—Can increase R&D expenditures if significant spillover effects	<i>IO:</i> Katz ^h Motta ^l D’Aspremont & Jacquemin ^m DeBondt & Veugelers ⁿ DeBondt et al. ^o Kamien et al. ⁱ Suzumura ^p Simpson & Vonortas ^q Vonortas ^r Brod & Shivakumar ^s
	Yes—Yields economies of scale, scope, or learning	<i>IO:</i> Combs ^g Petit & Towinski ⁱ <i>Strategic management:</i> Porter ^u Harrigan ^v Jarillo ^d Prahalad & Hamel ^k
	Yes—reduces risk	<i>Strategic management:</i> Harrigan ^v Kogut ^w Sanchez ^x Dixit & Pindyck ^y Trigeorgis ^z
Do research partnerships increase competition in the marketplace?	Yes—may decrease concentration	<i>IO:</i> Motta ^l Combs ^g
	Yes—increases market output & lowers price (via production cost reductions) if significant spillover effects	<i>IO:</i> Katz ^h D’Aspremont & Jacquemin ^m DeBondt & Veugelers ⁿ DeBondt et al. ^o Kamien et al. ⁱ Suzumura ^p Simpson & Vonortas ^q Vonortas ^r Brod & Shivakumar ^s
	No—market power	<i>IO:</i> Martin ^{aa}
	<i>Facilitates collusion in product market</i>	Rosenkrantz ^{bb}

Policy questions	Literature findings	Citations
	<i>First mover advantage or unique aggression of resources</i>	<i>Strategic management:</i> Porter ^u Harrigan ^v Jarillo ^d Mowery et al. ^e Hamel & Prahalad ^{cc} Teece ^{dd}
Do research partnerships increase consumer surplus through improved products or faster introduction?	Yes <i>But watch out for high pricing due to market power</i>	<i>IO:</i> Motta ^l <i>Strategic management:</i> Harrigan ^v Mowery et al. ^e Prahalad & Hamel ^k Hamel & Prahalad ^{cc}

^a B. Kogut, 'Joint Ventures: Theoretical and Empirical Perspectives', *Strategic Management Journal*, 9, 1998, pp. 319–332.

^b O.E. Williamson, 'Economics and Organization: A Primer', *California Management Review*, 38, 1996, pp. 131–146.

^c O.E. Williamson, *The Mechanisms of Governance* (Oxford, Oxford University Press, 1996).

^d J. Jarillo, 'On Strategic Networks', *Strategic Management Journal*, 19, 1988, pp. 31–41.

^e D.C. Mowery, J.E. Oxley & B.S. Silverman, 'Technological Overlap and Interfirm Cooperation: Implications for the Resource-Based View of the Firm', *Research Policy*, 27, 1998, pp. 507–523.

^f B. Gomez-Casseres, *The Alliance Revolution: The New Shape of Business Rivalry* (Cambridge, Harvard University Press, 1996).

^g K. Combs, 'The Role of Information Sharing in Cooperative Research and Development', *International Journal of Industrial Organization*, 11, 1993, pp. 535–551.

^h M.L. Katz, 'An Analysis of Cooperative Research and Development', *Rand Journal of Economics*, 17, 1986, pp. 527–543.

ⁱ M.I. Kamien, E. Muller & I. Zang, 'Research Joint Ventures and R&D Cartels', *American Economic Review*, 82, 1992, pp. 1293–1306.

^j M. I. Kamien & I. Zang, 'Competing Research Joint Ventures', *Journal of Economics and Management Strategy*, 2, 1993, pp. 24–40.

^k C.K. Prahalad & G. Hamel, 'The Core Competence of the Corporation', *Harvard Business Review*, May–June 1990, pp. 79–91.

^l M. Motta, 'Cooperative R&D and Vertical Product Differentiation', *International Journal of Industrial Organization*, 10, 1992, pp. 643–661.

^m C. d'Aspremont & A. Jacquemin, 'Cooperative and Non-Cooperative R&D in Duopoly with Spillovers', *American Economic Review*, 78, 1988, pp. 1133–1137.

ⁿ R. DeBondt & R. Veugelers, 'Strategic Investment with Spillovers', *European Journal of Political Economy*, 7, 1991, pp. 345–366.

^o R. DeBondt, P. Slaets & B. Cassiman, 'The Degree of Spillovers and the Number of Rivals for Maximum Effective R&D', *International Journal of Industrial Organization* 10, 1992, pp. 35–54.

^p K. Suzumura, 'Cooperative and Non-Cooperative R&D in an Oligopoly with Spillovers', *American Economic Review*, 82, 1992, pp. 1307–1320.

^q R.D. Simpson & N.S. Vonortas, 'Cournot Equilibrium with Imperfectly Appropriable R&D', *Journal of Industrial Economics*, 42, 1994, pp. 79–92.

^r N.S. Vonortas, 'Inter-Firm Cooperation with Imperfectly Appropriable Research', *International Journal of Industrial Organization*, 12, 1994, pp. 413–435.

^s A.C. Brod & R. Shivakumar, 'R&D Cooperation and the Joint Exploitation of R&D', *Canadian Journal of Economics*, 30, 1997, pp. 673–684.

^t M.L. Petit & B. Tolwinski, 'Technology Sharing Cartels and Industrial Structure', *International Journal of Industrial Organization*, 15, 1996, pp. 77–101.

^u M.E. Porter, 'Changing Patterns of International Competition', *California Management Review*, 28, 1986, pp. 9–40.

- ^v K.R. Harrigan, *Strategies for Joint Ventures* (Lexington, Lexington Books, 1985).
- ^w B. Kogut, 'Joint Ventures and the Option to Expand and Acquire', *Management Science*, 37, 1991, pp. 19–33.
- ^x R.A. Sanchez, 'Strategic Flexibility, Firm Organization, and Managerial Work in Dynamic Markets: A strategic-options perspective', in: P. Shrivastava, A. Huff & J.E. Dutton (Eds), *Advances in Strategic Management* (Greenwich, JAI Press, 1993), pp. 191–251.
- ^y A.K. Dixit & R.S. Pindyck, 'The Options Approach to Capital Investment', *Harvard Business Review*, May–June 1995, pp. 105–115.
- ^z L. Trigeorgis, *Real Options—Managerial Flexibility and Strategy in Resource Allocation* (Cambridge, MIT Press, 1996).
- ^{aa} S. Martin, 'R&D Joint Ventures and Tacit Product Market Collusion', *European Journal of Political Economy*, 11, 1994, pp. 733–741.
- ^{bb} S. Rosenkranz, 'Innovation and Cooperation under Vertical Product Differentiation', *International Journal of Industrial Organization*, 13, 1995, pp. 1–22.
- ^{cc} G.P. Hamel & C.K. Prahalad, 'Strategic Intent', *Harvard Business Review*, May–June 1989, pp. 63–76.
- ^{dd} D.J. Teece, 'Profiting from Technological Innovation: Implications for integration, collaboration, licensing and public policy', *Research Policy*, 15, 1986, pp. 285–305.

B. Findings from Empirical Research

Table 2 summarizes the extant empirical research broadly related to research partnerships. Clearly, the volume of theoretical research, based only on a comparison of the number of cited referenced in Table 1 compared to Table 2, dwarfs the volume of empirical research and the issues investigated empirically have not in general addressed any significant aspects of economic efficiency, an issue that is fundamental to establishing an economic foundation for research partnership formation. What the body of empirical research does, constrained of course by a short time period of limited information public-domain data, is to characterize trends in known research partnership activity and to chronicle self-reported motives for undertaking R&D with a research partnership framework. More empirical research is needed, but of a different type that has occupied the journals to date. Below we offer an agenda for such research keeping in mind that our focus and advocacy herein is on research that will complement the policy process.

Table 2. Summary of the empirical literature findings on research partnerships

Policy questions	Literature findings	Citations
Has the NCRA met its legislative goals	Number of RJVs files under NCRA has been volatile year to year due primarily to other institutional factors such as the creation of the Advanced Technology Program within the US Department of Commerce	Brod & Link ^a Link, Paton & Siegel ^b
None	Dominance of research relationships with North America, Japan, and EU declined in the 1990s compared to the 1970s and 1980s	Freeman & Hagedoorn ^c Hagedoorn ^d
None	Universities and federal laboratories are partners in larger RJV and are invited to solve basic research questions for firms	Baldwin ^e Baldwin & Link ^f Hall, Link & Scott ^g Vonortas ^h Leyden & Link ⁱ
None	RJVs are undertaken as a strategy of the organizing firm to increase market share	Link & Zmud ^j Link & Bauer ^k Tether ^l

^a A.C. Brod & A.N. Link, 'Trends in Cooperative Research Activity', in: M.P. Feldman & A.N. Link (Eds), *Innovation Policy in the Knowledge-Based Economy* (Boston, Kluwer, 2001), pp. 105–120.

^b A.N. Link, D. Paton & D. Siegel, 'An Analysis of Policy Initiatives to Promote Strategic Research Partnerships', *Research Policy*, 31, 2002, pp. 1459–1466.

^c C. Freeman & J. Hagedoorn, 'Catching Up or Falling Behind: Patterns in International Interfirm Technology Partnering', *World Development*, 22, 1994, pp. 771–780.

^d J. Hagedoorn, 'Trends and Patterns in Strategic Technology Partnering since the Early Seventies', *Review of Industrial Organization*, 11, 1996, pp. 601–616.

^e W.L. Baldwin, 'The U.S. Research University and the Joint Venture: Evolution of an Institution', *Review of Industrial Organization*, 11, 1996, pp. 629–653.

^f W.L. Baldwin & A.N. Link, 'Universities as Research Joint Venture Partners: Does Size of Firm of the Venture Matter?', *International Journal of Technology Management*, 15, 1998, pp. 895–913.

^g B.H. Hall, A.N. Link & J.T. Scott, 'Universities as Research Partners', *Review of Economics and Statistics*, forthcoming.

^h N.S. Vonortas, *Cooperation in Research and Development* (Boston, Kluwer, 1997).

ⁱ D.P. Leyden & A.N. Link, 'Federal Laboratories as Research Partners', *International Journal of Industrial Organization*, 17, 1999, pp. 572–592.

^j A.N. Link & R.W. Zmud, 'R&D Patterns in the Video Display Terminal Industry', *Journal of Product Innovation Management*, 2, 1984, pp. 106–115.

^k A.N. Link & L.L. Bauer, *Cooperative Research in U.S. Manufacturing* (Lexington, Lexington Books, 1989).

^l B.S. Tether, 'Who Co-operates for Innovation, and Why: An Empirical Analysis', *Research Policy*, 31, 2002, pp. 947–967.

4. Directions for Future Research

We conclude this paper with a proposed agenda of empirical research issues. This agenda is posited with the goal of providing guidance for future policy initiatives.

The incidence of research partnership activity: Although companies can file their research joint venture intentions with the US Department of Justice in order to obtain an indemnification from certain antitrust violations, if such violations are found, anecdotal evidence strongly suggests that filed partnerships are a small subset of all research that firms engage in collaboratively. One outcome from the 2000 NSF workshop referred to above will be the likely inclusion of an additional question or set of questions on NSF's RD-1 industrial survey to quantify both the number of and dollars allocated to research partnerships.¹¹ It is expected that this public effort will substantiate the anecdotal evidence that firms are involved in many more partnership activities than those that come under the NCRA umbrella. Still, we argue that researchers, through case studies and surveys should independently document the incidence of such activities; firms' decision-making calculus regarding the net benefits from undertaking and disclosing partnership activities (e.g. the economics of disclosure); and any differences in the nature of filed vs non-filed partnerships, where nature refers to type, scope, duration and strategic intent of the research.

The effectiveness of NCRA: Although the NCRA has been in effect since 1984, there has yet to be a systematic study of the effectiveness of that legislation in meeting its stated objectives. The one exception is the Brod and Link exploratory analysis.¹² Alternatively stated, case studies might reveal the proclivity toward partnership activity in a pre- and post-NCRA environment. Relatedly, case studies could reveal *ex post* the net benefits (e.g. return on investment) firms

¹¹ Certainly one or even a few questions about RJV activity will not address the issue of data adequacy, but it is an important start. We press in this section for case studies but are certainly aware that the ideal would be a concerted effort of combining objective and subjective data, and quantitative and qualitative analyses.

¹² A.C. Brod & A.N. Link, 'Trends in Cooperative Research Activity', in: M.P. Feldman & A.N. Link (Eds), *Innovation Policy in the Knowledge-Based Economy* (Boston, Kluwer, 2001), pp. 105–120.

receive from research undertaken proprietarily in-house vs in a partnership setting. Along these lines are then issues regarding the most economically efficient composition of the partnership, a point that the NSF RD-1 expected initiative is not expected to address. Consideration should be given to the role and effectiveness of universities, federal laboratories, and integrated firms as research partners as well as the managerial implications of how the partnership is organized from a best practices perspective.

The spillover of knowledge from a research partnership: Information has an economic value, and in any research partnership appropriability of research. By this we are not only referring to the research that is undertaken cooperatively but also the research knowledge that is brought to the table as background for the on-going project. Case studies should shed light on the diffusion of research information via the partnership and the net costs to the organizing firm from the loss of parts of that information. Such inquiries and the insights that they reveal would be valuable if obtained from both partnerships that remain intact through the defined research project as well as those that terminate early.

All of these agenda items, and certainly others, are requisite for a complete understanding of the economics of research partnerships and the net benefits, if any, from such. Along with the rich theoretical literature, this type of empirical foundation should better inform future policy initiatives.