An analysis of policy initiatives to promote strategic research partnerships.

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Abstract:

Strategic research partnerships (SRPs) have become a salient feature of the US National Innovation System. We provide an overview of SRPs and examine the antecedents and consequences of centerpiece legislation designed to stimulate the formation of SRPs: the National Cooperative Research Act (NCRA) of 1984. NCRA allows firms to disclose their research joint ventures (RJVs) to the Department of Justice, which enabled them to significantly reduce their exposure to antitrust litigation. We estimate an econometric model of trends in RJV filings and find that, as intended by the legislation, the propensity of firms to engage in RJVs is sensitive to changes in the global competitiveness of US high-technology industries. More importantly, our results suggest that the establishment of the Commerce Department's Advanced Technology Program, which provides financial support to firms that engage in collaborative research projects, induced firms to engage in additional (privately financed) RJVs. This is a spillover mechanism that warrants further attention as national innovation systems evolve.

Keywords: strategic research partnerships | research joint ventures | national cooperative research act | advanced technology program | research policy

Article:

1. Introduction

A major change in the US National Innovation System (Nelson, 1993) has been the rapid increase in strategic research partnerships (SRPs) involving firms, universities, non-profit organizations, federal research laboratories, and public agencies. The growth in US SRPs can be attributed, in part, to several bipartisan policy initiatives. These policy changes include an expansion of programs to support public–private technology partnerships, relaxation of antitrust enforcement to promote cooperative research, and adoption of various initiatives to promote more rapid diffusion of technologies from universities and federal laboratories to firms.

In this paper, we overview SRP activity and analyze the antecedents and consequences of centerpiece legislation designed to stimulate the formation of SRPs; the National Cooperative Research Act (NCRA) of 1984. NCRA established a system whereby firms can disclose their intentions to engage in research joint ventures (RJVs) to the US Department of Justice and thus, significantly reduce their exposure to antitrust litigation. In order to explore the determinants of trends in collaborative research projects, we outline and estimate an econometric model of the propensity of firms to disclose RJVs. We also consider the policy implications of our findings.

2. Overview of strategic research partnerships

SRPs are defined as any cooperative relationship involving organizations that conduct or sponsor R&D. Many of these partnerships constitute potential sources of R&D spillovers and economic growth. Examples include RJVs, strategic alliances and networks, consortia, cooperative research and development agreements (CRADAs), licensing and sponsored research agreements involving universities, government laboratories, and firms, university-based entrepreneurial start-ups, as well as co-authoring between academics and industry scientists.

It is important to distinguish between private–private partnerships and public–private partnerships when characterizing SRPs. Private–private partnerships are defined as relationships lead by and primarily composed of private organizations only. Examples include RJVs, consortia, strategic alliances, and networks involving two or more companies. Public–private partnerships receive some level of support from a public institution or may have a public institution as a direct or indirect member.3 Such support can range from direct subsidies, shared use of expertise and laboratory facilities, and tacit licensing agreements.

This funding distinction underscores the “strategic” aspect of SRPs. For private–private partnerships, the strategic objective is profit maximization.4 For public–private partnerships, the government agency also has a strategic goal, namely to address an innovation market failure (Martin and Scott, 2000) and ultimately to enhance economic growth. Table 1 summarizes the key features of several recent studies. Scholars from a number of disciplines have investigated aspects of SRP activity. Interdisciplinary interest in this topic offers several advantages, such as an increase in the number of datasets available to researchers, consideration of SRPs in specific industries and nations, a broader understanding of the antecedents and consequences of these relationships, a mix of quantitative and qualitative methods, and the use of alternative indicators of performance, since notions of performance vary substantially across fields.53

Table 1 is omitted from this formatted document.

In the remainder of this paper, we examine the antecedents and consequences of the NCRA. Given the difficulties of directly measuring SRP outcomes, as discussed in the research summarized in Table 1, we emphasize the time series variation in the propensity of firms to engage in SRPs in the aftermath of NCRA.

3. Antecedents and consequences of the NCRA

In the early 1980s, there was great concern in the United States regarding the pervasive slowdown in productivity growth and the concomitant decline in the global competitiveness of American firms in key high-technology industries. One of the alleged culprits of this productivity slowdown was a decline in the rate of technological innovation. The following excerpt from a report issued by the US House of Representatives shortly before the enactment of NCRA aptly reflects the mindset of policymakers at this time:6

> A number of indicators strongly suggest that the position of world technology leadership once held by the U.S. is declining. The U.S., only a decade ago, with only five percent of the world's population, was generating about 75% of the world's technology. Now, the U.S. 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 Committee 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 U.S. productivity and international competitiveness.

In response to such concerns, the NCRA was enacted "to promote research and development, encourage innovation, stimulate trade, and make necessary and appropriate modifications in the operation of the antitrust laws."7 The NCRA established a registration process whereby RJVs can disclose their research intentions to the Department of Justice.8 RJVs gain two significant benefits from such voluntary disclosure:

if subjected to criminal or civil action, they are evaluated under a rule of reason that determines whether the venture improves social welfare;

(ii) if found to fail a rule-of-reason analysis they are subject to actual rather than treble damages.

Fig. 1 presents data on annual RJV filings. It appears that RJVs increased virtually monotonically through 1995, and have since declined precipitously.9,10 To explore the economic rationale for this trend, we outline an econometric model of the propensity of firms to file RJVs.

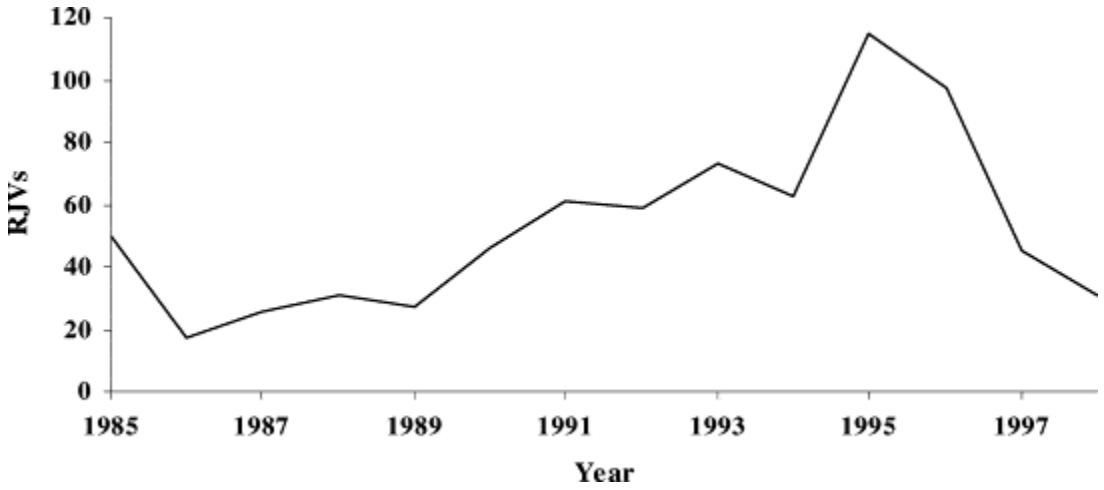

Fig. 1. Federal Register RJV Filings, by year 1985–1998.

4. Econometric model

We conjecture that there are several key determinants of the propensity of firms to announce their intentions to collaborate on research projects. Firms may engage in RJVs as a strategic response to competitive pressures from abroad. Specifically, when high-technology firms encounter enhanced global competition (TECHCOMP), they may be more inclined to develop partnerships with domestic rivals who are facing a similar global threat. Also, because of the NCRA, firms may assume that the federal government will be much less aggressive in pursuing antitrust violations when American firms are experiencing declining global market shares. Alternatively, if the competitive position of American high-technology firms improves, concerns regarding the threat of antitrust litigation could re-emerge. Thus, we expect an inverse relationship between TECHCOMP and the propensity to engage in RJVs.

We hypothesize that RJV filings will also be related to the percentage of industry-funded R&D devoted to development (DEVINT), as opposed to basic or applied research. This follows from the notion that firms engage in RJVs as a substitute for internal basic research projects. Two factors may induce such substitution. First, as noted in Hagedoorn et al. (2000), firms may use cooperative research arrangements to eliminate duplicative research costs and reduce time to market. Second, economic theory predicts that firms have a stronger incentive to form an RJV if the nature of the research undertaken is closer to basic research than applied research or

development (Link and Bauer, 1989). If such substitution occurs, we would expect to observe a positive correlation between DEVINT and RJV activity.

Economic conditions, as reflected by the business cycle (BCYC), could also influence the willingness of firms to embark on collaborative research projects. When the economy is weak, some firms will lack sufficient resources to finance R&D and thus, will be more inclined to access external resources and cooperative mechanisms to generate new knowledge. Alternatively, when conditions are favorable, firms are more likely to rely on internal funds to finance R&D. Therefore, we expect to observe an inverse relationship between BCYC and involvement in new cooperative research ventures.11

The discussion in this section yields the following econometric model, including time subscripts, a trend variable (TREND), and a stochastic error term (ε_t):[12]

equation(1)

$$RJV_t = \beta_0 + \beta_1\ TECHCOMP_t + \beta_2\ DEVINT_t + \beta_3\ BCYC_t + \beta_4\ TREND + \varepsilon_t$$

A complete description of the variables is presented in Table 2.

5. Empirical results

Negative binomial (generalized Poisson) parameter estimates of Eq. (1) are presented in Table 3.13 Consistent with our earlier discussion, there appears to be an inverse relationship between proxies for the global competitiveness of US firms in high-technology industries (TECHCOMP) and RJV activity.14 Our findings also suggest that a higher intensity of R&D investment in development (DEVINT) is associated with more RJVs. The negative coefficient on BCYC is consistent with our conjecture that RJV activity is counter-cyclical.15

Table 3. Negative binomial regressions of the propensity of firms to file RJVs

Independent variable	Parameter estimate
INTERCEPT	−4.631 (3.810)
TECHCOMP	−0.029** (0.012)
DEVINT	0.138* (0.052)
BCYC	−0.045* (0.015)
TREND	0.013** (0.006)
Log likelihood	−388.86

$\chi^2(1)$ ($\alpha = 1$)	65.53*
N	166

Notes: alternative lag structures were considered for the estimation of Eq. (1). We settled on a 12-month moving average for all of the independent variables. Heteroskedastic-consistent standard errors are reported in parentheses.

* Significant at the 1% level.

** Significant at the 5% level.

We now wish to examine the stability of this regression in the aftermath of three events that could have induced a structural change in the propensity of firms to engage in RJVs. This will provide further insight into the relationship between NCRA and other changes in the US National Innovation System. The first event was the election of Bill Clinton in November 1992, which shifted control of the Department of Justice from Republicans to Democrats. Democrats have been traditionally more aggressive in antitrust enforcement. Thus, Clinton's election could have induced firms to seek protection from potential litigation with respect to RJVs. The second event was the establishment of the US Commerce Department's Advanced Technology Program (ATP) in March 1991 to encourage collaborative research in defined areas.16 The third event was the National Cooperative Research and Production Act (NCRPA), enacted in July 1993, which amended the NCRA to include joint research and production joint ventures.

Table 4 summarizes the results of two widely used structural stability tests: the Chow and Wald tests. Only the ATP event appears to have induced a statistically significant structural change, using both procedures. Based on this finding, we re-specified Eq. (1), in order to take account of this ATP effect. These parameter estimates are presented in Table 5. The coefficient on the ATP dummy is positive and highly significant, indicating that the ATP induced firms to conduct and disclose additional RJVs. Note also that the coefficient on the interaction of ATP and TECHCOMP is negative and significant, which implies that ATP exacerbated the negative relationship between global high-tech competitiveness and the propensity to file RJVs.17

Table 4. Summary of results of structural stability tests

Possible event	Chow test	Wald test
ATP	17.26*	13.66*
Δ Administration	2.92	15.24*
NCRPA	8.25	13.94**

* Significant at the 1% level.

** Significant at the 5% level.

Table 5. Negative binomial regressions of the propensity of firms to file RJVs (includes ATP effects)

Independent variable	Parameter estimate
INTERCEPT	2.003 (4.790)
ATP	2.107* (0.537)
TECHCOMP	−0.043* (0.015)
ATP×TECHCOMP	−0.470* (0.142)
DEVINT	0.028 (0.057)
BCYC	−0.022 (0.024)
TREND	−0.004 (0.011)
Log likelihood	−383.1
$\chi^2(1)$ ($\alpha = 1$)	50.38*
N	166

Notes: Heteroskedastic-consistent standard errors are reported in parentheses.

* Significant at the 1% level.

6. Conclusions and policy implications

Two significant changes in the US National Innovation System were relaxation of antitrust enforcement to promote collaborative research, as embodied in the NCRA, and expansion of public–private SRP initiatives as reflected in the ATP. Our findings suggest that there is an inverse relationship between proxies for the global competitiveness of US firms in high-technology industries and their propensity to file RJVs. This result is consistent with the objective of the NCRA, in the sense that high-tech firms appear to rely more heavily on cooperative research when they experience a decline in competitive performance. We also find that ATP induced a structural shift in the propensity of firms to engage in RJVs and, more importantly, that this program exacerbated the connection between global high-tech competition and RJV activity.

These results imply that there may be two causes of the recent downturn in RJVs:

(a) The recent substantial increase in the global high-tech share of US firms (from 29% in 1994 to 38% in 1998).

(b) A substantial reduction in ATP funding, which has declined monotonically since 1995.

Our results also underscore the importance of examining complementary innovation-based policies. We find that public–private partnerships, such as ATP, may stimulate the formation of additional private–private partnerships. These are potential spillover mechanisms that warrant further attention as we seek to assess the impact of changes in the US National Innovation System (Nelson, 1993 and Mowery and Rosenberg, 1993).

Several caveats and extensions to our analysis should be noted. First, we have count, not value, measures of RJVs. It would be useful to re-estimate our model using outcome or performance measures and estimates of resources devoted to RJVs. Unfortunately, such input and output data are unavailable, although the National Science Foundation is undertaking an effort to collect such information (Link, in press). We disaggregated RJVs by broad technology fields, which did not significantly alter the findings presented herein. However, it is conceivable that there is still some underlying heterogeneity that is currently being masked in our aggregate analysis. Finally, it would be useful to explore the relationship between RJV activity and overall firm performance, in order to provide evidence on the proposition that RJVs may be undertaken as a second-best competitive strategy (Giarratana and Torissi, 2001).

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3 We consider SRPs involving universities as private–private, although a case they could be made that all universities are public, in the sense that receive state funds and/or federal research dollars. However, the important point regarding a public–private partnership is explicit financial support of the research, and this rarely occurs through university involvement as a research partner.

4 Some scholars have focused on the impact of SRPs on stock prices or accounting profits (Chan et al., 1997).

5 Authors typically interpret these performance measures as proxies for R&D spillovers.

6 This is an excerpt of comments during a meeting of the Subcommittee on Investigations and Oversight and the Subcommittee on Science, Research and Technology, 29–30 June 1983, for hearings on Japanese Technological Advances and possible United States responses using research joint ventures.

7 This purpose is stated as a preamble to the Act. The passage of the NCRA culminated a 5-year effort to ease antitrust enforcement regarding collaborative research. For a complete legislative history, see Link and Bauer (1989).

8 Filing an RJV is distinct from the decision to form or join an RJV. See Hagedoorn et al. (2000) for a review of the literature on the decision to form an RJV.

9 The data are derived from the Cooperative Research (CORE) database, constructed and maintained by Link for the National Science Foundation (Hagedoorn et al., 2000). The CORE

database uses Federal Register filing information as its primary information source and is available from Link upon request.

10 The number of RJVs filed also declined in 1999 and 2000. Unfortunately, we could not extend our econometric analysis beyond 1998, as some of the covariates were not available beyond 1998.

11 Link and Bauer (1989) report evidence (for US manufacturing firms) that is consistent with this hypothesis.

12 The time trend captures technology shocks and relevant secular trends, such as merger waves. We also added two dummy variables to control for institutional anomalies in the data, which are described in greater detail in the notes to Table 2. Given that the coefficients on these dummies are insignificant, we do not include these parameter estimates in our presentation of the econometric findings.

Table 2. Variable definitions and sources

Variable	Definition	Data source
RJV	Number of RJVs filed with the US Department of Justice, Monthly, 1985–1998	NSF CORE database
TECHCOMP	US trade balance in advanced technology products, Monthly, 1985–1998	US Department of Commerce, *US Trade with Advanced Technology*(McGuckin et al., 1989)
DEVINT	Annual percentage of industry-funded R&D allocated to development, 1985–1998	National Science Board, *Science & Engineering Indicators 2000*, Tables A2–6 and A2–17 and unpublished data from NSF
BCYC	The 12 months weighted average of US Industrial Production Index, (1992 = 100), seasonally adjusted, quarterly, 1985–1998	Board of Governors, *Federal Reserve Bulletin*, monthly
TREND	Time trend with a starting value of 1	

Notes: data are available on RJVs in the CORE database on the day that the RJV was noticed in the *Federal Register*. These data are then aggregated by month. In January 1985, seven RJVs were filed; in February 1985, 22 were filed and in March 1985 and thereafter for the next several years the monthly totals averaged five per month. The 22 filings in February 1985 were the second most over the 14-year period; there were 24 filings in December 1995 just after the pre-merger group in the US Department of Justice completed its reorganization and just before the Federal Government furloughed employees for a month. We interpret January and February

1985 as “blips”, in the sense that February represents an accumulation of pre-1985 collaborative activity that was filed in early January 1985 after the passage of the NCRA and noticed in the *Federal Register* in February 1985. We delete these 2 months from our time series, and thus our analysis has 166 observations. We control for the US Department of Justice reorganization and government furlough periods in 1995 with two dummy variables (whose coefficients turn out to be insignificant).

13 RJV is a count variable, so we considered Poisson and specifications. Given that the Poisson specification is decisively rejected, based on values of the $\chi 2$-statistic, we present only the negative binomial results. All results are available upon request from the authors.

14 The addition of a quadratic term for the competitiveness proxies yields a positive and significant coefficient (not shown), which implies that a strong improvement in competitive position could offset this inverse relationship.

15 These preliminary findings are robust to the use of monthly or quarterly data.

16 The ATP was established under the Omnibus Trade and Competitiveness Act of 1988 to “assist US businesses to improve their competitive position and promote US economic growth by accrediting the development of a variety of pre-competitive generic technologies by means of grants and cooperative agreements (e.g. industry-lead joint research and development ventures”). The ATP issued its first awards in March and April of 1991.

17 In both specifications, the coefficients on DEVINT and TREND are both insignificant. We also estimated the same regressions, using the ATP’s annual budget, rather than an ATP dummy. These results, which are available from the authors upon request, are similar to those reported in Table 5.