Stanford Law Review

Volume 68 February 2016

ARTICLE

The Private Order of Innovation Networks

Matthew Jennejohn*

Abstract. In a generation's time, collaborative methods of innovation have become a centerpiece of modern economic organization. Rather than creating technology primarily in-house, companies often enter into complex contractual arrangements whereby innovation processes cross firm boundaries. This collaborative approach gives a firm access to external expertise without executing a full acquisition.

Collaboration poses a puzzle for theories of economic organization. On one hand, uncertainty is significant when firms are jointly creating new technology, which makes formal contracts highly incomplete. On the other hand, innovation networks often appear too dynamic and heterogeneous for the typical prerequisites for informal constraints to readily obtain. How then are innovation networks governed?

In an important series of articles, Ronald Gilson, Charles Sabel, and Robert Scott argue that collaborating firms have devised a new variant of relational contracting to govern their joint efforts. This new governance form carefully blends formal agreements with

* Associate Professor of Law, J. Reuben Clark Law School, Brigham Young University. B.A. with Honors, Brigham Young University; M.Sc., London School of Economics; J.D., Columbia University School of Law. Earlier drafts of this Article were titled *Contract and Multidimensional Innovation Problems*. The Author thanks the Article's anonymous reviewers, the editors of the *Stanford Law Review*, and Afra Afsharipour, RonNell Andersen Jones, Clark Asay, Shima Baradaran, Bobby Bartlett, Brian Broughman, Jorge Contreras, Brigham Daniels, Lincoln Davies, Vic Fleischer, Fred Gedicks, George Geis, Joan Hemenway, Andy Hessick, Carissa Hessick, Christine Hurt, Jeremy Kidd, Kyle Mayer, Aaron Nielsen, Paul Norton, Kish Parella, Elizabeth Pollman, Jim Rasband, Amelia Rinehart, Jason Robison, Christina Sautter, Jeff Schwartz, Gordon Smith, Paul Stancil, Lisa Sun, Yane Svetiev, Andrew Tuch, and other participants at presentations at the 2015 Economics of Entrepreneurship and Innovation Conference at the University of Trier, 2014 Rocky Mountain Junior Scholars Forum, the Canadian Law and Economics Association's 2014 Annual Meeting, the Autumn 2014 BYU Law & Entrepreneurship Colloquium, the Southeastern Association of Law Schools' 2014 Annual Meeting, the 2014 BYU/University of Utah Junior Scholars Retreat, the recurring Transactional Law Workshop organized by Afra Afsharipour and Gordon Smith, and the Law and Entrepreneurship Workshop at the 2010 Law & Society Conference for helpful discussions and/or comments on the draft. The Author also thanks Jillaine Chaston, Steve Edmonds, Brittany Frandsen, Janet Lawrence, Jon McPherson, Derek Parry, Brandon Stone, and Yao Wen for excellent research assistance. All errors are the Author's.

informal contracts. The formal contract only indirectly governs the collaboration: instead of determining performance obligations, unique contractual provisions create an information-sharing regime that facilitates the development of informal constraints. In their parlance, formal contracts "braid" with informal social norms.

Braided contracting theory is a provocative conceptual advance, but questions arise when it is applied beyond the case studies upon which Gilson et al. base their argument. A broad analysis of alliance agreements reveals that many alliances do not include braiding mechanisms in situations where Gilson et al.'s theory would expect them, raising the question of how to understand alliance diversity. This Article argues that variation in alliance design is not surprising, however, if one takes a wider-ranging view of the exchange hazards collaborators face. Braided contracting theory's limitation is that it conceives of the exchange problem only in terms of opportunism problems. Building upon overlooked scholarship, this Article argues that exchange hazards in innovation networks are multidimensional. Rather than serve as tools for fostering informal constraints on opportunism, the unique provisions observed in alliance contracts directly address a broad confluence of problems collaborators face. Variation in alliance design is then understood as the result of those multiple exchange hazards recombining in different intensities across collaborations. This broader perspective of the contracting problem not only better explains the details of network governance but also refocuses our attention on an important if unappreciated source of innovation networks' fragility—the complex, often tenuous, interdependence between governance mechanisms.

This novel theory of the contractual infrastructure supporting innovation networks also has immediate normative implications. Foremost, it clarifies important aspects of the case law involving disputes between collaborators, which prior scholarship has overlooked. Courts adjudicating disputes between collaborators do not pursue minimalistic intervention designed to protect informal relational contracts as Gilson et al. argue, but rather directly address collaborative dysfunction in its full multidimensionality by leveraging multiple doctrines at once. Consistent with this reading of the case law are the unique dispute resolution systems often included in collaboration agreements. Those systems frequently bifurcate (or even trifurcate) dispute resolution on substantive grounds between different private and public tribunals. In short, the enforcement infrastructure is as multifaceted as the alliance agreements themselves. The result is a vision of innovation's private ordering that is more complex and theoretically rich than previously imagined.

Table of Contents

Introduction

The question of how law promotes innovation has attracted intense scholarly interest for well over a generation. Research has explored several answers to the problem, the most familiar being the role intellectual property rights play in incentivizing creative activity.[1] Additional work is progressing apace on how prizes and tax incentives complement intellectual property in promoting innovation,[2] how antitrust law affects innovation,[3] and how corporate and securities laws support the United States' "vibrant venture capital market."[4]

Less attention has been paid to understanding contract law's place in the legal infrastructure supporting innovation, however. This is curious given the increasingly critical role contracts play as firms pursue innovation collaboratively. Rather than relying entirely on in-house R&D capacity, firms in many high-technology industries ranging from pharmaceuticals to semiconductors now create technology through contractual alliances by which

1. Arrow's famous paradox—a party trying to exchange information must first disclose it in order for her counterparty to value it—is the common starting point for this literature on property's role in supporting innovation. *See* Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, *in* THE RATE AND DIRECTION OF INVENTIVE ACTIVITY: ECONOMIC AND SOCIAL FACTORS 609, 615 (1962). The conventional wisdom is that a grant of a property right in the information is a solution to the paradox. *See, e.g.*, Edmund W. Kitch, *The Nature and Function of the Patent System*, 20 J.L. & ECON. 265, 278 (1977) ("The patent creates a defined set of legal rights known to both parties at the outset of negotiations. . . . [T]he owner can [thus] disclose such information protected by the scope of the legal monopoly."). Recent scholarship has argued that intellectual property rights can also impede innovation in certain respects. *See, e.g.*, DAN L. BURK & MARK A. LEMLEY, THE PATENT CRISIS AND HOW THE COURTS CAN SOLVE IT 30-31 (2009); MICHAEL HELLER, THE GRIDLOCK ECONOMY: HOW TOO MUCH OWNERSHIP WRECKS MARKETS, STOPS INNOVATION, AND COSTS LIVES 1-22 (2008).

2. For an illustrative selection of the literature on prizes, see, for example, Michael Abramowicz, *Perfecting Patent Prizes*, 56 VAND. L. REV. 115 (2003); Fiona Murray et al., *Grand Innovation Prizes: A Theoretical, Normative, and Empirical Evaluation*, 41 RES. POL'Y 1779 (2012); and Brian D. Wright, *The Economics of Invention Incentives: Patents, Prizes, and Research Contracts*, 73 AM. ECON. REV. 691 (1983). For an analysis of the efficacy of R&D tax credits, see Nick Bloom et al., *Do R&D Tax Credits Work?: Evidence from a Panel of Countries 1979-1997*, 85 J. PUB. ECON. 1 (2002).

3. *See* Jonathan B. Baker, *Beyond Schumpeter vs. Arrow: How Antitrust Fosters Innovation*, 74 ANTITRUST L.J. 575 (2007); Herbert Hovenkamp, *The Intellectual Property-Antitrust Interface*, *in* 3 ABA SECTION OF ANTITRUST LAW, ISSUES IN COMPETITION LAW AND POLICY 1979, 1979-80 (2008).

4. Bernard S. Black & Ronald J. Gilson, *Venture Capital and the Structure of Capital Markets: Banks Versus Stock Markets*, 47 J. FIN. ECON. 243, 245 (1998); *see also, e.g.*, Robert P. Bartlett, III, *Venture Capital, Agency Costs, and the False Dichotomy of the Corporation*, 54 UCLA L. REV. 37 (2006); Brian Broughman & Jesse M. Fried, *Carrots and Sticks: How VCs Induce Entrepreneurial Teams to Sell Startups*, 98 CORNELL L. REV. 1319 (2013); Ronald J. Gilson, *Locating Innovation: The Endogeneity of Technology, Organizational Structure, and Financial Contracting*, 110 COLUM. L. REV. 885 (2010); D. Gordon Smith, *The Exit Structure of Venture Capital*, 53 UCLA L. REV. 315 (2005).

they partially integrate development capabilities via contract, short of consummating a full acquisition.[5] Recent examples include Google's collaboration with Novartis for the development of smart contact lenses,[6] Apple's partnership with IBM to develop mobility solutions for the corporate market,[7] and GlaxoSmithKline and the National Institute of Health's joint work on developing a long-awaited Ebola vaccine.[8] Buffeted by highly competitive global markets, many firms hope that innovating through collaborative approaches will produce new technology in a way that is better, faster, and cheaper.

Unfortunately, that hope is frequently unrealized. Consider a timely example from the aerospace industry: few recent industrial gambles rival the bet Boeing made in its collaborative approach to the design and production of the 787 Dreamliner. Under pressure throughout the 1990s to respond to a surging Airbus, which had attracted 50% of the passenger aircraft market by 1997,[9] Boeing responded in 2003 with an ambitious plan to recapture market

5. During much of the twentieth century, innovation was often organized within the boundaries of a company. Many of the storied R&D centers of the mid-twentieth century—such as Bell Labs, Lockheed's Skunk Works, and Xerox's PARC—were found within the borders of a Chandlerian firm. *See* ALFRED D. CHANDLER, JR., THE VISIBLE HAND: THE MANAGERIAL REVOLUTION IN AMERICAN BUSINESS 1-3 (1977) (arguing that the definitive characteristic of the mid-twentieth-century economic organization was the coordination of multiple operating units accomplished through managerial hierarchy rather than market mechanisms). While the prototypical vertically integrated production arrangement of the mid-twentieth century continues to enjoy vitality, deverticalized approaches to innovation have become a regular fixture in the contemporary economic order. *See* Timothy J. Sturgeon, *Modular Production Networks: A New American Model of Industrial Organization*, 11 INDUS. & CORP. CHANGE 451, 452 (2002). Under pressure from dynamic global markets, firms increasingly collaborate with one another to access and thereby leverage expertise they could not readily develop in-house. *See* Kathleen M. Eisenhardt & Claudia Bird Schoonhoven, *Resource-Based View of Strategic Alliance Formation: Strategic and Social Effects in Entrepreneurial Firms*, 7 ORG. SCI. 136, 136 (1996); John Hagedoorn & Jos Schakenraad, *Inter-Firm Partnerships and Co-Operative Strategies in Core Technologies*, *in* NEW EXPLORATIONS IN THE ECONOMICS OF TECHNICAL CHANGE 3, 9-13 (C. Freeman & L. Soete eds., 1990); Kathryn Rudie Harrigan, *Joint Ventures and Competitive Strategy*, 9 STRATEGIC MGMT. J. 141, 142 (1988).

6. Mark Scott, *Novartis Joins with Google to Develop Contact Lens that Monitors Blood Sugar*, N.Y. TIMES (July 15, 2014), http://nyti.ms/1mRkalA.

7. Tim Bradshaw & Richard Waters, *Apple and IBM Take On Corporate Market Together*, FIN. TIMES (July 15, 2014, 10:21 PM), http://on.ft.com/Ubvl3Y.

8. Press Release, Nat'l Inst. of Allergy & Infectious Diseases, Nat'l Insts. of Health, NIH to Launch Human Safety Study of Ebola Vaccine Candidate (Aug. 28, 2014), http://www.niaid.nih.gov/news/newsreleases/2014/Pages/EbolaVaxCandidate.aspx.

9. *Boeing, Airbus Share Honours in 2013 Orders/Deliveries Race—But It's Not About Winners and Losers*, CAPA: CTR. FOR AVIATION (Jan. 17, 2014), http://centreforaviation.com/analysis/boeing-airbus-share-honours-in-2013-ordersdeliveries-race---but-its-not-about-winners-and-losers-147949; *Record-Breakers (1993-2000)*, AIRBUS, http://www.airbus.com/company/history/the-narrative/record-breakers-1993-2000 (last visited Feb. 2, 2016).

share by developing a technologically advanced wide-body aircraft.[10] Use of carbon composite materials and a revolutionary battery system would increase the aircraft's operating efficiency, reducing costs for carriers while also improving passenger experience by transforming long-haul routes that once required a layover into nonstop flights.[11] Furthermore, an extensively outsourced design and production process would bring this advanced aircraft to market at a low price and record pace, with initial projections showing a forty percent reduction in development costs and thirty-three percent reduction in development time.[12] The collaborative approach to innovation familiar in industries ranging from pharmaceuticals to electronics to automobiles was coming to Boeing's commercial aerospace program.

Demand for the 787 exceeded expectations, with 848 orders for the new aircraft booked.[13] However, not all went as planned. Development of the 787 went dramatically over budget, and rollout was delayed at least seven times, resulting in a debut three years behind schedule.[14] And as delivery to carriers began in 2011, system malfunctions quickly mounted. The main landing gear did not extend properly.[15] Engines failed.[16] Hydraulics problems arose.[17] Fuel lines leaked.[18] Two battery fires occurred: while a 787 taxied in Boston and

10. Christopher S. Tang & Joshua D. Zimmerman, *Managing New Product Development and Supply Chain Risks: The Boeing 787 Case*, 10 SUPPLY CHAIN F., no. 2, 2009, at 74, 74.

11. *Id.*; Kevin Bullis, *Grounded Boeing 787 Dreamliners Use Batteries Prone to Overheating*, MIT TECH. REV. (Jan. 16, 2013), http://www.technologyreview.com/news/509981/grounded-boeing-787-dreamliners-use-batteries-prone-to-overheating ("Boeing's 787 is the first commercial aircraft to use lithium-ion batteries . . . ."); *787 Electrical Systems: Batteries and Advanced Airplanes*, BOEING, http://787updates.newairplane.com/787-Electrical-Systems/Batteries-and-Advanced-Airplanes (last visited Feb. 2, 2016) (noting that lithium-ion batteries have "[s]imilar functionality to that of [traditional] NiCd batteries while weighing 30 percent less," and that NiCd batteries are "heavier, larger, and less powerful").

12. *See* Tang & Zimmerman, *supra* note 10, at 77.

13. Steve Denning, *The Boeing Debacle: Seven Lessons Every CEO Must Learn*, FORBES (Jan. 17, 2013, 7:24 AM), http://onforb.es/XcYsxn.

14. *Id.*

15. *Boeing 787 Dreamliner Hit by Landing Gear Glitch*, REUTERS (Nov. 8, 2011, 3:55 AM EST), http://www.reuters.com/article/2011/11/08/uk-boeing-dreamliner-glitch-idUSLNE7A603L20111108.

16. Jason Paur, *NTSB Urges Action After Engine Failures in New Boeing 787, 747 Airliners*, WIRED (Sept. 17, 2012, 2:36 PM), http://www.wired.com/2012/09/ntsb-boeing-787-engines.

17. *Airline Reports Problem with Hydraulic Pump in Dreamliner*, CHI. TRIB. (Sept. 16, 2013), http://articles.chicagotribune.com/2013-09-16/business/chi-dreamliner-hydraulic-pump-in-dreamliner-20130916_1_hydraulic-pump-the-dreamliner-overheating-batteries.

18. Jad Mouawad, *Fuel Leak Is Latest Setback for Boeing's Dreamliner*, N.Y. TIMES (Jan. 8, 2013), http://nyti.ms/VDEai5.

while another flew over Japan,[19] which subsequently led to the grounding of all 787s around the world.[20] Congressional hearings ensued.[21] To some, the 787 had become "an object lesson in how not to build an airplane."[22]

According to a joint Federal Aviation Administration and Boeing study issued in 2014, a source of Boeing's problems was its poorly structured collaborative approach to innovation.[23] For prior aircraft programs, Boeing had pursued a "build to print" sourcing strategy, by which Boeing designed specifications for parts, contracted directly with a large number of suppliers for the production of those exact parts, and then assembled those parts into subsystems and, in turn, the complete aircraft.[24] Abandoning past practice for the 787, Boeing followed a "build to performance" sourcing model, by which it devolved design and assembly responsibility for distinct subsystems (e.g., fuselage sections, wings, landing gear, etc.) to fifteen tier-one suppliers, leaving Boeing to coordinate efforts and handle final assembly.[25] In other words, rather than providing specific directions on what parts to provide, Boeing gave the tier-one suppliers a framework of performance targets for their respective subsystems, allowing suppliers to determine how those targets would be met. This approach was intended to leverage supplier expertise and reduce Boeing's upfront capital expenditures,[26] but coordination problems quickly overwhelmed the process. In a number of cases, subsystems from different suppliers did not work with one another properly, requiring Boeing engineers

19. Alan Levin, *Boeing's Dreamliner Battery Fire Caused by Design, Probe Finds*, BLOOMBERG BUS. (Dec. 1, 2014, 6:07 PM MST), http://bloom.bg/1Lcxssf.

20. *See Lessons Learned from the Boeing 787 Incidents: Hearing Before the Subcomm. on Aviation of the H. Comm. on Transp. & Infrastructure*, 113th Cong. 32-33 (2013) (statement of Margaret M. Gilligan, Associate Administrator, Federal Aviation Administration); Bullis, *supra* note 11.

21. *See Lessons Learned from the Boeing 787 Incidents*, *supra* note 20.

22. James Surowiecki, *Requiem for a Dreamliner?*, NEW YORKER (Feb. 4, 2013), http://www.newyorker.com/magazine/2013/02/04/requiem-for-a-dreamliner.

23. BOEING 787-8 CRITICAL SYS. REVIEW TEAM, BOEING 787-8 DESIGN, CERTIFICATION, AND MANUFACTURING SYSTEMS REVIEW 12-13 (2014) (finding that Boeing's business model, which gave suppliers "a larger role in developing, testing, and certifying integrated systems for the B787," created "unanticipated manufacturing challenges" due to the "learning curve" and "late engineering changes" suppliers faced).

24. Suresh Kotha & Kannan Srikanth, *Managing a Global Partnership Model: Lessons from the Boeing 787 'Dreamliner' Program*, 3 GLOBAL STRATEGY J. 41, 47 (2013) (italics omitted).

25. *Id.*

26. Christopher Drew, *A Dream Interrupted at Boeing*, N.Y. TIMES (Sept. 5, 2009), http://nyti.ms/1mHQUr7 (reporting an aviation analyst's comment that "[t]he idea [behind the 787's outsourced design process] was to get the risk off their books and get other people to do the heavy lifting for them, ... [b]ut the flaw was that it led to a kind of 'engineering light' approach, and the problems on the 787 can be traced to that").

to develop expensive work-arounds.[27] Incentive mechanisms in Boeing's supplier contracts only made matters worse: because the contracts provided that suppliers would not be paid until all subsystems were assembled correctly, a lag by one supplier undercut other suppliers' incentives to be on time.[28] A mechanism meant to prod the supply base forward actually held it back. Problems with one supplier, Vought Aircraft Industries, became so severe that Boeing eventually acquired the Vought factory involved with the Dreamliner, controlling that portion of the production process through ownership rather than contract.[29]

Such challenges are not unique to Boeing. The failure in Autumn 2014 of Apple and GT Advanced's collaboration to create sapphire screens for the iPhone 6, which precipitated GT Advanced's bankruptcy, provides another recent example.[30] A number of studies have found that a majority of alliances fail.[31] Such failures are all the more troubling as we come to appreciate the collateral economic risks involved with shifting to more collaborative production arrangements. Evidence continues to mount that decisions to outsource and offshore can erode the R&D, engineering, and manufacturing capabilities often held within networks of individuals and companies.[32] Dismantling enterprises without realizing a net benefit in return is a poor trade.

Interfirm alliances thus present a paradox. On one hand, parties are relying on contracts more than ever before to realize innovation outcomes; on the other hand, contract's limits as a governance device are routinely exposed. Contract's tensile strength, to borrow an engineering term,[33] is impressive, but

27. Stephen Denning, *What Went Wrong at Boeing*, 41 STRATEGY & LEADERSHIP, no. 3, 2013, at 36, 37-39 (summarizing supply chain problems underlying the delays in the 787's production process).

28. *See* Tang & Zimmerman, *supra* note 10, at 80.

29. *Id.* at 81.

30. Peg Brickley, *GT Advanced Says It Can't Afford to Fight Apple, Must Settle*, WALL ST. J. (Oct. 28, 2014, 4:10 PM ET), http://on.wsj.com/1hS5dXE. Of course, in some cases, those collaborations may simply be bumping up against the limits of science. But like the Boeing example discussed above, there is reason to believe that contract design plays a role in a collaboration's performance. For example, a recent survey of executives involved in interfirm alliances found that contract design was a key contributor to collaboration success. *See* DELOITTE, CORPORATE DEVELOPMENT 2012: LEVERAGING THE POWER OF RELATIONSHIPS IN M&A 13-17 (2012).

31. *See* Seung Ho Park & Gerardo R. Ungson, *Interfirm Rivalry and Managerial Complexity: A Conceptual Framework of Alliance Failure*, 12 ORG. SCI. 37, 38 (2001) (noting that over fifty percent of alliances fail and that "overwhelming empirical evidence" indicates "that alliances are unstable").

32. *See, e.g.*, Gary P. Pisano & Willy C. Shih, *Restoring American Competitiveness*, HARV. BUS. REV., July-Aug. 2009, at 114, 116-19.

33. Tensile strength is a measure of how much force is required to pull something, such as a wire, to the point where it breaks. *See, e.g.*, S.S. Brenner, *Tensile Strength of Whiskers*, 27

footnote continued on next page

it has limits. What causes those limits? Relatedly, how should courts intervene when collaborations founder? For example, how should contract doctrine apply in the context of collaborative innovation? Answering those questions is critical for private parties and their counsel trying to design more effective agreements, and for public officials attempting to craft policy responses.

Given the complexity of collaborative relationships, and the multidisciplinary toolkit required for accurate analysis, understanding the limits of contract as a governance device in innovation networks is a Herculean task. But a new line of legal research, anchored by Gilson, Sabel, and Scott's comprehensive theory of contracting for innovation, is undertaking to do just that.[34] This scholarship takes the economics literature on contract design as its starting point.[35] It then applies and, in its most ambitious moments, extends contract economics to explain how collaborators fashion novel contractual governance mechanisms to incentivize each collaborator's behavior in situations where high uncertainty creates openings for opportunistic behavior.[36] Gilson et al. argue, for example, that contracting for innovation depends upon a unique blend of both formal contract provisions, enforceable in a court of law, and informal constraints, which rely upon

---

J. APPLIED PHYSICS 1484, 1484 (1956) (presenting results of experiments testing the tensile strength of strands of iron, copper, and silver).

34. *See* Ronald J. Gilson et al., *Braiding: The Interaction of Formal and Informal Contracting in Theory, Practice, and Doctrine*, 110 COLUM. L. REV. 1377 (2010) [hereinafter Gilson et al., *Braiding*]; Ronald J. Gilson et al., *Contracting for Innovation: Vertical Disintegration and Interfirm Collaboration*, 109 COLUM. L. REV. 431 (2009) [hereinafter Gilson et al., *Contracting for Innovation*]. Legal scholars' response to this problem has been belated, with the role of legal institutions in preventing collaboration failure only recently attracting scholarly attention. George Dent was the first to analyze alliance contracting. George Dent, *Lawyers and Trust in Business Alliances*, 58 BUS. LAW. 45, 45 (2002). Gordon Smith also wrote an early article on the use of governance committees in alliances. D. Gordon Smith, *The Exit Structure of Strategic Alliances*, 2005 U. ILL. L. REV. 303. Attention has become more sustained in the last eight years. *See, e.g.*, Lisa Bernstein, *Beyond Relational Contracts: Social Capital and Network Governance in Procurement Contracts*, 8 J. LEGAL ANALYSIS (forthcoming 2016) (manuscript at 3), http://papers.ssrn.com/abstract=2711841; Fabrizio Cafaggi, *Introduction* to CONTRACTUAL NETWORKS, INTER-FIRM COOPERATION AND ECONOMIC GROWTH 1 (Fabrizio Cafaggi ed., 2011); George S. Geis, *An Empirical Examination of Business Outsourcing Transactions*, 96 VA. L. REV. 241 (2010) [hereinafter Geis, *An Empirical Examination of Business Outsourcing Transactions*]; George S. Geis, *The Space Between Markets and Hierarchies*, 95 VA. L. REV. 99 (2009) [hereinafter Geis, *The Space Between Markets and Hierarchies*]; Gilson et al., *Braiding*, *supra*; Gilson et al., *Contracting for Innovation*, *supra*; Matthew C. Jennejohn, *Collaboration, Innovation, and Contract Design*, 14 STAN. J.L. BUS. & FIN. 83 (2008) [hereinafter Jennejohn, *Collaboration, Innovation, and Contract Design*]; Matthew C. Jennejohn, *Contract Adjudication in a Collaborative Economy*, 5 VA. L. & BUS. REV. 173 (2010) [hereinafter Jennejohn, *Contract Adjudication in a Collaborative Economy*].

35. For an overview of the economics of incomplete contracts, see Parts I.B.1 and I.B.2 below.

36. *See infra* Parts I.B.2, I.B.3.

extralegal sanctions to police behavior.[37] In short, they argue that formal contract provisions create unique information-sharing routines, which foster informal governance by (1) making each collaborator's performance more transparent, (2) revealing whether the parties are prone to cheating, and (3) locking the parties into the partnership as they make mutual investments in relationship-specific learning.[38] This "braid" of formal and informal contracting harnesses the opportunism problems Gilson et al. see plaguing interfirm collaborations.[39] In Gilson et al.'s telling, braided contracting is an important theoretical advance that not only illuminates how collaborations are governed, but also portends broader implications for our general theories of economic organization.[40]

Gilson et al.'s theory of braided contracting breaks new theoretical ground, and in so doing illuminates new questions for theories of economic organization and plays a central role in their subsequent scholarship on the role of contract law and courts in American capitalism.[41] But closer analysis of a broader sample of agreements suggests that braiding may not provide a complete picture of innovation networks' private ordering. As one looks beyond the four contracts at the heart of their analysis[42] to a broader collection of alliance agreements, a number of questions arise. For example, many alliance contracts give one or both partners veto rights over certain decisions that appear to conflict with Gilson et al.'s braiding mechanism: the allocation of a veto would allow a party to unilaterally undercut the mutual investment in relationship-specific information that plays an important part in their braiding model. Also, intellectual property ownership issues, which are unsurprisingly prominent in many alliance contracts, are not directly addressed in Gilson et al.'s braiding theory, and so they provide no explanation of how ownership allocation affects governance. Finally, and perhaps most fundamentally, Gilson et al.'s theory does not account for the rich diversity of governance strategies observed in the design of many alliance contracts. Some agreements display the hallmark governance mechanisms of braiding theory, but many do not, which raises the basic question of how those collaborations

37. *See* Gilson et al., *Contracting for Innovation*, *supra* note 34, at 476-89.

38. *See infra* Part I.B.3.

39. *See infra* notes 121-28 and accompanying text.

40. Gilson et al., *Contracting for Innovation*, *supra* note 34, at 494-501.

41. Ronald J. Gilson et al., *Contract and Innovation: The Limited Role of Generalist Courts in the Evolution of Novel Contractual Forms*, 88 N.Y.U. L. REV. 170, 172 (2013) [hereinafter Gilson et al., *Contract and Innovation*]; Ronald J. Gilson et al., *Text* and *Context: Contract Interpretation as Contract Design*, 100 CORNELL L. REV. 23, 32-33 (2014).

42. *See* Gilson et al., *Braiding*, *supra* note 34, at 1405-08 (discussing a contract between Bristol-Myers Squibb and Pharmacopeia); Gilson et al., *Contracting for Innovation*, *supra* note 34, at 458-71 (discussing contracts between John Deere and Stanadyne, Apple and SCI Systems, and Warner-Lambert and Ligand Pharmaceuticals).

are governed if not by braiding.[43] In short, as Gilson et al. candidly foresaw, a complete picture of how innovation networks are governed requires further theoretical evolution.[44]

Given the complexity of innovation networks, achieving a more complete understanding of their governance requires a sustained, deliberate effort. This Article is a first step. Its purpose is not to close debate, but to build upon Gilson et al.'s contribution and to pivot the literature towards a series of new and potentially fruitful questions for further research. It attempts to do so in two respects. First, the Article argues that prior scholarship does not provide a complete explanation of how alliance contracts are designed because it overlooks important classes of exchange hazards collaborators face. The Article then introduces a new conceptual tool to fill that gap in the research—the idea of *multivalent contracting*, explained below.[45] A multivalent conception of contract mechanisms provides a clearer picture of innovation networks by expanding our view of the forces that shape the design of alliance contracts. It also allows us to better understand the interdependencies between contract provisions created to respond to that wider array of innovation problems.[46]

This Article begins in Part I by situating Gilson et al.'s braiding theory in the broader literature, including not only Macaulay and Macneil's original work on "relational contracting," but also subsequent scholarship on the economics of contracting.[47] The Article then argues that the theory of braided

43. Exploring such diversity is a critical opportunity because of what Williamson has referred to as the "discriminating alignment hypothesis," which posits that comparing different governance structures is a fruitful method for exploring economic organization because transactions with different attributes are governed—or "aligned"—with different mechanisms. *See* Oliver E. Williamson, *The Economics of Governance*, 95 AM. ECON. REV. (PAPERS & PROC.) 1, 15-16 (2005).

44. *See* Gilson et al., *Contracting for Innovation*, *supra* note 34, at 459 (noting that their theory is to some extent tentative, as it is based on the analysis of a small number of agreements, and that "[i]n subsequent work, we will test our theoretical predictions against a larger group of contracts that support collaborative innovation").

45. *See infra* Part II.B.

46. In articulating a theory of how discrete contract provisions interact in response to a multitude of hazards, this Article builds upon important, if often, unexploited prior scholarship that has recognized a variety of exchange hazards shaping economic organization. *See* Lisa Bernstein, *Merchant Law in a Modern Economy*, *in* PHILOSOPHICAL FOUNDATIONS OF CONTRACT LAW 238, 259-70 (Gregory Klass et al. eds., 2014); Margaret M. Blair & Lynn A. Stout, *A Team Production Theory of Corporate Law*, 85 VA. L. REV. 247, 249-50 (1999); Bengt Holmström & John Roberts, *The Boundaries of the Firm Revisited*, J. ECON. PERSP., Fall 1998, at 73, 75.

47. *See* Stewart Macaulay, *Non-Contractual Relations in Business: A Preliminary Study*, 28 AM. SOC. REV. 55, 55-56 (1963); Ian R. Macneil, *Contracts: Adjustment of Long-Term Economic Relations Under Classical, Neoclassical, and Relational Contract Law*, 72 NW. U. L. REV. 854, 886-900 (1978). Macneil understood contractual "relations" to encompass the full spectrum of interactions between the parties, not just their formally enforceable agreements, and that such relations often arose when complex transactions were projected into the future. Macneil, *supra*, at 856-59. This broader "relational" contract

footnote continued on next page

contracting does not fully explain key details of alliance design because it, and the relational contracting literature more generally, oversimplifies the contracting problems collaborators face. A narrow view of those problems obscures aspects of alliance contract design and leads to an incomplete diagnosis of collaborative dysfunction.

To recalibrate the scholarship, this Article proposes a novel theoretical reframing of alliance contract design in Part II. Building upon management and intellectual property scholarship as much as traditional contract economics, this Article argues that the diversity of alliance governance strategies can be explained by including the concepts of spillovers and coordination entropy in our theoretical framework.[48] That multidimensional conception of exchange hazards has an intriguing implication. It suggests that, rather than being single-minded tools for addressing only the opportunism threat that has preoccupied much scholarship in contract economics, contract provisions can be multivalent, responding to multiple hazards simultaneously.[49] The concept of multivalence provides a powerful lens for exploring alliance design in greater detail because it allows us to focus on how a given governance mechanism interacts across a broader spectrum of applicable exchange hazards.[50] For example, if a contract provision interacts with two hazards—perhaps by exacerbating Hazard *A* as it minimizes Hazard *B*—and if that interaction results in a net loss, a party may entirely forego using the mechanism, which we would otherwise expect to be employed from a theoretical perspective that focuses only on, say, Hazard *B*. The design of alliance contracts involves a balancing of tradeoffs between more than one exchange hazard. A multivalent view of contracting highlights the contingent nature of governance mechanisms in alliance agreements, and in so doing shines new light on the intricate interdependencies between governance mechanisms that combine to form the latticework of a complex agreement.

To illustrate the promise of this reframing, Part III undertakes a preliminary empirical analysis of alliance contracts' use of management committees, a unique type of governance mechanism that exemplifies braiding theory. This Part first analyzes committee use through a qualitative analysis of three alliance contracts. That qualitative analysis is meant to build intuition and provide context for the larger-*n* quantitative analysis that follows. The results of that preliminary quantitative analysis of a larger sample of 146

---

then became a mechanism for achieving flexibility in the exchange relationship over time. *Id.* at 886-900.

48. *See infra* Part II.A.

49. *See* 10 OXFORD ENGLISH DICTIONARY 92 (2d ed. 1989) (defining "multivalence" as "the property of having many meanings or interpretations"). A more prosaic metaphor may be a multipurpose tool, such as a Swiss Army knife, which is designed for more than one use.

50. *See infra* Part II.B.

alliance agreements, taken from a hand-collected database currently being developed as part of a continuing research project on alliance design, are then presented. Finally, this Part revisits the three agreements Gilson et al. used in their original article, explaining how a multivalent approach explains some of their differences. These analyses are designed simply to demonstrate proof of concept, deferring more thorough and rigorous studies extending beyond management committees to later research.[51] The preliminary results suggest that such committees are designed to address spillover and entropy problems in addition to opportunism risks, and that differing intensities in those hazards explains the diversity observed in governance-committee use. Thus, a multivalent approach captures dynamics that braided contracting does not entirely apprehend.

This positive theory of multivalent contracting also suggests important normative insights by clarifying courts' role when collaborations fail—an issue discussed more fully in Part IV. Consistent with the view that formal contracts only indirectly govern collaborations by fostering informal constraints on opportunism, Gilson et al. have taken a limited view of judicial intervention, arguing that a minimalistic application of contract doctrine—where courts intervene only to vindicate parties' reliance interests—is the answer to collaborative dysfunction.[52] However, neither the available case law nor the privately ordered dispute resolution systems that collaborators often use clearly support the claim that minimalistic contract enforcement is appropriate. Rather, consistent with a multidimensional conception of exchange hazards, it appears that the actual issue tribunals face when resolving disputes between collaborators is how to employ a multitude of adjacent doctrines most effectively. To illustrate, this Article revisits *Eli Lilly & Co. v. Emisphere Technologies, Inc.*,[53] which is becoming a paradigmatic case in the literature.[54] A reinterpretation of the decision shows that the case offers, at most, ambivalent support for minimalism because the court's subsequent decision with respect to relief vindicated the aggrieved party's expectation interest. An alternative, arguably more faithful, reading is that the *Eli Lilly* court's central problem was how to balance the application of both contract and patent law to a multivalent contract. Furthermore, private dispute

51. The complexity of transactional research requires circumspection. *See* Brian J.M. Quinn, *Putting Your Money Where Your Mouth Is: The Performance of Earnouts in Corporate Acquisitions*, 81 U. CIN. L. REV. 127, 165-67 (2012) (calling for "modesty in claims made of those of us who study transactional law").

52. *See infra* Part IV.A.

53. 408 F. Supp. 2d 668 (S.D. Ind. 2006).

54. *See, e.g.*, ROBERT E. SCOTT & JODI S. KRAUS, CONTRACT LAW AND THEORY 390-96 (5th ed. 2013) (including *Eli Lilly* in the first-year Contracts curriculum as an example of enforcing a braided agreement); Gilson et al., *Contract and Innovation*, *supra* note 41, at 194 (discussing *Eli Lilly* as an example of braided contract enforcement); *see also* Gilson et al., *Braiding*, *supra* note 34, at 1416-18 (introducing *Eli Lilly* into the literature).

resolution systems, which bifurcate adjudication between multiple tribunals based on a dispute's underlying substance, further suggest that a complete understanding of law's role in supporting collaborative exchange requires us to consider how a constellation of legal institutions coheres. The multivalent approach proposed in this Article responds directly to this issue because it provides a framework for exploring how equally implicated doctrines, such as property or antitrust, operate in tandem (or at cross-purposes) with contract. Thus, a multidimensional approach clarifies the case law and also brings the actual problems with the enforcement infrastructure into focus: first, how different doctrinal "levers"[55] can be balanced to not only target certain hazards, but also to minimize tradeoffs between responses to different transaction costs; second, how those levers can be used to close down socially inefficient arbitrage opportunities.

Finally, this Article concludes by summarizing the argument and then by revisiting Ian Macneil's original project of establishing a relational approach to contract law.[56] Although Macneil's seminal contribution on the role of informal—or "relational"—contracting in modern exchange continues to underpin the study of transaction design, his complex conceptual framework has fallen into disuse, and his normative arguments in favor of contextualist enforcement have not been pursued.[57] This Article does not embrace Macneil's normative position, but it raises the possibility that overlooked aspects of his conceptual framework might be repurposed to advance the study of complex contractual structures.

I. Formal and Informal Governance in Alliance Contracts

Any theory of contract design must have answers for two questions: First, what hazards to exchange must transacting parties confront? And second, what governance tools can parties use to eliminate, or at least check, those hazards? Over the years, contract economics research has gravitated towards a unidimensional conception of exchange hazards—namely, that exchange often gives opportunistic parties the chance to "hold up" their counterparty for a greater share of the surplus resulting from the transaction.[58] There is less consensus, however, on how parties respond to that holdup problem. A large literature has developed on how formal contract provisions can police opportunism problems, such as the allocation of control rights, the use of options, the careful balancing of rule-like versus standard-like contractual

55. *See* Dan L. Burk & Mark A. Lemley, *Policy Levers in Patent Law*, 89 VA. L. REV. 1575, 1579 (2003).

56. *See* Macneil, *supra* note 47, at 855.

57. *See, e.g.*, Melvin A. Eisenberg, *Why There Is No Law of Relational Contracts*, 94 NW. U. L. REV. 805, 812-21 (2000).

58. *See infra* Part I.B.1.

obligations.[59] Another strand of scholarship argues that informal constraints prevent opportunism as much as, or more than, formal enforcement. This perspective draws upon the pioneering relational contracting work of Macaulay and Macneil, who argued that court enforcement is often not sufficient or perhaps necessary to fully police relational contracts, which cannot completely pin down each party's future obligations due to high uncertainty.[60] Informal governance mechanisms—such as social norms, repeated dealings, or reputational effects—pressure parties to live up to their contractual obligations.[61] Trust, not only recourse to the courts, keeps commerce on its rails.[62] The conventional view is that formal and informal governance mechanisms are substitutes for one another court enforcement "crowds out" informal governance by undermining the unwritten norms supporting exchange.[63]

Recent research on collaborative innovation introduces an interesting twist to the theory of contract design by arguing that formal and informal governance mechanisms are not substitutes for one another but rather complements.[64] Led by Gilson et al.'s braiding theory, this research argues that collaborators establish and augment informal constraints through a unique

59. *See infra* Part I.B.2.

60. *See* Macaulay, *supra* note 47, at 62-63; Macneil, *supra* note 47, at 887-93.

61. *See* Macaulay, *supra* note 47, at 63-64; Macneil, *supra* note 47, at 898.

62. *See, e.g.*, ERIC A. POSNER, LAW AND SOCIAL NORMS 148-66 (2000) (describing the role informal governance plays in exchange relationships); Robert Cooter, *Do Good Laws Make Good Citizens?: An Economic Analysis of Internalized Norms*, 86 VA. L. REV. 1577, 1579-80 (2000); Robert D. Cooter, *Three Effects of Social Norms on Law: Expression, Deterrence, and Internalization*, 79 OR. L. REV. 1, 3 (2000); Edward M. Iacobucci, *On the Interaction Between Legal and Reputational Sanctions*, 43 J. LEGAL STUD. 189, 189 (2014); A. Mitchell Polinsky & Steven Shavell, *The Uneasy Case for Product Liability*, 123 HARV. L. REV. 1437, 1440-43 (2010) (explaining that market forces provide firms an incentive to produce safe products even in the absence of products liability); *see also* Dan M. Kahan & Eric A. Posner, *Shaming White-Collar Criminals: A Proposal for Reform of the Federal Sentencing Guidelines*, 42 J.L. & ECON. 365, 365-66 (1999) (arguing that shaming is "a cost-effective and politically acceptable alternative to the short terms of imprisonment" that white-collar offenders typically receive); Doron Teichman, *Sex, Shame, and the Law: An Economic Perspective on Megan's Laws*, 42 HARV. J. ON LEGIS. 355, 357 (2005) (arguing that nonlegal sanctions can also play a role in punishing convicted sex offenders).

63. *See, e.g.*, Iris Bohnet et al., *More Order with Less Law: On Contract Enforcement, Trust, and Crowding*, 95 AM. POL. SCI. REV. 131, 132 (2001) (finding evidence that intermediate levels of contract enforcement crowd out informal governance mechanisms, but low levels of enforcement "crowd in"—that is, induce people to be more cautious when entering in to contracts and informal norms); *see also* Michael D. Ryall & Rachelle C. Sampson, *Formal Contracts in the Presence of Relational Enforcement Mechanisms: Evidence from Technology Development Projects*, 55 MGMT. SCI. 906, 907 (2009) (noting that the majority of firms in their study waive court enforcement, suggesting that the parties may wish to avoid formal enforcement's crowding-out effect).

64. *See infra* Part I.A.3.

collection of formal contractual provisions.[65] Those formal mechanisms combine to foster informal constraints that otherwise may not occur in the dynamic heterogeneous markets in which much collaboration occurs in the modern economy.[66] Formal and informal contracts are two complementary strands of a braided approach to governance, and it is with this new offshoot of the larger literature on relational contracting that this Article engages.

Approaching alliance contracts as a blend of formal and informal governance mechanisms has opened important new avenues in the study of contracting, but it has also overlooked important aspects of alliance contract design. For instance, common methods, such as joint ownership, for coping with uncertain rights to the intellectual property resulting from these collaborations—a much-discussed topic in the practitioner literature—are unaddressed. How do governance mechanisms meant to fill gaps in incomplete contracts[67] also respond to incomplete property rights?[68] It is also not fully clear how reciprocal veto rights, which are often granted to both parties in many alliances, fits into braided contracting theory. How do veto rights affect the information-sharing protocols and contract referee mechanisms at the heart of the braided theories?

But most interesting is the more fundamental difficulty braided contracting theory has in explaining the diversity of design strategies that collaborators pursue. Many collaboration agreements do not include the hallmark mechanisms indicative of braided governance, and yet these contracts appear as incomplete as agreements with braiding mechanisms, reopening the fundamental question of how such arrangements are controlled. If uncertainty is consistent across agreements both with and without braided governance mechanisms, how are collaborations without braided mechanisms governed? If our theory is to advance beyond high abstraction so as to provide

65. *See id.*

66. Gilson et al. proceed on the assumption that the common prerequisites for informal governance do not obtain in many markets. Gilson et al., *Braiding*, *supra* note 34, at 1397-98. This Article also proceeds on that assumption in order to test their theory on its own grounds, although it appears possible, if not likely, that informal governance may play an important, if nuanced and asymmetric, role in many alliances. That question is left to subsequent research.

67. An incomplete contract is one that does not fully describe each party's obligations for every potential future contingency that may arise. Robert E. Scott & George G. Triantis, *Incomplete Contracts and the Theory of Contract Design*, 56 CASE W. RES. L. REV. 187, 190 (2005).

68. This question presupposes a material difference between the definition of contract and property rights. For useful discussions of the distinction, which is often glossed over in the law and economics literature, see generally Kirsten Foss & Nicolai Foss, *Coasian and Modern Property Rights Economics*, 11 J. INSTITUTIONAL ECON. 391 (2015); and Thomas W. Merrill & Henry E. Smith, *What Happened to Property in Law and Economics?*, 111 YALE L.J. 357, 357-60 (2001).

accurate guidance to enforcement courts, transactional attorneys, and policymakers, these issues must be addressed.

A. Defining the Unit of Analysis: The Alliance Agreement

Before proceeding, it is necessary to briefly address a definitional issue. In the multidisciplinary literature on collaborative production arrangements, the contracts in question are often only abstractly defined. "Strategic alliance" is a phrase often used to describe these agreements, but that term has been used to describe a wide variety of contracts, including supply agreements, licensing agreements, joint ventures, joint development agreements, and even alternative entities such as limited liability companies. Thus, a threshold issue for any study of collaborative innovation is to define with some precision what type of contract is being examined.

The contracts studied here contain a creative element at their core.[69] Their central purpose is to structure a joint discovery process by which new technology is created. In practitioners' parlance, they are often considered a variety of "technology transactions," although care should be taken to differentiate the alliance agreements studied here from a technology-transfer contract such as a licensing agreement. As a preeminent treatise notes, these agreements "fall in the large gray area between traditional contractual arrangements and corporate acquisitions," and the substance of these agreements typically "remains to be completed, and often defined, over time."[70]

These alliance agreements tend to be highly complex and customized to their respective circumstances. Nevertheless, the following common elements can be identified:[71]

- Scope (a definition of the scope of the joint development project(s), often including the identification of certain targets or goals, allocation of primary responsibilities to both parties, and an initial research plan);
- Management (administrative mechanisms, such as change procedures or steering committees, which are typically staffed with an equal number of representatives from each party and are bound by unanimity rules);

69. Parties may enter into alliances for a variety of reasons, not all of which are innovation-related. For example, it is common in many industries for alliances to be used for joint purchasing or marketing. This Article does not address such alliances, focusing rather on those created for the purposes of pursuing a joint innovation project.

70. THOMAS F. VILLENEUVE ET AL., CORPORATE PARTNERING: STRUCTURING & NEGOTIATING DOMESTIC & INTERNATIONAL STRATEGIC ALLIANCES 1-2 (5th ed. 2015)

71. The elements listed below are condensed from Villeneuve et al.'s treatise. *See id.* at 3-7 to 3-86 (providing an overview of these key provisions and other terms often included in alliance contracts).

- Financing (funding provisions, which may include upfront payments, royalties, periodic budgets, and/or milestone (earnout) schedules);
- "Background IP" licensing (license grants, often from both parties to one another, on either an exclusive or nonexclusive basis to "background" IP to be used during joint development);
- "Foreground IP" ownership (technology ownership provisions, which determine whether a party will solely own certain "foreground" IP developed during the collaboration, or whether both parties will own that technology jointly);
- Termination (duration and termination provisions, which may provide for termination for convenience by one or more parties, and which may structure technology ownership depending upon how the collaboration concludes); and
- Dispute resolution system (dispute resolution provisions, which may provide for arbitration or, in some cases, more elaborate schemes by which dispute resolution is bifurcated between private arbitrators and public courts).

The logic driving these collaborations originates in the nature of modern innovation. Products and production processes are often cumulative in nature and comprise complex systems;[72] because that complexity frequently invites gains to specialization and in turn the division of labor, expertise fragments, and innovation becomes a group endeavor.[73] Collaboration gives firms access to technology and know-how otherwise out of reach. The days of isolated inventors dreaming up new ideas in romantically monastic garages or backyard labs are largely gone in many industries, if they ever existed at all.[74]

B. The Lessons of Incomplete Contract Theory

Contemporary relational contract theory, of which the braided governance argument is a part, owes as much to contract economics as to Macaulay's and Macneil's original sociological approaches. This Article situates braided governance theory in the relevant economics literature. The literature that has accumulated over the years is immense and cannot be summarized in

72. *See* Lee Fleming, *Recombinant Uncertainty in Technological Search*, 47 MGMT. SCI. 117, 118 (2001) (describing the inventive process as a recombination of components and ideas).

73. *See* ASHISH ARORA ET AL., MARKETS FOR TECHNOLOGY: THE ECONOMICS OF INNOVATION AND CORPORATE STRATEGY 46, 87-89 (2001).

74. *See* Mark A. Lemley, *The Myth of the Sole Inventor*, 110 MICH. L. REV. 709, 710-11 (2012). An exception where single inventors or small teams and modest startup investments can still produce world-class innovation is the development of certain types of software products. *See* Burk & Lemley, *supra* note 55, at 1582-83.

its entirety here.[75] What follows is enough to orient a reader approaching the braided governance literature, which is of primary interest here.

1. The recipe for opportunistic "holdup"

Collaborative innovation agreements are a classic, perhaps extreme, example of what the economics literature refers to as contractual "incompleteness." An incomplete contract is one that does not fully pin down each party's obligations for every potential future contingency that may arise.[76] As derived from Coase's original conception of a transaction cost,[77] incompleteness occurs for two interrelated reasons. First, collaborating on the creation of a new product or process requires decisions to be made under conditions of uncertainty. Highly uncertain decision environments prevent parties from fully anticipating future events, leading them to overlook useful governance measures.[78] Second, even if the parties do anticipate the future well, they must spend resources on drafting, monitoring, and enforcing their agreement.[79] Parties must bear the ex ante costs of searching for potential counterparties, negotiating, and drafting a contract's terms. Then they must shoulder the ex post costs of monitoring performance and, if partial performance or nonperformance is detected, of enforcing the agreement. Two conditions must be met for a contract term to be enforceable. First, at a minimum, events upon which certain agreed-upon outcomes depend must be "observable"—each party to the contract must be able to observe such events in order to determine whether the other party is failing to perform its end of the

75. For a useful overview of the literature, see Eric Brousseau & Jean-Michel Glachant, *The Economics of Contracts and the Renewal of Economics*, *in* THE ECONOMICS OF CONTRACTS: THEORIES AND APPLICATIONS 3 (Eric Brousseau & Jean-Michel Glachant eds., 2002). For more technical introductions, see PATRICK BOLTON & MATHIAS DEWATRIPONT, CONTRACT THEORY 1-43 (2005); and BERNARD SALANIÉ, THE ECONOMICS OF CONTRACTS: A PRIMER 1-8, 193-209 (2d ed. 2005).

76. Scott & Triantis, *supra* note 67, at 190.

77. R.H. Coase, *The Problem of Social Cost*, 3 J.L. & ECON. 1, 15 (1960). In Coase's original terms, transaction costs are resources spent "to discover who it is that one wishes to deal with . . . and on what terms, to conduct negotiations leading up to a bargain, to draw up the contract, to undertake the inspection needed to make sure that the terms of the contract are being observed, and so on." *Id.*

78. *See* OLIVER E. WILLIAMSON, THE ECONOMIC INSTITUTIONS OF CAPITALISM: FIRMS, MARKETS, RELATIONAL CONTRACTING 30, 44-47 (1985). For a useful overview of the economic debate regarding whether decisionmaking under uncertainty means parties simply cannot efficiently describe future contingencies, or means they actually cannot foresee them in the first place, see ANNA GRANDORI, EPISTEMIC ECONOMICS AND ORGANIZATION: FORMS OF RATIONALITY AND GOVERNANCE FOR A WISER ECONOMY 44-47 (2013).

79. *See* WILLIAMSON, *supra* note 78, at 20-21.

bargain.[80] Second, events must not only be observable between the parties, but also "verifiable" by a third party (such as a judge or arbitrator) tasked with adjudicating a dispute under the contract.[81]

As originally conceived by Coase, the transaction cost concept consisted of those measurement costs, with uncertainty an implicit assumption.[82] The result was a capacious idea, readily applicable to a wide variety of situations where collecting and measuring information related to exchange was challenging. However, subsequent economists led by Nobel Laureate Oliver Williamson, among others, have tended to focus more narrowly on particularly pernicious situations where the uncertainty and measurement costs discussed above combine with parties' natural opportunism and what is known as "asset specificity."[83]

This combination of uncertainty, measurement costs, opportunism, and asset specificity creates what is commonly referred to as the "holdup" problem.[84] The basic insight is that the threat of opportunism is particularly potent when parties enter into an arrangement that requires them to make relationship-specific investments, which are investments in assets that they cannot use in a new deal with a different counterparty.[85] Relationship-specific investment makes a party vulnerable to an opportunistic counterparty who may try to extract more of the surplus resulting from the exchange, knowing that the party who made the relationship-specific investment is essentially "stuck" and cannot go elsewhere in the market. One potential solution to that dilemma is simply to renegotiate the contract ex post, when uncertainty resolves. But unless parties are able to carefully control the scope of renegotiation, reopening the bargain at this point renders a party who has made relationship-specific investments vulnerable to the threat that an opportunistic counterparty will hold up the relationship unless concessions are

80. For an overview, see Benjamin E. Hermalin et al., *Contract Law*, *in* 1 HANDBOOK OF LAW AND ECONOMICS 3, 68-69 (A. Mitchell Polinsky & Steven Shavell eds., 2007).

81. *Id.*

82. *See* WILLIAMSON, *supra* note 78, at 78 n.7; *cf.* Ronald Coase, *The Conduct of Economics: The Example of Fisher Body and General Motors*, 15 J. ECON. & MGMT. STRATEGY 255, 263-69 (2006) (criticizing theories overly focused upon holdup threats). This broad definition is similar to Arrow's articulation of the transaction cost concept, which is simply "the costs of running the economic system." Kenneth J. Arrow, *The Organization of Economic Activity: Issues Pertinent to the Choice of Market Versus Nonmarket Allocation*, *in* 1 JOINT ECONOMIC COMMITTEE, 91ST CONG., THE ANALYSIS AND EVALUATION OF PUBLIC EXPENDITURES: THE PPB SYSTEM 47, 48 (Comm. Print 1969).

83. *See, e.g.*, WILLIAMSON, *supra* note 78, at 30-32.

84. *See* Benjamin Klein et al., *Vertical Integration, Appropriable Rents, and the Competitive Contracting Process*, 21 J.L. & ECON. 297, 298-99 (1978) (discussing how relationship-specific investment can allow a party to opportunistically hold up its counterparty).

85. *Id.*

provided.[86] Failure to strictly regulate ex post renegotiation can have a pernicious effect on the contractual relationship from start to finish: if a party understands that her counterparty can pretextually threaten to hold up the relationship in order to renegotiate the contract ex post, then that party will underinvest in the relationship ex ante in an effort to preemptively minimize losses.[87] A party may conclude that it should skimp on investing in the relationship because there is a material threat that the other party will squeeze them for a bigger slice of the pie once the investment is made.

2. Formal and informal responses to opportunism

Where contracts are incomplete and holdup problems acute, a firm may decide to integrate production, choosing to manage operations internally rather than through arm's-length contracts.[88] A sprawling literature on the "theory of the firm" explores the circumstances in which that integration decision is made.[89] But opportunism and relationship-specific investment do not always lead to vertical integration, as the phenomenon of interfirm collaboration makes obvious.

How then might contracts address opportunism concerns? Contractual responses to the holdup problem come in formal and informal varieties. Formal governance strategies are built around a classical understanding of the institutional infrastructure supporting contracts: parties bargain for certain obligations to be included in an agreement, and if there is a breach of those obligations, court enforcement is available to fashion a remedy.[90] An extensive

86. OLIVER HART, FIRMS, CONTRACTS, AND FINANCIAL STRUCTURE 26-27 (1995); *see also* Benjamin Klein, *Why Hold-Ups Occur: The Self-Enforcing Range of Contractual Relationships*, 34 ECON. INQUIRY 444, 445-46 (1996) (explaining that holdups occur because the contract form provides a place for opportunism).

87. HART, *supra* note 86, at 27.

88. *See* WILLIAMSON, *supra* note 78, at 89-98.

89. The threat of holdup provides the motivating logic for the dominant theories of the firm found in the economics literature: Williamson's transaction cost economics and Hart's incomplete contract theory. Although those theories differ materially in their details, both posit that organizational boundaries are responses to holdup problems, through either the virtues of hierarchical authority in Williamson's theory or the prerogatives of property rights in Hart's. For a concise overview, see Robert Gibbons, *Four Formal(izable) Theories of the Firm?*, 58 J. ECON. BEHAV. & ORG. 200, 202-09 (2005). To provide an illustration of the role holdup may play in the decision to vertically integrate production, consider General Motors' decision to acquire Fisher Body in the mid-1920s, a canonical example in the literature. According to Klein et al., Fisher opportunistically took advantage of the price provisions in the agreement by using labor-intensive production processes and refusing to locate their plants adjacent to GM's plants, which both inflated Fisher's profits under the cost-plus pricing formula. Klein et al., *supra* note 84, at 308-09. When attempts to renegotiate the agreement foundered, GM chose to acquire Fisher Body in its entirety, which Klein et al. consider evidence of holdup threats shaping firm boundaries. *See id.* at 309-10.

90. *See* Macneil, *supra* note 47, at 862-65.

literature has identified a number of forms such formal strategies may take. For example, in some situations, if the price at which one party may exercise her option is set at a level incentivizing optimal investment by her counterparty, option contracts may be a solution to the threat of holdup.[91] Parties may also opt to use more flexible "standards"—or soft terms—as opposed to bright-line "rules"—or hard terms.[92] When parties are unable to pin down obligations in the event certain contingencies unfold, a vague standard—such as a "best efforts" provision—may operate as a coverall. Such a blanket provision essentially tasks a tribunal with the job of policing opportunism ex post.[93] In addition to such safeguards, formal contracts may also allocate control rights to make certain types of future decisions to either party, which may also play the role of contractual gap-filler.[94] From this perspective, aligning incentives is then a matter of allocating control rights efficiently.[95]

A second body of scholarship argues that informal governance tools may prevent holdup problems. This work originated in Macaulay's pathbreaking study, which found that commercial actors often do not invoke contractual protections when disputes arise.[96] It was given further theoretical nuance in Macneil's work on relational contracting and economic sociologists' research on how transactions are embedded in broader social networks.[97] More

91. *See* Joel S. Demski & David E.M. Sappington, *Resolving Double Moral Hazard Problems with Buyout Agreements*, 22 RAND J. ECON. 232, 232-33 (1991); *see also* B. Douglas Bernheim & Michael D. Whinston, *Incomplete Contracts and Strategic Ambiguity*, 88 AM. ECON. REV. 902, 902-04 (1998). *But see* Aaron S. Edlin & Benjamin E. Hermalin, *Contract Renegotiation and Options in Agency Problems*, 16 J.L. ECON. & ORG. 395, 395-97 (2000) (showing that in some situations no contract, including an option contract, can incentivize efficient performance).

92. Robert E. Scott & George G. Triantis, *Anticipating Litigation in Contract Design*, 115 YALE L.J. 814, 820-21 (2006). Herbert Simon originally conceived of the problem as a matter of balancing commitment devices, which guarantee a basic level of performance, with flexibility mechanisms, which allow the parties to adjust their expectations as the relationship progresses. *See* Herbert A. Simon, *A Formal Theory of the Employment Relationship*, 19 ECONOMETRICA 293, 294-95, 305 (1951); *see also* Ian R. Macneil, *The Many Futures of Contracts*, 47 S. CAL. L. REV. 691, 718 (1974) (explaining that a vast amount of economic activity is carried out in nonspecific contracts and with flexible standards).

93. Scott & Triantis, *supra* note 92, at 825-30. There is an obvious tradeoff: parties economize on upfront transaction costs but only by deferring them until ex post enforcement becomes necessary. This may sound like a form of kicking the can down the road, but it may lead to net efficiencies if parties can control enforcement costs (for example, by choosing the mode of enforcement, such as arbitration or litigation, or varying procedural rules, such as burdens of proof). *Id.* at 856-58.

94. HART, *supra* note 86, at 30-31, 38-45; Sanford J. Grossman & Oliver D. Hart, *The Costs and Benefits of Ownership: A Theory of Vertical and Lateral Integration*, 94 J. POL. ECON. 691, 692-93 (1986).

95. *See* HART, *supra* note 86, at 33.

96. Macaulay, *supra* note 47, at 60-61.

97. *See* Mark Granovetter, *Economic Action and Social Structure: The Problem of Embeddedness*, 91 AM. J. SOC. 481, 481-83 (1985); Macneil, *supra* note 47, at 887.

recently, this line of research has been introduced into economic theories through the idea that contracts can be "self-enforcing."[98] The common insight running throughout this scholarship is that social constraints—commonly conceived in terms of reputational effects or repeated games—can dissuade parties from behaving opportunistically when formal contractual enforcement mechanisms cannot.[99] Court enforcement, for example, may be too costly or risky, and so parties may rely on informal devices to police opportunism.[100] Or formal court enforcement may interfere with informal norms.[101] The prerequisite, of course, to effective informal governance is the existence of a social network and/or repeated dealings in which the transaction occurs, with classic examples including somewhat insular producer groups such as ranchers in Shasta County, California; Jewish diamond merchants; American cotton growers; and Maghribi traders.[102]

3. Braiding formal and informal contracting

Collaboration presents a unique challenge to the standard contract theory outlined above because, on one hand, contracts would appear to be radically incomplete and in turn rife with holdup risks,[103] but on the other hand, firms are not resorting to integrated modes of production. How then is opportunism controlled? Uncertainty appears to be so endemic as to overwhelm formal contract measures. One response in the literature has been to focus primarily upon the role of the informal governance mechanisms mentioned above.[104]

98. *See* Klein, *supra* note 86, at 449-50.

99. *Id.*

100. *Id.* at 448-49 (noting that the costs of court enforcement of formal contracts may lead parties to opt instead for "private enforcement mechanisms").

101. Robert E. Scott, *The Promise and the Peril of Relational Contract Theory*, *in* REVISITING THE CONTRACTS SCHOLARSHIP OF STEWART MACAULAY: ON THE EMPIRICAL AND THE LYRICAL 105, 111-12 (Jean Braucher et al. eds., 2013) (summarizing research on formal enforcement's crowding-out effect on informal norms).

102. *See, e.g.*, ROBERT C. ELLICKSON, ORDER WITHOUT LAW: HOW NEIGHBORS SETTLE DISPUTES 19-25, 40 (1991) (discussing the Shasta County ranchers); Lisa Bernstein, *Opting Out of the Legal System: Extralegal Contractual Relations in the Diamond Industry*, 21 J. LEGAL STUD. 115 (1992) (discussing the diamond industry); Lisa Bernstein, *Private Commercial Law in the Cotton Industry: Creating Cooperation Through Rules, Norms, and Institutions*, 99 MICH. L. REV. 1724 (2001) (discussing the cotton industry); Avner Greif, *Contract Enforceability and Economic Institutions in Early Trade: The Maghribi Traders' Coalition*, 83 AM. ECON. REV. 525 (1993) (discussing Maghribi traders).

103. A common starting point is that collaborative innovation presents the prospect of "Knightian" uncertainty, a reference to Frank Knight's famous, if in some circles controversial, differentiation between risk and uncertainty. Gilson et al., *Contracting for Innovation*, *supra* note 34, at 449 n.50; Jennejohn, *Collaboration, Innovation, and Contract Design*, *supra* note 34, at 137-38. For the original source of this concept, see FRANK H. KNIGHT, RISK, UNCERTAINTY AND PROFIT 214-15 (1921).

104. *See, e.g.*, Dent, *supra* note 34, at 49-52; Ranjay Gulati & Harbir Singh, *The Architecture of Cooperation: Managing Coordination Costs and Appropriation Concerns in Strategic*

footnote continued on next page

This scholarship sees collaborative innovation as relying heavily on norms of trust, a quintessential case of relational contracting.[105] But informal contracting theories must explain how social norms govern transactions in the dynamic and heterogeneous global markets in which collaborative innovation often occurs. How do the social connections necessary for informal governance obtain in such markets, where communities may be diffuse and transactions do not necessarily repeat?[106] The international semiconductor industry, for example, presumably does not enjoy the same intimacy as Shasta County ranching.[107] This is not to say that modern high-technology industries are appallingly bereft of trust, but rather that theory must grapple with a complicated reality where both markets and organizations are complex and fluid.

An intriguing line of scholarship understands interfirm collaboration as a situation where both formal and informal governance institutions work in tandem.[108] Rather than seeing formal governance mechanisms as substitutes for informal constraints, this research argues that formal and informal contracting operate as complements. Parties employ a blended strategy whereby they mix and match governance institutions.[109] The most

Alliances, 43 ADMIN. SCI. Q. 781, 790-91 (1998); Ranjay Gulati, *Does Familiarity Breed Trust?: The Implications of Repeated Ties for Contractual Choice in Alliances*, 38 ACAD. MGMT. J. 85, 86 (1995).

105. *See* Naomi R. Lamoreaux et al., *Beyond Markets and Hierarchies: Toward a New Synthesis of American Business History*, 108 AM. HIST. REV. 404, 407-08 (2003) (arguing that the deverticalization of productive organization in the last quarter of the twentieth century is frequently governed through informal relational contracting, such as expectations of repeated dealings); *see also* Walter W. Powell et al., *Interorganizational Collaboration and the Locus of Innovation: Networks of Learning in Biotechnology*, 41 ADMIN. SCI. Q. 116, 116-17 (1996).

106. Robert E. Scott, *The Case for Formalism in Relational Contract*, 94 NW. U. L. REV. 847, 865-66 (2000).

107. *See* ELLICKSON, *supra* note 102, at 20-21.

108. *See* Gilson et al., *Contracting for Innovation*, *supra* note 34, at 434; Laura Poppo & Todd Zenger, *Do Formal Contracts and Relational Governance Function as Substitutes or Complements?*, 23 STRAT. MGMT. J. 707, 708 (2002); Ryall & Sampson, *supra* note 63, at 906-07. *See generally* Iva Bozovic & Gillian K. Hadfield, *Scaffolding: Using Formal Contracts to Build Informal Relations in Support of Innovation* 7-10 (USC Ctr. in Law, Econ. & Org., Research Paper No. C12-3, 2012), http://weblaw.usc.edu/centers/class/class-workshops/usc-legal-studies-working-papers/documents/C12_3_paper.pdf (arguing that formal contracts serve as "scaffolding" supporting informal governance mechanisms).

109. Perhaps the earliest argument that formal and informal governance mechanisms can be complements is found in a 2002 study by Poppo and Zenger. Poppo & Zenger, *supra* note 108, at 708-09, 719-22. In an empirical analysis of information-services transactions using a survey method, they found evidence that customization of formal contracts increased with higher levels of informal governance. *Id.* at 719-21. In other words, rather than crowding out informal constraints, formal contracts actually sat side-by-side with informal governance. Tellingly, and consistent with my argument in Part II, Poppo and Zenger attribute the ability of formal governance mechanisms to

footnote continued on next page

comprehensive explication of such blended contracting is Gilson, Sabel, and Scott's theory of contracting for innovation.[110] In their terminology, formal contract terms "braid" with informal constraints to create a combined governance mechanism.

Their starting point is that collaborative innovation creates an environment of continuous uncertainty, which both exacerbates holdup risk and frustrates traditional attempts to allocate risk ex ante through formal contract provisions.[111] To illustrate, Gilson et al. describe three paradigmatic contracts, involving John Deere and Stanadyne, Apple and SCI Systems, and Ligand and Warner-Lambert.[112] The Deere/Stanadyne Agreement was a long-term contract for the supply of certain engine components.[113] The Apple/SCI Agreement accomplished the divestiture of one of Apple's production facilities

complement informal constraints to differing types of exchange hazards. *Id.* at 722. That is, formal contract terms respond to certain types of hazards, and informal constraints to others, and therefore they do not undercut one another.

110. Gilson et al., *Contracting for Innovation*, *supra* note 34, at 433-36. Bozovic and Hadfield outline a similar argument, describing formal contracts as "scaffolding" for informal governance mechanisms, rather than using Gilson et al.'s "braiding" term. Bozovic & Hadfield, *supra* note 108, at 7. Under their theory, express contract terms can help improve the efficacy of informal constraints even if those formal terms are not enforced in court. *Id.* at 3-4. The drafting and subsequent interpretation of formal terms—by the parties, not a third-party tribunal—act as a benchmark by which the parties determine whether their respective performances constitute a breach of the agreement. *Id.* at 8. This in turn supports informal enforcement mechanisms by providing a conceptual infrastructure by which the parties can categorize their performance into "breach" or "not breach" categories. *Id.* In some respects, this argument is similar to Gilson et al.'s theory: both see trust emerging endogenously from the exchange relationship, with formal contracts playing a pivotal role in shaping information processing among the parties to the agreement. In Bozovic and Hadfield's model, that trust grows as the parties proceed with the relationship, referring repeatedly to the written agreement to inform their assessments of one another's behavior; in Gilson et al.'s model, informal constraints become efficacious as the formal information revelation system renders performances observable.

111. Gilson et al., *Contracting for Innovation*, *supra* note 34, at 449, 451-52, 455-57. Opportunism problems arising from continuous uncertainty are the central concern in Gilson et al.'s *Contracting for Innovation* article and subsequent *Braiding* article. *See id.* at 455-58 (focusing on holdup problems); Gilson et al., *Braiding*, *supra* note 34, at 1388, 1392, 1395 (same). There is, however, a section of the former article that acknowledges the possibility of multiple exchange hazards. *See* Gilson et al., *Contracting for Innovation*, *supra* note 34, at 494-99 (acknowledging that many exchange hazards, such as agency problems and knowledge diffusion challenges, may shape economic organization). One way to understand this Article's project is as an attempt to embrace the broader view of exchange hazards that Gilson et al. recognize, but do not exploit, in their theory.

112. Gilson et al., *Contracting for Innovation*, *supra* note 34, at 458-71. Gilson et al. also discuss a contract between Bristol-Myers Squibb and Pharmacopeia in a later article. *See* Gilson et al., *Braiding*, *supra* note 34, at 1405-08. The discussion of the Bristol-Myers Squibb/Pharmacopeia Agreement in that article and the Ligand/Warner-Lambert Agreement, which is outlined below, are highly similar, so the Bristol-Myers Squibb/Pharmacopeia Agreement is not addressed here.

113. Gilson et al., *Contracting for Innovation*, *supra* note 34, at 458-60.

and established a long-term supply arrangement of personal computers and components.[114] The Ligand/Warner-Lambert Agreement created a joint development process for the discovery and commercialization of certain small-molecule compounds.[115]

In all three agreements, Gilson et al. see indications of high uncertainty. They argue that the Deere/Stanadyne Agreement is surprisingly open-ended because the contract does not define what Stanadyne was to develop or require Deere to actually purchase anything Stanadyne created.[116] The Apple/SCI Systems Agreement also displays high uncertainty, since the Agreement contemplates an ongoing process of codesign and product revision.[117] And the Ligand/Warner-Lambert Agreement launches the parties' collaboration on a research path envisioned to change over time.[118]

In Gilson et al.'s telling, a number of novel formal contract mechanisms are used in collaboration agreements to, in a sense, artificially manufacture the prerequisites for informal constraints. They posit that these formal mechanisms are unenforceable in court, which then raises the question why they are included in the contract at all.[119] Gilson et al. argue that these mechanisms render private information observable, screen for opportunistic counterparties, and increase the costs parties would incur when switching to another partner, thereby facilitating informal governance mechanisms that harness holdup problems.[120] In that way, the contract forms a braid that interweaves informal and formal governance.[121]

The central strand of the braid is a unique set of contract mechanisms. First, the contracts require both parties to invest in relationship-specific information and structure that investment through adaption protocols, such as formal plans, process guidelines, and codesign requirements.[122] Second, these contracts include what Gilson et al. refer to as the "contract referee" mechanism—such as a committee with unanimous decisionmaking requirements and "dispute escalation" processes[123]—which is understood as a tool that reveals information symmetrically between the collaborating

114. *Id.* at 463.

115. *Id.* at 468.

116. *Id.* at 459-60.

117. *Id.* at 463-67.

118. *See id.* at 467-71.

119. *Id.* at 488.

120. Gilson et al., *Braiding*, *supra* note 34, at 1403.

121. *See* Gilson et al., *Contracting for Innovation*, *supra* note 34, at 448-58.

122. *Id.* at 476-78.

123. A dispute escalation process requires lower-level executives to refer disputes to higher-level executives when impasses are reached.

parties.[124] The unanimity requirement allows a party to demand more information from a partner, while escalation serves a disciplinary function by requiring lower-level executives to share information in good faith.[125] As parties invest in information specific to their collaboration, their switching costs (i.e., the cost of replacing a counterparty) also increase, which acts as a further constraint on opportunistic behavior.[126] Finally, Gilson et al. argue that this information sharing screens out partners who are "naturally opportunistic"—starting to share information gives a party insight into its counterparty's predilection for fair dealing.[127] In short, formal contracts bring otherwise unobservable information out into the open, allowing for effective informal governance of those relationships. By doing so, the formal provisions of the contract complement and, in a way, manufacture informal constraints; these in turn allows parties to benefit from the flexibility of informal governance in environments otherwise nonconducive to reputation effects, trust, or the prospect of repeated dealing.[128]

Gilson et al. find evidence of such information-sharing protocols and contract referee mechanisms in the three agreements they summarize. In the Deere/Stanadyne Agreement, they point to, first, Stanadyne's obligation to participate in Deere's "Achieving Excellence" supplier program as an information-sharing protocol.[129] Second, they point to a dispute escalation process capped with mandatory arbitration as an example of a contract referee mechanism.[130] In the Apple/SCI Systems Agreement, they argue, the contractual braid was anchored in requirements to (i) create regular product plans—the content of which was not determined at the time of execution, (ii) colocate engineers during the prototyping and production process, and (iii) collaborate when changes to project plans were necessary.[131] The contract contains no dispute escalation process,[132] but Gilson et al. assert that it creates an unspoken obligation of "good faith dispute resolution."[133] Finally, in the Ligand/Warner-Lambert Agreement, Gilson et al. point to the Joint Research Committee, which was required to make research decisions unanimously.[134]

124. Gilson et al., *Contracting for Innovation*, *supra* note 34, at 479-81.

125. *Id.* at 480-81.

126. *Id.* at 481-86.

127. *Id.* at 481, 486-89.

128. Gilson et al., *Braiding*, *supra* note 34, at 1398-1403.

129. Gilson et al., *Contracting for Innovation*, *supra* note 34, at 461 & n.79.

130. *Id.* at 462-63.

131. *Id.* at 465-66.

132. *See* Fountain Manufacturing Agreement Between Apple Computer, Inc. and SCI Systems, Inc. (May 31, 1996), http://contracts.onecle.com/apple/scis.mfg.1996.05.31.shtml.

133. Gilson et al., *Contracting for Innovation*, *supra* note 34, at 466.

134. *Id.* at 469-70.

Disputes within the Joint Research Committee were escalated to increasing tiers of senior management, which comprised that collaboration's referee mechanism.[135]

Finally, Gilson et al. tie their theory of braided governance mechanisms to the allocation of control rights. In many cases, allocating control rights to either party will be futile because uncertainty is continuous, and so it will never be clear which party should be given the decision right.[136] However, they also posit that, in some situations, a collaboration can have a predictable end, where uncertainty resolves into risk, and parties therefore predetermine the collaboration's endgame by providing a series of nested options on the results of the collaboration.[137] This guards against ex post renegotiation, which would undermine ex ante investment in the collaboration.

4. Summary

In summary, contract economists and, in turn, legal scholars, have taken a one-dimensional view of the challenges firms face when collaborating. Opportunistic holdup is seen as the primary motivator shaping contract design. Gilson et al.'s theory follows that traditional conception of the contracting problem by also focusing on the threat of holdup. Where Gilson et al. make a novel contribution to the literature is their claim that two types of governance mechanisms—formal and informal contracts—are combined in response to the holdup problem. That braided approach is an important, if incremental, advance because it conceives of the infrastructure supporting contracts as a collection of complementary institutions. The either/or understanding of the interface between formal and informal contracts is transformed into a networked approach, where formal and informal institutions are interdependent nodes in a cohesive set of enforcement institutions. The variety of governance strategies outlined above does not simply comprise a menu where just one item is chosen to the exclusion of the other options. Rather, multiple items can be selected and combined, expanding the range of solutions that can be fashioned. As will be discussed below in Part II, this more systemic approach to thinking about governance strategies

135. *Id.* at 470.

136. *Id.* at 457-58 ("When the parties must adapt continuously, uncertainty about *which* party's opportunism needs to be constrained, and a consequent inability to predict the decisions that actually will have to be made, imply that [allocating control rights via] options [is] not a feasible technique for assuring efficient adaptation.").

137. *Id.* at 490-92 (discussing the nested options in the termination provisions of a pharmaceutical collaboration agreement). Options are considered "nested" if they comprise a chain of interrelated decision points responding to a sequence of contingencies. *See, e.g.*, Timothy A. Luehrman, *Strategy as a Portfolio of Real Options*, HARV. BUS. REV., Sept.-Oct. 1998, at 89, 96-98.

may be a key to the gray area between markets and hierarchies taking firmer, if not uncontested, shape.

C. The Limits of Braided Governance

Gilson et al.'s theory represents an important conceptual advance that illuminates a number of new theoretical and empirical avenues. But questions also arise with some casual empiricism. One question is what veto rights—which many alliances allocate to both firms either in the form of no-cause termination provisions or committees bound by unanimity rules—imply for braided contracting theory.[138] The importance of such veto rights has been a refrain in the related literature on venture capital contracting,[139] and Gordon Smith in an earlier work argued that the unanimity rules in steering committees play a critical governance role by allowing a party to deadlock the committee without breaching the contract.[140] Those veto rights raise questions for Gilson et al.'s model, which construes braiding mechanisms as furthering the single goal of more closely intertwining the parties. How do iterative information-exchange mechanisms operate if one of the parties can threaten to unilaterally hold up or entirely terminate the agreement early in the process before uncertainty resolves?

A second question relates to the role intellectual property rights play in structuring alliance agreements. Licensing background IP into a collaboration and determining ownership of the foreground IP resulting from the joint efforts is a paramount concern in the practitioner literature on collaborative innovation.[141] Indeed, the ownership, prosecution, and protection of

138. Gilson et al. consider property rights theory, which argues that gaps in agreements should be filled by allocating a control right to the party with the assets most complementary to the relationship-specific investments being made. *See* Gilson et al., *Contracting for Innovation*, *supra* note 34, at 456-57 (citing Grossman & Hart, *supra* note 94, at 697-700; and Oliver Hart & John Moore, *Property Rights and the Nature of the Firm*, 98 J. POL. ECON. 1119, 1121-24 (1990)); *see also* George Baker et al., Contracting for Control 2-7 (May 14, 2006) (unpublished manuscript), http://web.stanford.edu/group/SITE/archive/SITE_2006/Web%20Session%206/Gibbons.pdf. Gilson et al. argue that in environments of continuous uncertainty, allocating a control right to one party or the other will be impossible. Gilson et al., *Contracting for Innovation*, *supra* note 34, at 456. They do not, however, consider the implications of giving both parties a veto right over key decisions.

139. *See, e.g.*, PAUL GOMPERS & JOSH LERNER, THE VENTURE CAPITAL CYCLE 72-77 (2d ed. 2004); Douglas Cumming, *Contracts and Exits in Venture Capital Finance*, 21 REV. FIN. STUD. 1947, 1948 (2008).

140. Smith, *supra* note 34, at 305; *see also* Ranjay Gulati et al., *Breaking Up Is Never Easy: Planning for Exit in a Strategic Alliance*, CAL. MGMT. REV., Summer 2008, at 147, 148-49 (discussing how poorly designed termination provisions lead to governance problems).

141. *See, e.g.*, VILLENEUVE ET AL., *supra* note 70, at 3-12 to 3-21; Stephen C. Costalas & Thomas A. Rayski, *Negotiating Pharma Collaboration Agreements: Common and Critical Issues*, 5 LIFE SCI. L. & INDUSTRY REP. 525, 526 (2011) (listing determination of rights to foreground IP as a critical issue and noting that "[t]he principal goal of collaborations is

footnote continued on next page

foreground IP are key—if overlooked—topics in many of the agreements that form the basis of Gilson et al.'s braiding theory.[142] Furthermore, foreground IP is often owned jointly in collaborations,[143] which complicates arguments, such as Gilson et al.'s, that endgames are structured by granting options to either party over resulting technology.

There is a more fundamental puzzle underlying alliance contracts, however, bedeviling braided contracting theory. That is the question of why there is such diversity observed in alliance design. Reviewing a large number of alliance contracts reveals a startling variety in governance strategies.[144] For example, some agreements include baroquely detailed committee systems akin to a board of directors in a corporation. Some include milestone-compensation mechanisms, or earnouts. Some carefully delineate technology ownership, control over patent prosecution, and defense against patent infringement. But a significant number of contracts do not include such provisions. What explains the differences? Per Williamson's "discriminating alignment

---

the development of intellectual property assets that will create value for the collaborators"); Carolyn L. Craig, *Intellectual Property Considerations for Strategic Alliances—Questions, Considerations, and Putting the Information to Use*, 2010 INTELL. PROP. ISSUES BUS. TRANSACTIONS 105, 110-12; E. Richard Gold & Tania Bubela, *Drafting Effective Collaborative Research Agreements and Related Contracts*, *in* 1 INTELLECTUAL PROPERTY MANAGEMENT IN HEALTH AND AGRICULTURAL INNOVATION: A HANDBOOK OF BEST PRACTICES 725, 732-38 (Anatole Krattiger et al. eds., 2007); Dave Green & Todd Navrat, *Joint Ventures & Strategic Alliances*, 2010 INTELL. PROP. ISSUES BUS. TRANSACTIONS 473, 479; Gary H. Moore, *Joint Ventures and Strategic Alliances: Ownership of Developed Intellectual Property*, 2010 INTELL. PROP. ISSUES BUS. TRANSACTIONS 121, 123; Kurt M. Saunders, *The Role of Intellectual Property Rights in Negotiating and Planning a Research Joint Venture*, 7 MARQ. INTELL. PROP. L. REV. 75, 77-78 (2003); Kagan Binder, PLLC, Joint Development Agreement Checklist (2004), http://www.kaganbinder.com/wp-content/uploads/2014/04/11-JointDevelopmentCL.pdf (including as key negotiating points "status of background intellectual property," "ownership of IP that is the fruit of the agreement," "[w]ho bears responsibility/costs for filing patent applications," and "framework for IP license or business arrangement after conclusion" (capitalization altered)).

142. For example, the Ligand/Warner-Lambert Agreement has extensive provisions allocating ownership in foreground IP and guiding the patent prosecution and enforcement process. *See* Research, Development, and License Agreement by and Between Warner-Lambert Company and Ligand Pharmaceuticals Incorporated 24-26 (Sept. 1, 1999), http://contracts.onecle.com/ligand/warner.rd.1999.09.01.shtml [hereinafter Ligand/Warner-Lambert Agreement].

143. *See* MARTIN A. BADER, INTELLECTUAL PROPERTY MANAGEMENT IN R&D COLLABORATIONS: THE CASE OF THE SERVICE INDUSTRY SECTOR 16 & fig.7 (2006) (showing that joint ownership of intellectual property is increasing over time); *see also infra* Table 3 (indicating that sixty-six percent of the alliance contracts sampled provide for joint ownership of foreground IP).

144. *See infra* Table 1 (illustrating differences in three exemplary alliance agreements); *infra* Table 3 (illustrating diversity across sample of 146 alliance agreements).

hypothesis," exploring that diversity is a method for defining the determinants of alliance structure.[145]

To understand why diversity raises questions for braiding theory, we must first appreciate braiding theory's view of what causes contractual variety. Gilson et al. do not ignore alliance diversity. They understand variation to be a function of transactional discreteness:

> [D]ifferences in the new contractual patterns we observe are driven by the nature of the barriers to ex post opportunism, which in turn are dictated by the substance of the transaction. *The structure of contracts for collaborative innovation differ most importantly depending on whether the contemplated collaboration is long-term—involving an ongoing stream of interactive innovations—or whether it involves a discrete project aimed at producing a single innovation such as a patentable product or process.*[146]

To illustrate, Gilson et al. point to the alleged difference in their Deere/Stanadyne and Ligand/Warner-Lambert examples. In their telling, the Deere/Stanadyne Agreement is an open-ended partnership, which contemplates continuous uncertainty that does not resolve and includes legally unenforceable obligations.[147] On the other hand, the Ligand/Warner-Lambert Agreement envisions a point when uncertainty resolves and, in turn, includes a variety of enforceable provisions.[148] In short, the two agreements differ with respect to the nature of the uncertainty anticipated throughout the course of the collaborations.

There is reason to pause before relying entirely upon a notion of project discreteness, however, because discreteness is a difficult concept to operationalize. For example, when Gilson et al.'s paradigmatic examples of discreteness and nondiscreteness, the Ligand/Warner-Lambert and Deere/Stanadyne Agreements respectively, are read closely, it is hard to see how the scopes of their projects are materially different. Like the Ligand/Warner-Lambert Agreement, the Deere/Stanadyne Agreement delineates the products to be developed during the collaboration.[149] But Gilson et al. assert that the Deere/Stanadyne Agreement was nondiscrete because the introduction of new products was "inevitable," and it was likely that the introduction of those new products would produce a high level of uncertainty because the contract does not define those future products' specifications.[150]

---

145. *See* Williamson, *supra* note 43, at 6 (discussing the elements of the discriminating alignment hypothesis).

146. Gilson et al., *Contracting for Innovation*, *supra* note 34, at 473-74 (emphasis added).

147. *Id.* at 474.

148. *See id.* at 475.

149. *See* Deere & Company and Stanadyne Corporation Long Term Agreement 24-26 (Nov. 1, 2001) (providing price lists for predetermined parts to be produced pursuant to the agreement) [hereinafter Deere/Stanadyne Agreement].

150. Gilson et al., *Contracting for Innovation*, *supra* note 34, at 460.

That assumption of inevitable new product introduction is strong, however, because Deere and Stanadyne had a longstanding relationship in which product development appeared stable. The 2001 Deere/Stanadyne Agreement Gilson et al. analyze was not the first contract between the two companies. For example, an earlier long-term supply contract between Deere and Stanadyne was entered into in 1996.[151] The 1996 agreement had many of the same provisions as the 2001 agreement, including, importantly, the same selection of products as envisioned in the 2001 agreement, suggesting a significant level of stability in the relationship.[152] Certainly, incremental improvements in product performance were expected, which would require innovation at least on the margins, but perhaps the uncertainty in the Deere/Stanadyne collaboration was not as radical as Gilson et al. assume.

In light of the ambiguity in Gilson et al.'s formulation of discreteness, this Article proceeds on the following basis: the determination of a defined set of targets or project goals on the face of an alliance contract is indication that the collaboration is discrete in scope. For example, a life sciences agreement that defines the initial target compounds, or a semiconductor agreement that determines the type of integrated circuit to be developed, is considered discrete in scope. This Article does not make assumptions with respect to the likelihood of product changes.

On that basis, a large majority of the agreements analyzed in Part III below are discrete: of the 146 contracts examined, the vast majority—92%—have discretely defined scopes.[153] As reported in more detail in Part III, scope discreteness does not correlate with the use of a governance mechanism associated with braiding: a consensus-based administrative committee. Of the 146 agreements, only 52% include such committees, and the correlation between scope discreteness and committee use is not significant.[154] One observes agreements contemplating discrete projects that *do* use such committee mechanisms, contrary to Gilson et al.'s reasoning, as well as contracts appearing to contemplate "ongoing stream[s] of interactive innovations"[155] that *do not* include the governance mechanisms Gilson et al.

151. Deere/Stanadyne Supply Agreement (Dec. 16, 1996).

152. For instance, the recitals of the 1996 agreement state that "DEERE desires to purchase rotary diesel fuel injection pumps and Pencil Nozzles . . . from STANADYNE," the original letter of intent attached to the agreement includes fuel injection pumps and pencil nozzles, and the attachments to the 1996 agreement include price lists for two types of fuel injection pumps. *See id.* at 1. The 2001 agreement also includes price lists for pumps and "pencil injectors." *See* Deere/Stanadyne Agreement, *supra* note 149, at 24-26. The continuity of the relationship also suggests that, practically speaking, there was little likelihood that Deere would not purchase any of Stanadyne's products, contrary to Gilson et al.'s assertion.

153. *See infra* Table 3.

154. *Id.*

155. Gilson et al., *Contracting for Innovation*, *supra* note 34, at 473.

describe. Thus, at least with respect to committee use, scope discreteness does not appear to provide a reliable explanation for variation. Other factors must affect the design of alliance agreements.

II. Multivalent Contracting

The previous Part argued that braided contracting theory does not capture some important details of how collaborations are governed. This Part argues that reframing the problem can achieve greater clarity. It explores the possibility that a broader conception of the hazards affecting exchange provides a clearer lens through which to understand collaboration. The argument is that expanding the menu of exchange hazards from a singular focus on holdup problems to also include "spillover" and "entropy" issues explains alliance diversity by illuminating the interdependencies between collaborators' governance strategies. In a word, alliance contract provisions are *multivalent*. They respond to a number of exchange hazards at once,[156] which presents the possibility that a governance response to one hazard may augment or conflict with the response to another type of hazard. Variations in the array of hazards that collaborators face thus may explain differences in governance choices. In short, a multivalent framework addresses the diversity puzzle raised in Part I.C above, while also shedding light on the secondary questions of the roles of veto rights and intellectual property rights.

If one recalls the simple two-part organizing device introduced in Part I, which divides contract design theories into (1) a notion of the exchange hazards parties face and then (2) ideas of how parties address those hazards, it will become apparent that this argument is in effect a more extensive and perhaps radical version of Gilson et al.'s theoretical move. Braided contracting theory took a traditional holdup-focused view of the exchange problem but presented a creative vision of governance mechanisms, which shifted the focus to how multiple governance tools can be cobbled together into a coherent response to opportunism. The theory proposed here involves applying that multidimensional focus not only to governance mechanisms, but also to how we understand exchange hazards. Both sides of the theoretical equation are expanded. By ignoring the possibility of multiple exchange hazards, braiding

156. *See* Kyle J. Mayer & Robert M. Salomon, *Capabilities, Contractual Hazards, and Governance: Integrating Resource-Based and Transaction Cost Perspectives*, 49 ACAD. MGMT. J. 942, 943-44 (2006) (examining the effect of a variety of exchange hazards, including holdup threats, observability problems, and appropriability concerns, on contract design); Jeffrey J. Reuer & Africa Ariño, *Strategic Alliance Contracts: Dimensions and Determinants of Contractual Complexity*, 28 STRATEGIC MGMT. J. 313, 314 (2007) ("[I]t is also quite likely that alliances' contractual designs are related to many of the core constructs that occupy center stage in alliance research such as relational governance mechanisms, capabilities, transactional attributes, alliance adaptation, and so forth."). My concept of multivalence crystalizes this idea and illuminates the potential contingency between governance responses.

theory does not go far enough, truncating the scope of the potential interdependencies between governance mechanisms. This Article attempts to show how the next step might be taken.

There are, however, limits to the argument presented here. By further exposing the complexity of the decision landscape collaborators face, I create a difficult modeling challenge. Teasing out with precision how collaborators navigate the multiple hazards they face will take a significant amount of empirical work, which this Article does not attempt to address. Rather, it sets forth a basic theoretical framework, which will inform subsequent research and suggest immediate policy guidance, as discussed in Part IV below.

Yet it is also worth emphasizing the importance of the theoretical reframing presented here. By focusing our attention on the interdependencies between exchange hazards and governance mechanisms, the multivalent approach isolates an important source of instability in collaborative innovation relationships: imbalances within the network of governance mechanisms employed in an alliance contract. Rather than constructing a just-so story of how alliance contracts can successfully harness opportunism, this theory embraces the contingency of innovation networks' governance arrangements and provides the rudiments of a language for understanding that dynamism.

A. Expanding the Menu of Exchange Hazards

A number of researchers have begun exploring a wider range of transaction costs, such as information spillovers and coordination entropy.[157] Both of these costs refer to problems associated with managing knowledge, although the details are slightly different. By spillovers, we mean that parties cannot capture the full value of their assets without spending resources defining and policing asset boundaries.[158] For example, in instances of collaborative innovation, where the exact contours of foreground IP are not known ex ante, there can be significant uncertainty in defining those asset boundaries. By entropy, we mean that resources must be spent to synchronize efforts and learning processes among team members. As specialization increases individual expertise, it simultaneously undermines the development

157. *See infra* notes 174-82 and accompanying text (discussing the effect of spillovers on firm boundaries and contract design); *infra* notes 188-200 and accompanying text (discussing the role of entropy on firm boundaries and contract design). There are, of course, other types of costs that fall outside of the opportunistic holdup, spillovers, and entropy triad. For example, regulatory risks and the costs of complying with tax and accounting rules certainly affect contract design. *See* Steven L. Schwarcz, *Explaining the Value of Transactional Lawyering*, 12 STAN. J.L. BUS. & FIN. 486, 500-02 (2007). My multivalent framework for including spillover and entropy costs into our theory provides a foundation for subsequent work including an even broader array of transaction costs.

158. *See infra* notes 163-68 and accompanying text.

of a shared language, raising the costs of communicating that expertise among team members.[159]

These alternative types of transaction costs are consistent with Coase's original conception of the term.[160] They too originate in the uncertainty and measurement challenges discussed in Part I.B above. The difference between holdups and spillover and entropy hazards lies in how we think about uncertainty and measurement costs' implications. While contract economics has focused on how uncertainty and measurement problems combine with opportunism and asset specificity to lead to holdup problems, the literature discussed below in Parts II.A.1 and II.A.2 concludes that uncertainty and measurement problems also affect the definition of property rights and the coordination of complex processes across firm boundaries.

To be clear, conventional contract economics does not deny the existence of spillover and entropy problems. It simply views them as uninteresting.[161] Consider, for example, Gilson et al.'s view of entropy concerns: "One might imagine many reasons for writing down adaption protocols [in alliance agreements]: The process builds consensus, enhances learning, minimizes misunderstanding, and the like. *But none of those reasons explains why the elaborate governance structures in these contracts are made part of a formal contract.*"[162] Governance mechanisms are directed towards agency costs—the threat that a swindling party may pull their counterparty over a barrel if given the chance. This Subpart's goal is to show how this conception of transaction costs is unnecessarily limited.

1. Spillovers, or appropriability problems

The refrain in the practitioner literature regarding the importance of intellectual property issues in collaborations is unsurprising.[163] Exclusive control over assets cannot be taken for granted.[164] Resources must be spent policing the boundaries of one's assets and, if necessary, excluding others

159. *See infra* notes 183-87 and accompanying text.

160. *See* R.H. Coase, *The Nature of the Firm*, 4 ECONOMICA 386, 390-92 (1937) (providing a broad list of transaction costs, including price discovery, negotiation, difficulty in forecasting, uncertainty, and regulation).

161. *See* Hermalin et al., *supra* note 80, at 3 (noting that the economics literature has focused on contracts as incentive mechanisms, rather than as pure coordination tools).

162. Gilson et al., *Contracting for Innovation*, *supra* note 34, at 476 (emphasis added).

163. *See supra* note 141 and accompanying text.

164. *See* Mark A. Lemley & Carl Shapiro, *Probabilistic Patents*, J. ECON. PERSP., Spring 2005, at 75, 76 ("Virtually all property rights contain some element of uncertainty."). Defining property rights in any context is costly. *See* Gary D. Libecap, *A Transactions-Costs Approach to the Analysis of Property Rights*, *in* THE ECONOMICS OF CONTRACTS: THEORIES AND APPLICATIONS, *supra* note 75, at 140, 146.

attempting to encroach.[165] Where the consumption of an asset in question is nonrivalrous, such as with intangible goods, then defining and enforcing one's property rights can be particularly costly given the ease with which the asset's value can be misappropriated.[166] Property rights can be uncertain.[167] As a result, spillovers occur as information leaks from one party to another.[168]

Uncertainty with respect to intellectual property boundaries tends to vary between industries.[169] A number of studies have identified industries, such as pharmaceuticals, life sciences, and chemicals, where relatively low uncertainty has led to comparatively strong intellectual property rights.[170] Conversely, a number of sectors, such as aerospace, semiconductors, and software, have been shown to have weak intellectual property protection.[171] The varying amenability of technology to codification plays a key role: where boundaries to a technological asset can be readily defined and enforcement institutions are efficient, the costs associated with protecting one's intellectual property rights can be manageable.[172] In turn, patents' scopes differ between industries, with a correspondence closer to one patent to one product in chemicals,

165. *See* Steven N.S. Cheung, *The Structure of a Contract and the Theory of a Non-Exclusive Resource*, 13 J.L. & ECON. 49, 67 (1970).

166. *See* Brett M. Frischmann & Mark A. Lemley, *Spillovers*, 107 COLUM. L. REV. 257, 272-74 (2007).

167. Property rights are rarely completely defined, and some uncertainty as to ownership is common. Problems arise where, due to high costs of defining a property right, that uncertainty becomes so pronounced so as to impede exchange. *See* Thomas W. Merrill, *Trespass, Nuisance, and the Costs of Determining Property Rights*, 14 J. LEGAL STUD. 13, 24 (1985) ("To be sure, uncertainty about who holds the property right is not invariably fatal to an agreement. . . . However, if the parties differ in their estimate of the probability of who holds the right, or in their preference for risk, then there may be no range of bid and asked prices within which they can agree on an exchange.").

168. Frischmann & Lemley, *supra* note 166, at 262 (defining spillovers as "direct benefits (or costs) realized by third parties—agents who are not participating in the relevant market and thus have not transacted with the provider of the benefits or costs").

169. *See* John R. Allison & Mark A. Lemley, *The Growing Complexity of the United States Patent System*, 82 B.U. L. REV. 77, 93-94, 93 tbl.1 (2002) (showing that patents are heterogeneous across industries).

170. *See, e.g.*, BURK & LEMLEY, *supra* note 1, at 47.

171. *See, e.g.*, James Bessen & Robert M. Hunt, *An Empirical Look at Software Patents*, 16 J. ECON. & MGMT. STRATEGY 157, 162 (2007); Dan Callaway, *Patent Incentives in the Semiconductor Industry*, 4 HASTINGS BUS. L.J. 135, 142-43 (2008); Bronwyn H. Hall & Rosemarie Ham Ziedonis, *The Patent Paradox Revisited: An Empirical Study of Patenting in the U.S. Semiconductor Industry, 1979-1995*, 32 RAND J. ECON. 101, 102-04 (2001) (exploring the paradox of the "relative ineffectiveness of patents" and yet frequent patenting in the semiconductor industry, and finding that semiconductor firms increased their patenting activity to win defensive "patent portfolio races" and not to "win strong legal rights to a standalone technological prize").

172. *See, e.g.*, Ashish Arora & Andrea Fosfuri, *Licensing in the Chemical Industry*, *in* THE ECONOMICS OF CONTRACTS: THEORIES AND APPLICATIONS, *supra* note 75, at 373, 389-90 (discussing how technology in certain industries, such as chemicals, is more amenable to codification, which lowers the costs of effective patent protection).

pharmaceuticals, and life sciences, while the correspondence in industries such as electronics, software, and aerospace tends to be multiple patents to one product.[173]

Uncertain intellectual property rights affect inventors' incentives to innovate. Developing an innovation typically requires an inventor to communicate and transact with third parties, perhaps for financing or for codevelopment.[174] Weak intellectual property rights may frustrate that exchange if a technology holder cannot share detailed information in precontractual negotiations without disclosing the very information she is attempting to protect.[175] In turn, a growing body of scholarship examines how the characteristics of the intellectual property regime affect market structure and firm boundaries. The research argues that the ability to profit from an innovation may depend on control of complementary assets, suggesting that firm boundaries could act as important appropriability mechanisms where property rights in foreground IP are uncertain.[176] Scholarship has found that, where property rights are comparatively strong, markets for technology can develop, leading to a finer division of labor between upstream research firms and downstream manufacturers.[177] In contrast, where intellectual property rights are insufficiently defined, organizational boundaries may play a greater role in addressing appropriability problems. In other words, incompleteness in property rights, just like incompleteness in contracting, can motivate vertical integration decisions.[178]

---

173. BURK & LEMLEY, *supra* note 1, at 53-54 ("The strength of this correspondence [between one patent to one product] varies by industry. In some industries, such as chemistry and pharmaceuticals, a single patent normally covers a single product—a new chemical or a new use for that chemical. In industries such as semiconductors, by contrast, new products are so complex that they can incorporate hundreds and even thousands of different inventions—inventions frequently patented by different companies.").

174. Michael J. Burstein, *Exchanging Information Without Intellectual Property*, 91 TEX. L. REV. 227, 241-42 (2012).

175. *See* Arrow, *supra* note 1, at 615.

176. David J. Teece, *Profiting from Technological Innovation: Implications for Integration, Collaboration, Licensing and Public Policy*, 15 RES. POL'Y 285, 304 (1986).

177. *See, e.g.,* ARORA ET AL., *supra* note 73, at 115-17 ("[S]tronger [intellectual property rights] can enhance the efficiency of technology transfers, and hence encourage the diffusion of technology . . . ."); Ashish Arora & Robert P. Merges, *Specialized Supply Firms, Property Rights and Firm Boundaries*, 13 INDUS. & CORP. CHANGE 451, 453-54 (2004); Jonathan M. Barnett, *Intellectual Property as a Law of Organization*, 84 S. CAL. L. REV. 785, 791-92 (2011); Naomi R. Lamoreaux & Kenneth L. Sokoloff, *Long-Term Change in the Organization of Inventive Activity*, 93 PROC. NAT'L ACAD. SCI. U.S. 12,686, 12,686 (1996); Naomi R. Lamoreaux & Kenneth L. Sokoloff, *Location and Technological Change in the American Glass Industry During the Late Nineteenth and Early Twentieth Centuries* 3 (Nat'l Bureau of Econ. Research, Working Paper No. 5938, 1997), http://www.nber.org/papers/w5938.pdf.

178. *See* Oren Bar-Gill & Gideon Parchomovsky, *Law and the Boundaries of Technology-Intensive Firms*, 157 U. PA. L. REV. 1649, 1656-57 (2009); Robert P. Merges, Intellectual Property Rights, Input Markets, and the Value of Intangible Assets 4 (Feb. 9, 1999)

footnote continued on next page

Recent research has also extended the appropriability framework to transaction design. For example, in a well-known analysis of 165 alliances between U.S. manufacturing firms, Oxley found evidence that spillovers led to collaborations using more hierarchical governance structures.[179] In related research, Oxley finds that the level of intellectual property protection available through a legal system affects alliance design, with more hierarchical structures being used where weak appropriability regimes are implicated.[180] In a study of 303 contracts entered into by an information technology company, Mayer similarly finds that concerns over spillovers influence the extent to which corporations use internal employees versus subcontractors.[181] Burstein has separately argued that informal contracting plays a role in addressing spillover concerns in the development of new technology.[182]

In summary, the literature analyzing the role of contracts in addressing knowledge spillovers performs the opposite theoretical move that braided contracting theory undertakes. Whereas braiding theory takes a narrow view

---

(unpublished manuscript), https://www.law.berkeley.edu/files/iprights.pdf. Another strand of research examines how intellectual property law affects transaction costs. *See* Dan L. Burk & Brett H. McDonnell, *The Goldilocks Hypothesis: Balancing Intellectual Property Rights at the Boundary of the Firm*, 2007 U. ILL. L. REV. 575, 576-77 (arguing that intellectual property rights play a role in demarcating firm boundaries); Dan L. Burk, *Intellectual Property and the Firm*, 71 U. CHI. L. REV. 3, 4-6 (2004) (arguing that intellectual property law reflects Hart's theory of the firm); Paul J. Heald, *A Transaction Costs Theory of Patent Law*, 66 OHIO ST. L.J. 473, 476-77 (2005) (arguing that patents respond to team production and asset partitioning problems within the firm).

A recent example of vertical integration in response to spillover problems is Google's 2011 acquisition of Motorola Mobility, understood as a move to protect Google's Android mobile operating system and its valuable ecosystem of app developers from patent infringement claims. *See, e.g.*, Shira Ovide, *Google-Motorola: It's All About the Patents*, WALL ST. J.: DEAL J. (Aug. 15, 2011, 10:03 AM ET), http://on.wsj.com/17j2OKD. We can also see evidence of appropriability concerns in the canonical GM-Fisher Body case study; for a discussion, see note 89 above. In his criticism of Klein's holdup theory of GM-Fisher Body, Robert Freeland argues that part of GM's motivation for acquiring Fisher Body was not a concern over opportunistic holdup but a fear that critical information would leak to competitors. Robert F. Freeland, *Creating Holdup Through Vertical Integration: Fisher Body Revisited*, 43 J.L. & ECON. 33, 40 (2000).

179. Joanne E. Oxley, *Appropriability Hazards and Governance in Strategic Alliances: A Transaction Cost Approach*, 13 J.L. ECON. & ORG. 387, 402-06 (1997).

180. Joanne E. Oxley, *Institutional Environment and the Mechanisms of Governance: The Impact of Intellectual Property Protection on the Structure of Inter-Firm Alliances*, 38 J. ECON. BEHAV. & ORG. 283, 299-306 (1999); *see also* John Hagedoorn et al., *Intellectual Property Rights and the Governance of International R&D Partnerships*, 36 J. INT'L BUS. STUD. 175, 175-76 (2005).

181. Kyle J. Mayer, *Spillovers and Governance: An Analysis of Knowledge and Reputational Spillovers in Information Technology*, 49 ACAD. MGMT. J. 69, 77-82 (2006).

182. Burstein, *supra* note 174, at 262-74; *see also* Peter Lee, *Transcending the Tacit Dimension: Patents, Relationships, and Organizational Integration in Technology Transfer*, 100 CALIF. L. REV. 1503, 1508 (2012) (noting a number of informal mechanisms supporting technology transfer).

of the contracting problem, spillover research embraces an expanded view—property rights, and not just contract rights, are uncertain. But while braiding theory innovates with respect to the governance mechanisms collaborators use, spillover theories maintain a traditional view of governance mechanisms. The question is typically how the classic categories of governance mechanisms respond to a different impetus.

2. Entropy, or coordination problems

Perhaps the most basic challenge collaborative innovation presents is coordinating a joint learning process across two or more organizations. Any productive activity involving more than one actor presents a coordination problem—who is going to do what and when.[183] Where tasks are simple, coordination can be achieved through straightforward communication rules. But where tasks are complex, coordination poses significant information costs on actors.[184] Because of cognitive limits, actors engaged in a complex task cannot fully process or anticipate one another's interactions, and the prospect for coordination failure—in the form of omissions, duplication, or lack of interoperability—arises. Failure to synchronize the interactions of a production team can lead to entropy.

Coordination problems between collaborators can be profound in at least two senses. First, firms collaborating in order to access knowledge that they cannot efficiently develop internally must confront a learning curve when working with a party that does have that expertise.[185] Surmounting that learning curve often requires increasing the contact points between collaborating firms, as they combine teams and share information, and those interconnections can lead to entropy if not contained within routines for progressing through the joint learning process.[186] Second, firms must also

183. *See* HERBERT H. CLARK, USING LANGUAGE 91 (1996) ("In each joint act, the participants face a coordination problem: What participatory actions do they expect each other to take? To solve this problem, they need a coordination device—something to tell them which actions are expected.").

184. *See* HERBERT A. SIMON, ADMINISTRATIVE BEHAVIOR: A STUDY OF DECISION-MAKING PROCESSES IN ADMINISTRATIVE ORGANIZATIONS 93-97 (4th ed. 1997).

185. *See* Stefano Brusoni et al., *Knowledge Specialization, Organizational Coupling, and the Boundaries of the Firm: Why Do Firms Know More than They Make?*, 46 ADMIN. SCI. Q. 597, 597-98 (2001) (arguing that some internal expertise is required in order to effectively collaborate).

186. Gulati & Singh, *supra* note 104, at 784 ("Concerns about anticipated coordination costs are particularly salient in strategic alliances, which can entail significant coordination of activities between the partners . . . . [Those costs] arise[] from the complexity of ongoing coordination of activities to be completed jointly or individually across organizational boundaries and the difficulties associated with decomposing tasks and specifying a precise division of labor across partners in the alliance . . . ."); *see also* Gaurav Laroia & Shiv Krishnan, *Managing Drug Discovery Alliances for Success*, RES.

footnote continued on next page

coordinate among the multiple collaborations they simultaneously have underway. That is, they must ensure that developments in one project complement progress in adjacent areas. As we saw in the example of the Boeing 787, in modern aerospace engineering, where multiple suppliers often develop subsystems in tandem, "concurrency risk"—or the risk that suppliers will get out of step in the codevelopment process—can be a concern.[187] This means that they must add a further layer of complexity, in effect replicating bilateral coordination across multiple partnerships.

Such entropy problems can be an impetus for vertical integration. If knowledge is tacit and therefore difficult to transfer, then integrating production into a single organization can improve information flows between team members.[188] Firms may integrate to economize on production costs, not only transaction costs.[189]

Integration may economize on production costs in three respects. First, and perhaps most obviously, firms can be superior to markets in transferring information in that they provide established communication channels between

---

TECH. MGMT., Sept.-Oct. 2005, at 42, 44-45 (recommending that alliance design respond to task complexity); Reuer & Ariño, *supra* note 156, at 315.

187. *See Hearing on Fiscal Year 2013 Navy, Marine Corps and Air Force Tactical Aviation Programs Before the Subcomm. on Tactical Air & Land Forces of the H. Comm. on Armed Services*, 112th Cong. 10 (2012) (statement of Michael J. Sullivan, Director, Acquisition and Sourcing, U.S. Government Accountability Office); *see also* Jennejohn, *Contract Adjudication in a Collaborative Economy*, *supra* note 34, at 184-85, 190-94. Coordination problems are not isolated to massive engineering projects. *See, e.g.*, Alan M. Wing et al., *Optimal Feedback Correction in String Quartet Synchronization*, J. ROYAL SOC'Y INTERFACE, Apr. 2014, at *1, http://rsif.royalsocietypublishing.org/content/11/93/20131125.long (discussing hierarchical and emergent coordination strategies in string quartets).

188. *See* Harold Demsetz, *The Theory of the Firm Revisited*, 4 J.L. ECON. & ORG. 141, 157-61 (1988).

189. *See, e.g.*, RICHARD N. LANGLOIS & PAUL L. ROBERTSON, FIRMS, MARKETS AND ECONOMIC CHANGE: A DYNAMIC THEORY OF BUSINESS INSTITUTIONS 2-4 (1995); Nicholas Argyres, *Evidence on the Role of Firm Capabilities in Vertical Integration Decisions*, 17 STRATEGIC MGMT. J. 129, 130 (1996); Bruce Kogut & Udo Zander, *Knowledge of the Firm, Combinative Capabilities, and the Replication of Technology*, 3 ORG. SCI. 383, 384 (1992); Kirk Monteverde, *Technical Dialog as an Incentive for Vertical Integration in the Semiconductor Industry*, 41 MGMT. SCI. 1624, 1624-25 (1995).

A number of scholars have reinterpreted the GM-Fisher Body integration decision as a response to coordination problems. *See* Ramon Casadesus-Masanell & Daniel F. Spulber, *The Fable of Fisher Body*, 43 J.L. & ECON. 67, 76-86, 94-98 (2000) (arguing that the merger was part of GM's broader strategy of using vertical integration to improve the quality of demand information and production scheduling, concerns exacerbated by the regular model changes GM introduced in 1923, and that the merger allowed GM to better leverage the Fisher brothers' know-how and executive talents throughout GM's multidivisional structure, a new mode of internal organization that taxed the incumbent management); *see also* Freeland, *supra* note 178, at 48-55; Susan Helper et al., *Pragmatic Collaborations: Advancing Knowledge While Controlling Opportunism*, 9 INDUS. & CORP. CHANGE 443, 452-60 (2000).

employees and management.[190] However, as teams scale, bureaucracy poses its own costs, and so two additional theories have developed. One argument posits that internal organization facilitates social routines, which "codify technologies into a language accessible to a wider circle of individuals."[191] That is, the company form may be a tool for transferring tacit knowledge from employee to employee, either through a common "language" or, more subliminally, in the form of organizational routines.[192] Another argument is that firms may reflect a modularity strategy for coordinating information flows.[193] Stemming from Herbert Simon's theory of nearly decomposable systems,[194] modular system design is an approach for contending with complex systems by breaking them up into constituent parts—collections of interrelated tasks, or "modules," and then isolating, or "hiding," information within those modules.[195] Segregating information amplifies communication within the boundaries of a module, while simultaneously reducing noise from outside those boundaries.[196] The isolation resulting from information hiding does not undermine the operation of the broader system so long as a standardized interface or "architecture" determines how outputs from each

190. *See* Kathleen R. Conner, *A Historical Comparison of Resource-Based Theory and Five Schools of Thought Within Industrial Organization Economics: Do We Have a New Theory of the Firm?*, 17 J. MGMT. 121, 139 (1991); Kathleen R. Conner & C.K. Prahalad, *A Resource-Based Theory of the Firm: Knowledge Versus Opportunism*, 7 ORG. SCI. 477, 484-86 (1996); Demsetz, *supra* note 188, at 157-58; Jack A. Nickerson & Todd R. Zenger, *A Knowledge-Based Theory of the Firm—The Problem-Solving Perspective*, 15 ORG. SCI. 617, 623-27 (2004).

191. Kogut & Zander, *supra* note 189, at 389; *see also* Bruce Kogut & Udo Zander, *What Firms Do?: Coordination, Identity, and Learning*, 7 ORG. SCI. 502, 507-12 (1996).

192. RICHARD R. NELSON & SIDNEY G. WINTER, AN EVOLUTIONARY THEORY OF ECONOMIC CHANGE 99-107 (1982); *see also* LANGLOIS & ROBERTSON, *supra* note 189, at 16-17; Robert M. Grant, *Toward a Knowledge-Based Theory of the Firm*, 17 STRATEGIC MGMT. J. (WINTER SPECIAL ISSUE) 109, 115-16 (1996). A firm's portfolio of such routines constitutes its unique capabilities, and, as such, that portfolio may comprise a source of competitive advantage. LANGLOIS & ROBERTSON, *supra* note 189, at 3.

193. Modular theories of organization find their foundation in seminal work by Herbert Simon. *See* Herbert A. Simon, *The Architecture of Complexity*, 106 PROC. AM. PHIL. SOC'Y 467, 467-68 (1962). Modularity theory was further developed in the organizational context through work by Carliss Baldwin, Kim Clark, Rebecca Henderson, Richard Langlois, Richard Robertson, and Eric von Hippel. *See* 1 CARLISS Y. BALDWIN & KIM B. CLARK, DESIGN RULES: THE POWER OF MODULARITY 1-18 (2000); Rebecca M. Henderson & Kim B. Clark, *Architectural Innovation: The Reconfiguration of Existing Product Technologies and the Failure of Established Firms*, 35 ADMIN. SCI. Q. 9, 9-10 (1990); Eric von Hippel, *Task Partitioning: An Innovation Process Variable*, 19 RES. POL'Y 407, 407 (1990).

194. *See, e.g.*, Simon, *supra* note 193, at 473-76.

195. Henry E. Smith, *Modularity in Contracts: Boilerplate and Information Flow*, 104 MICH. L. REV. 1175, 1176-77 (2006).

196. *Id.* at 1176.

module cohere.[197] Development across modules can take place asynchronously, and modules can be mixed and matched depending on the needs of a given situation.[198]

There is evidence that both the routines and modularity theories are reflected in the design of complex transactions. For example, in prior work, I explored the possibility that contracts governing collaborative innovation institutionalize "experimentalist" routines, which respond to entropy problems that arise as parties attempt to discover new technological possibilities.[199] Blair, O'Hara O'Connor, and Kirchhoefer take a different approach, arguing that parties structuring alliance agreements address entropy issues according to modular design principles, which reduce interactions so as to isolate distinct modules and standardize interoperability procedures.[200]

In summary, the literature on coordination problems takes a new view of both the organizational problem and the institutional response. The problem is not only one of incentive alignment, but it rather encompasses more fundamental challenges of entropy. In turn, the governance response is conceptualized in qualitatively different terms, with formal contracts

197. *Id.* at 1179-1203 (outlining how modular organization can operate effectively through a consistent architecture).

198. *See* 1 BALDWIN & CLARK, *supra* note 193, at 262-66 (modeling circumstances when it is efficient to develop parallel modules and to substitute one module for another).

199. *See* Jennejohn, *Collaboration, Innovation, and Contract Design*, *supra* note 34, at 140-49. That article argued that parties employed "generative" contracts, which included unique benchmarking, simultaneous engineering, and error detection and correction mechanisms to establish routines for uncovering problems, cooperatively fashioning solutions in real time, and, in so doing, further defining their respective self-interests. *Id.* That argument echoes in some respects a similar idea that Williamson introduced in his early writing. *See* OLIVER E. WILLIAMSON, MARKETS AND HIERARCHIES: ANALYSIS AND ANTITRUST IMPLICATIONS; A STUDY IN THE ECONOMICS OF INTERNAL ORGANIZATION 25 (1975) ("An additional advantage of internal organization is that it promotes convergent expectations, serving in this way to attenuate uncertainties that are generated when interdependent parties make independent decisions with respect to changing market circumstances." (citation omitted)).

The foundation for this approach is largely found in Sabel's earlier writings. *See, e.g.*, MICHAEL J. PIORE & CHARLES F. SABEL, THE SECOND INDUSTRIAL DIVIDE: POSSIBILITIES FOR PROSPERITY 13-18 (1984); Helper et al., *supra* note 189, at 482-83; Charles F. Sabel, *Learning by Monitoring: The Institutions of Economic Development*, *in* HANDBOOK OF ECONOMIC SOCIOLOGY 137, 137-39 (Neil J. Smelser & Richard Swedberg eds., 1994) [hereinafter Sabel, *Learning by Monitoring*]; Charles F. Sabel, *A Real-Time Revolution in Routines*, *in* THE FIRM AS A COLLABORATIVE COMMUNITY: RECONSTRUCTING TRUST IN THE KNOWLEDGE ECONOMY 106, 106-10 (Charles Heckscher & Paul S. Adler eds., 2006); Charles F. Sabel, *Ungoverned Production: An American View of the Novel Universalism of Japanese Production Methods and Their Awkward Fit with Current Forms of Corporate Governance*, *in* CONVERGENCE AND PERSISTENCE IN CORPORATE GOVERNANCE 310, 310 (Jeffrey N. Gordon & Mark J. Roe eds., 2004).

200. Margaret M. Blair et al., *Outsourcing, Modularity, and the Theory of the Firm*, 2011 BYU L. REV. 263, 267-68.

reflecting strategies for structuring—either through routinization or modulation—the process of interorganizational learning.

B. The Implications of Multidimensional Exchange Hazards

The discussion in this Part has so far laid the groundwork for the claim that multiple types of transaction costs affect the design of relational contracts. Including spillover and entropy concerns in our theory of economic organization introduces an intriguing possibility: rather than just responding to holdup threats, collaborators may design their agreements to address an array of innovation problems. In other words, both sides of the theoretical equation—how exchange hazards are understood and how governance tools are fashioned—can be pluralistic. The result is a highly complex decision landscape. Parties not only have to navigate more than one type of transaction cost, but they must also choose how to combine different types of governance tools into a coherent portfolio—the multivalent contract.

Multidimensionality raises two important possibilities. First, it expands our understanding of the ends a governance mechanism can serve. Consider, for example, how the management committees at the core of Gilson et al.'s braiding theory might serve purposes other than addressing opportunistic holdup. Perhaps the most obvious explanation for consensus-based committees is that they give parties veto rights over the trajectory of the collaboration, not that they foster informal constraints.[201] As Gordon Smith notes, consensual decisionmaking allows parties to put the brakes on a joint discovery process without breaching the terms of the deal.[202] A multidimensional perspective illuminates why those rights may be so important. Consensus-based committees give a party a veto right at three points in the collaborative relationship where spillover issues arise.[203]

First, in the collaboration's early stages, a unanimity requirement gives a party a chance to steer the collaboration in a direction that avoids outcomes that may, for example, conflict with adjacent areas of that party's patent portfolio or with other collaborations that it might have underway. In that way, the party can "design away" from fraught areas, and target "white space" in the patent landscape where some freedom of movement is available. Potential externalities are nipped in the bud, as it were. Delineation of discrete project boundaries is consistent with this reading—the committee is a tool for

201. Smith, *supra* note 34, at 303-05.

202. *Id.* at 316.

203. These committees can also remain in operation after the collaboration terminates, emphasizing the importance of concerns over ex post appropriability rather than ex ante investment. *See, e.g.*, License and Research Collaboration Agreement Between Genelabs Technologies, Inc. and Gilead Sciences, Inc. 31-33 (Sept. 29, 2004) (establishing a stand-alone patent committee, which operated according to unanimity rules and was to continue operating after the end of the research program term).

policing those boundaries and ensuring that the collaboration does not experience mission drift that interferes with adjacent projects.

Second, the unanimity requirement gives a party a veto over definitional decisions relating to the boundaries of intellectual property.[204] The committee is a forum for negotiating the relationship between background IP and foreground IP as well as for drawing dividing lines based on those relationships.[205] Each party has a tool for protecting its interest when decisions are being made as to whether an invention will fall within one party's exclusive ownership or whether it will be owned jointly. Relatedly, the unanimity requirement allows a party to prevent its counterparty from making decisions with respect to patent prosecution or enforcement that might affect those boundary decisions or other aspects of a party's background IP.[206]

Finally, where foreground IP is jointly owned, the veto is a means for controlling spillovers that could result from the choices of the other co-owner. Because U.S. patent law allows a joint owner to license and otherwise exploit a jointly owned asset without requiring approval of or accounting to the other owner(s), a party could find itself in a situation where, for example, its collaborator is licensing foreground IP to one of the party's competitors. Contract provisions requiring collective decisionmaking on licensing jointly owned foreground IP to third parties allows a party to address such situations,[207] and the veto right approximates through contractual means the right to exclude that arises from sole ownership.

But veto rights responding to spillover concerns cannot be the entire explanation for consensus-based committees. An explanation focused on veto

204. Escalation procedures complement consensual decisionmaking's veto role in addressing appropriability concerns. Escalation may address appropriability problems because they enlist more senior executives—with an increasingly panoramic view of the patent landscape, a comprehensive understanding of the firm's background IP and R&D pipelines, and a fuller understanding of all the company's strategic interests—into the dispute resolution process. *See* Stephen I. Glover & Alisa Babitz, *Drafting the Joint Venture Agreement*, *in* 1 PARTNERSHIPS, JOINT VENTURES & STRATEGIC ALLIANCES 6-1, 6-123 (Stephen I. Glover & Craig M. Wasserman eds., rev. ed. 2010) ("The venturers' executive officers may have a broader perspective than the individuals who are involved with the venture's problems on a day-to-day basis, and thus may be able to break the impasse."). Escalation may be about gaining perspective on one's asset portfolio and its valuation as much as it is about fostering information flows.

205. Note that the coordination issues discussed above extend to the intellectual property context where parties must cooperate with respect to things like patent filings. *See* Costalas & Rayski, *supra* note 141, at 526-27.

206. *See, e.g.*, *id.* at 527 ("[An] intellectual property owner may be reluctant to cede control of enforcement of pre-existing intellectual property to a collaborator because of the risk that the validity of the intellectual property may be challenged by the defendant in an enforcement action.").

207. *See* BADER, *supra* note 143, at 16 (finding that joint ownership of foreground IP causes "increased administrative efforts before and after the collaboration").

rights struggles to explain why multiple committees are used in some collaborations. If a consensus-based committee is simply a general-purpose veto mechanism, then why go to the trouble of establishing more than one such committee?

Perhaps governance committees are also part of a modularity strategy. Where interactions between parties are thick, collaborators delegate management of those issues to a committee bound by a unanimity rule, which creates partial separation between the committee and the constituent firms, thereby compartmentalizing the decision environment. That separation allows the committee representatives to specialize in managing the discovery process. On the flip side, delegating management to a dedicated committee allows the parent firms to focus on systemic coordination issues while the committee focuses on coordination issues at the bilateral level. As the task environment's complexity increases, there is greater separation of and devolution to subcommittees. Finally, a modularity strategy allows disputes to be cabined, preserving executives' time and preventing dispute resolution in the context of a continuing relationship from transforming into litigation.

The possibility of more than one exchange hazard affecting economic organization is attracting the sustained interest of management researchers, who are beginning to explore how governance choice correlates with indicia of problems other than holdup.[208] For example, Oxley and Sampson examine how spillover concerns and collaborators' ability to absorb one another's know-how affects the scope of electronics and telecommunications alliances,

208. A limitation of some of this research is that it tends to focus on the role Williamson's concept of hierarchy plays in the design of governance mechanisms. Much attention, for example, has been paid to the question whether a collaboration is structured as a more hierarchical equity joint venture or as a less hierarchical contractual alliance. For example, Gulati and Singh examine the effects that both appropriability and coordination costs have on alliance governance structures, using a sample of collaborations from 1970 to 1989 in the life sciences, new materials (such as ceramics, polymers, and composites), and automotive industries. Gulati & Singh, *supra* note 104, at 801-02. They conclude that collaborators use more hierarchical governance structures—equity joint ventures—when coordination costs increase. *Id.* at 801-07. And in a broad study encompassing over twenty industries, Casciaro finds that task and strategic uncertainties, not uncertainty as to a partner's willingness to cooperate, are the primary drivers of the choice between equity joint ventures and contractual governance in collaborations. Tiziana Casciaro, *Determinants of Governance Structure in Alliances: The Role of Strategic, Task and Partner Uncertainties*, 12 INDUS. & CORP. CHANGE 1223, 1239-44 (2003). Even studies that do take a more detailed look at alliance contract provisions often use the Williamsonian lens to identify alliance contracts that are more or less hierarchical. Geis, *The Space Between Markets and Hierarchies*, *supra* note 34, at 107 n.28; Jeffrey J. Reuer & Shivaram V. Devarakonda, *Mechanisms of Hybrid Governance: Administrative Committees in Non-Equity Alliances*, 59 ACAD. MGMT. J. (forthcoming Apr. 2016) (manuscript at 5, 8-9) (on file with author). Hierarchy is often a useful concept, but high-level categorizations of hierarchical versus nonhierarchical arrangements can obscure important design details. To achieve the level of detail being pursued here, a tool more precise than hierarchy is necessary.

finding that greater spillover concerns and the parties' relative capacities to absorb information influence scope decisions.[209] In a study examining over 400 service contracts entered into by a single firm, Mayer and Salomon find evidence of interdependence between coordination problems and holdup problems: greater differences in parties' technological capabilities influence the intensity of the contractual hazards (such as holdup problems) the firms face, which in turn affects contractual governance choice.[210] Kale, Singh, and Perlmutter find that informal governance mechanisms can help address not only opportunism concerns but also joint learning problems.[211] Reuer and Devarakonda find evidence that a combination of exchange hazards affects the design of steering committees in alliance contracts.[212]

That expanded understanding of contracts' ends naturally leads to the second implication: governance mechanisms are interdependent. A contract provision that addresses holdup problems may also affect, either positively or negatively, the mitigation of spillover and/or entropy concerns. The possibility of governance mechanisms complementing or substituting for one another occurs at a much more fine-grained level than the formal/informal debate envisions: the provisions of the *formal* contract may be complements to or substitutes for one another, and then we must ask how those formal

209. Joanne E. Oxley & Rachelle C. Sampson, *The Scope and Governance of International R&D Alliances*, 25 STRATEGIC MGMT. J. 723, 735-45 (2004); *see also* Rachelle C. Sampson, *Organizational Choice in R&D Alliances: Knowledge-Based and Transaction Cost Perspectives*, 25 MANAGERIAL & DECISION ECON. 421, 429-33 (2004) (finding evidence that parties' capabilities affect alliance structure but that, when collaborators' capabilities are dramatically different, opportunism problems appear to drive alliance structure).

210. Mayer & Salomon, *supra* note 156, at 951-55.

211. Prashant Kale et al., *Learning and Protection of Proprietary Assets in Strategic Alliances: Building Relational Capital*, 21 STRATEGIC MGMT. J. 217, 226-28 (2000).

212. Reuer & Devarakonda, *supra* note 208 (manuscript at 33). Analyzing a large sample of life sciences agreements, they find that governance committees are used in response to not only moral hazard problems, but also misappropriation of knowledge and coordination problems. *Id.* (manuscript at 8). Committee use correlates positively and significantly with an overlap in partners' technological portfolios, which is used as a measure of appropriability risk. They also find that project complexity correlates positively and significantly with committee use, suggesting that opportunism concerns shape alliance design. Finally, they find that both sequential and reciprocal task interdependencies correlate positively and significantly with committee use, providing evidence that coordination problems affect alliance design. Based on those results, Reuer and Devarakonda argue that committees address multiple exchange hazards through Williamsonian hierarchy. Hierarchy improves governance along three dimensions: (1) monitoring of opportunistic behavior is improved as information becomes centralized in an authoritative committee; (2) information leakage is prevented because all information is routed through the committee, reducing unstructured communication between the parties, and because the committee can design tasks and allocate responsibilities to minimize exposure to certain information; and (3) information processing is improved as a central organ decomposes and allocates related tasks, and as information is cabined within semiautonomous subcommittees. *Id.* (manuscript at 12-19, 33).

provisions interact with any informal constraints that may affect the relationship. The implication is that governance mechanisms can present multidimensional tradeoffs.

To illustrate, consider the following hypothesis: committees' responses to spillover problems may be complementary to their responses to entropy problems, but they may exacerbate holdup problems. A committee may be employed when intellectual property rights are strong and the intellectual property landscape is organized tightly, as in the life sciences and chemical industries, to prevent spillovers by midwifing new asset boundaries and coordinating a modulated task structure, as outlined above. In that respect, the committee governance mechanism operates to address the two exchange hazards in a complementary fashion. But there is a countervailing risk: the committee itself invites holdup via the unanimous decisionmaking rule, which presents an opportunity for deadlock. Therefore, it is only in those collaborations where coordination problems and intellectual-property-boundary definition are critical enough that parties are regularly willing to invite the holdup risk that comes with committee governance. In other words, holdup does influence the use of administrative mechanisms, but not in the way Gilson et al. envision—the contract referee mechanism *creates* holdup risk in some circumstances rather than minimizing it.[213] It is the balance between spillover and entropy concerns on one hand and holdup problems on the other that explains why certain industries use committees, unanimity rules, and escalation procedures and some do not.[214]

Recognizing the contingent relationships between governance devices is powerful because it provides a framework for understanding at a detailed level the diversity of design strategies we observe in practice. If only holdup problems motivate contract design, then, as we saw in Part I.C above, differences in governance strategy are befuddling unless there is reason to believe that the intensity of holdup threats differs materially between collaborations. By acknowledging the potential for tradeoffs between governance tools, multiple exchange hazards gives us a framework for understanding why one collaboration may employ different mechanisms than

213. *See, e.g.*, Onyx Pharm., Inc. v. Bayer Corp., No. C 09-2145 MHP, 2011 WL 7905185, at *4 (N.D. Cal. May 10, 2011) (recounting how Bayer representatives refused to agree in joint committee meetings so as to protect Bayer's investment in a compound being developed outside of the collaboration with Onyx, and how Onyx eventually was forced to acquiesce to Bayer's position).

214. This is not to say that holdup and ex ante underinvestment concerns are not important. Rather holdup may simply be addressed through other contractual mechanisms, such as efforts obligations, instead of a steering committee. Thus multiple hazards may coexist, simultaneously affecting contract design. A multivalent perspective brings the interdependent nature of contract provisions into focus. The contingency of governance mechanisms is emphasized, and the question whether mechanisms are substitutes or complements becomes much more fine grained.

another collaboration. Variations between the intensity of exchange hazards collectively affecting one collaborative relationship and the next lead to different governance tradeoffs for different collaborations. By illuminating those tradeoffs, a multidimensional approach removes the straightjacket of the holdup paradigm.

III. Demonstrating Proof of Concept

This Part explores whether the approach suggested above provides an answer to the fundamental question why we see such diversity in alliance contracts. Recall that Gilson et al.'s argument was that variations between alliances' respective scopes explain diversity, but a survey of a larger sample of contracts casts initial doubt on that explanation because scope appears to be constant across agreements. Something else affects alliance design.

To tackle that question, this Part explores the hypothetical above—that committees are used where spillover and entropy problems outweigh holdup risk—by employing a preliminary mixed-methods empirical analysis. This Part first discusses in detail the use of such committees in three discrete alliance contracts, involving GlaxoSmithKline and Anacor, Boeing and Spirit Aerosystems, and Intel and Nanosys respectively. It then presents the results of a logistic regression analysis of a hand-collected sample of 146 alliance agreements taken from four industries. Finally, it revisits the three agreements Gilson et al. use as the foundation for their braiding theory and argues that a multivalent approach explains certain aspects of those contracts' designs. The goal in undertaking these analyses is not to conclusively test specific propositions but to explore possibilities while also creating a roadmap for moving beyond the inductive approach employed in prior scholarship, which broadly generalized from a handful of illustrative agreements.[215] Preliminary results suggest that committees are used when the need to respond to spillover and entropy threats outweighs the costs of potential committee deadlock, which might be used opportunistically. In other words, the decision to use a committee involves balancing tradeoffs between responses to different exchange hazards. Finally, this Part concludes by discussing the multivalent approach's implications for future theoretical development.

215. *See, e.g.*, Gilson et al., *Braiding*, *supra* note 34, at 1405-08 (discussing one agreement); Gilson et al., *Contracting for Innovation*, *supra* note 34, at 458-71 (discussing three exemplary agreements). Other studies take a similar approach. Gordon Smith reports the analysis of a handful of contracts. *See* Smith, *supra* note 34, at 308, 314, 315. Poppo and Zenger, as well as Bozovic and Hadfield, cast a wider net, but they do not examine express provisions at all, relying instead on survey data. *See* Poppo & Zenger, *supra* note 108, at 713-14; Bozovic & Hadfield, *supra* note 108, at 2. In my earlier work, I examined a larger number of agreements but only analyzed a small number of discrete provisions. *See* Jennejohn, *Collaboration, Innovation, and Contract Design*, *supra* note 34, at 117-21.

A. Building Intuition with Three Illustrative Collaborations

To build intuition, a qualitative analysis of three illustrative alliance agreements, each from a different industry, is presented first. Taken together, these three examples suggest that the use of administrative mechanisms such as management committees corresponds with spillover and entropy concerns, not with variations in project discreteness as Gilson et al. assert. Of course, the brief comparison below does not capture the full nuance of the agreements. For the interested reader, public versions of the agreements, including summary term sheets, are available on SSRN.[216]

The first contract is a 2007 collaboration agreement between GlaxoSmithKline plc (GSK) and Anacor Pharmaceuticals, Inc.[217] In that agreement GSK and Anacor agreed to research, develop, and commercialize boron-based systemic anti-infectives against four targets.[218] The collaboration was structured to give GSK a series of options to exclusively commercialize the compounds developed over the course of the collaboration.[219] In return, Anacor received funding—an upfront payment, milestone payments, royalties, and an interest in jointly developed intellectual property—and access to GSK's regulatory and marketing expertise.[220] It appears that this governance approach has been successful because the collaboration has expanded over the years to include additional projects.[221]

The second agreement is a 2005 codesign and supply agreement between Boeing Company and Spirit Aerosystems for forward fuselage sections for the

216. *See* Matthew C. Jennejohn, Exemplary Contracts and Summary Term Sheets for *The Private Order of Innovation Networks* (2015), http://ssrn.com/abstract=2670088.

217. Research and Development Collaboration, Option and License Agreement Between Smithkline Beecham Corporation D/B/A GlaxoSmithKline and Anacor Pharmaceuticals, Inc. (Oct. 5, 2007) [hereinafter GSK/Anacor Agreement].

218. *Id.* at 1; s*ee also Strategic Alliances*, ANACOR, http://www.anacor.com/strategic_alliances.php (last visited Feb. 2, 2016) ("In October 2007, we entered into a research and development collaboration, option and license agreement with GSK for the discovery, development and worldwide commercialization of boron-based systemic anti-infectives against four discovery targets . . . .").

219. GSK/Anacor Agreement, *supra* note 217, at 38-45. However, Anacor was required to pay GSK milestone payments and royalties for compounds for which GSK chose not to exercise its option to commercialize similar to those set forth above. *Id.* at 45-46. In other words, a reciprocal system existed with payments depending upon which party commercialized a compound.

220. *Id.* at 38-45.

221. In July 2010, GSK exercised its option under the agreement to obtain an exclusive license to further develop and commercialize Anacor's lead systemic antibiotic for the treatment of certain infections. *Strategic Alliances*, *supra* note 218. On September 2, 2011, the parties amended and expanded their collaboration to expand GSK's rights and to add new programs for tuberculosis and malaria. Master Amendment to Research and Development Collaboration, Option and License Agreement [Between GSK and Anacor] (Sept. 2, 2011).

787 Dreamliner.[222] This agreement is an example of the collaborative sourcing strategy Boeing pursued, as described in the Introduction. In addition to other tier-one suppliers in the 787 production network, Spirit experienced delays,[223] which led to a series of amendments to the original agreement.[224] Some commentators have considered the Boeing/Spirit relationship a relative success, however, because Spirit responded to problems with greater alacrity than other suppliers, resolving problems more quickly than elsewhere in the 787's supply chain.[225]

The third agreement is a 2003 cooperative development agreement between Intel Corporation and Nanosys, Inc. for the codevelopment of memory-related chip technologies. Nanosys is an advanced materials company that develops products utilizing inorganic nanostructures, with applications ranging from semiconductors to renewable energy.[226] The purpose of the agreement was to fund early stage research that, if fruitful, would lead to an exclusive development arrangement and, ultimately, to a commercialization agreement.[227] The Intel/Nanosys Agreement was designed to give Intel access to Nanosys's intellectual property and expertise for the purpose of developing

222. The agreement between Boeing and Spirit Aerosystems is found in two primary contracts. The first is an umbrella General Terms Agreement. The earliest publicly available version of this contract is Amendment 1 to General Terms Agreement Between the Boeing Company and Spirit Aerosystems Incorporated (Apr. 1, 2006) [hereinafter Boeing/Spirit Amendment 1], which provides a full restatement of the agreement. The second contract is the more specific Special Business Provisions. *See* Special Business Provisions Between the Boeing Company and Spirit Aerosystems, Incorporated (June 16, 2005) [hereinafter Boeing/Spirit Agreement]. Press reports indicate that Spirit Aerosystems provides forward fuselage sections for the Dreamliner program. *See* James Wallace, *Boeing Unveils Nose Section of New 787*, SEATTLE POST-INTELLIGENCER (Aug. 25, 2005, 10:00 PM), http://www.seattlepi.com/business/article/Boeing-unveils-nose-section-of-new-787-1181470.php.

223. *See* Michael Mecham, *Boeing, Spirit AeroSystems Agree on Compensation Package for 787 Delays*, AVIATION DAILY (Jan. 14, 2011), http://aviationweek.com/awin/boeing-spirit-aerosystems-agree-compensation-package-787-delays.

224. *See, e.g.*, Amendment 2 to General Terms Agreement BCA-65530-0016 Between the Boeing Company and Spirit AeroSystems, Inc. (Mar. 4, 2011); Amendment 7 Special Business Provisions Between the Boeing Company and Sprit Aerosystems, Incorporated (Feb. 4, 2011); Amendment 8 Special Business Provisions Between the Boeing Company and Spirit Aerosystems, Incorporated (Feb. 3, 2011); Memorandum of Agreement Between the Boeing Company and Spirit Aerosystems, Inc. Encompassing a Revision to Special Business Provisions MS-65530-0016 (Mar. 9, 2012).

225. *E.g.*, Kotha & Srikanth, *supra* note 24, at 51.

226. Press Release, Nanosys, Inc., Nanosys and Sharp Expand Development Agreement for Nanotechnology-Enabled Products (Feb. 19, 2008), http://www.nanowerk.com/news/newsid=4591.php.

227. Intel Corp. & Nanosys Inc., Cooperative Development Agreement 5 (Dec. 15, 2003) [hereinafter Intel/Nanosys Agreement].

the new technology[228] and to fund Nanosys's research efforts through a system of stepped payments.[229]

As summarized in Table 1, side-by-side comparison of the three agreements reveals several striking dissimilarities. Consider first how differently the agreements treat administrative mechanisms. In the GSK/Anacor Agreement, the project management, escalation, and dispute resolution provisions are extensive in their complexity. At the heart of the agreement was an elaborate governance structure involving two tiers of committees, all bound by unanimity rules, and a complex dispute resolution system that shunted disputes to three types of tribunals depending on the underlying substance of the controversy.[230] In the Intel/Nanosys Agreement, on the other hand, such mechanisms are entirely absent. The Boeing/Spirit Agreement occupies a middle ground of sorts: limited governance bodies are established, including a pricing-dispute committee and "Life Cycle Product Teams" for individual projects, and a simple dispute escalation process is established,[231] but neither the scope nor the unanimity requirements of the GSK/Anacor Agreement's administrative mechanisms are replicated. Similar discrepancies are also observed with endgame structuring. The GSK/Anacor Agreement exhibits the careful nesting of options over the foreground IP resulting from collaboration.[232] But those options are absent in the Intel/Nanosys and Boeing/Spirit Agreements.

What might explain the different approaches to administrative mechanisms across the three agreements? We do not see much support for Gilson et al.'s claim that variations in project discreteness explain differences in governance strategies. In all three collaborations, discrete projects are identified ex ante,[233] and in no case is the collaboration a loosely defined partnership to pursue unknown objectives. The financing mechanisms also do not clearly correlate with the use of management committees: the use of both upfront and milestone payments corresponds with a management committee in the GSK/Anacor contract,[234] but the Intel/Nanosys Agreement, which also

228. *Id.*

229. The Intel/Nanosys Agreement's financial incentives were simpler than those in the GSK/Anacor Agreement. Nanosys's primary remuneration was a series of payments, released at the commencement of the collaboration and every three months thereafter over the term of the agreement. *Id.* at 7. Intel also paid Nanosys a fixed amount for each Nanosys full-time employee, chosen by Intel, who participated in the project. *Id.* at 7-8.

230. *See infra* Figure 1 (providing a process map of the committee-escalation process); *see also* GSK/Anacor Agreement, *supra* note 217, at 19, 26, 28-30, 73-74.

231. Boeing/Spirit Amendment 1, *supra* note 222, at 40; Boeing/Spirit Agreement, *supra* note 222, at 46-47, attachment 1.

232. GSK/Anacor Agreement, *supra* note 217, at 69-72.

233. *Id.* at 16; Boeing/Spirit Agreement, *supra* note 222, at 18; Intel/Nanosys Agreement, *supra* note 227, at 1, exhibit A.

234. GSK/Anacor Agreement, *supra* note 217, at 38, 45-46.

has upfront and milestone payments,[235] has no such committee. Differing regulatory environments also do not appear to explain committee use: although the Food and Drug Administration process corresponds with committee use in the GSK/Anacor collaboration, Federal Aviation Administration regulatory oversight does not correlate with committee use in the Boeing/Spirit deal. Nor do the durations of the agreements suggest a clear explanation for differing committee use—all three contracts are long term, and allocate unilateral termination rights.

But spillover and entropy issues may provide an explanation for why the three agreements took different approaches with respect to management committees. Examining the contracts' conduct provisions reveals a highly structured task delineation in the GSK/Anacor contract but less finely separated divisions in the Boeing/Spirit and Intel/Nanosys agreements. For example, the GSK/Anacor Agreement carefully segmented each party's respective tasks with care, suggesting that the parties did not want one's responsibilities to bleed over into another's.[236] Boeing/Spirit and Intel/Nanosys made no such segmentation and indeed provided for the colocation of employees, indicating that tasks were more finely interwoven among the parties.[237] Those different approaches to task delineation also correspond with how the collaborators addressed intellectual property ownership. The foreground IP provisions in the GSK/Anacor contract were highly complex, carefully providing for how ownership of foreground IP would be allocated, obliging parties to use reasonable best efforts to achieve a certain scope of patent protection, giving GSK consultation rights to Anacor's patent prosecution decisions, and establishing a specific Patent Subcommittee to oversee prosecution and resolve disputes.[238] Neither the Boeing/Spirit Agreement nor the Intel/Nanosys Agreement went to such lengths. Given the relative weakness of patent rights in the aerospace and integrated-circuit industries compared to life sciences and pharmaceuticals,[239] the paucity of the intellectual property provisions in the Boeing/Spirit and Intel/Nanosys Agreements is unsurprising: rather than investing in the definition of rights to individual patents like the GSK/Anacor Agreement, the Boeing/Spirit and Intel/Nanosys Agreements are consistent with a defensive patenting strategy where rights are defined when individual patents are aggregated into broader

235. Intel/Nanosys Agreement, *supra* note 227, at 7.

236. GSK/Anacor Agreement, *supra* note 217, at 17-18 (designating separate responsibilities for each party).

237. *See* Boeing/Spirit Amendment 1, *supra* note 222, at 9-10 (providing for colocation of Boeing employees at Spirit facilities); Intel/Nanosys Agreement, *supra* note 227, at 4 (providing for colocation of Intel employees at Nanosys facilities).

238. GSK/Anacor Agreement, *supra* note 217, at 30, 54.

239. *See supra* notes 169-73 and accompanying text.

portfolios.[240] In short, the patterns observed with respect to the use of management committees in these three exemplary agreements are consistent with the spillover and entropy explanations outlined in Part II.B above.

Table 1
Comparing Key Terms of the
GlaxoSmithKline/Anacor, Boeing/Spirit, and Intel/Nanosys Agreements

Provision	GSK/Anacor	Boeing/Spirit	Intel/Nanosys
R&D Scope	Discrete projects identified ex ante.	Discrete projects identified ex ante.	Discrete projects identified ex ante.
Conduct of R&D	Parties' tasks carefully delineated. Parties' R&D conduct subject to "diligent efforts" obligation.	Parties' tasks less finely separated. Provision is made for colocation of employees.	Parties' tasks less finely separated. Provision is made for colocation of employees.
Project Management, Escalation, and Dispute Resolution	Complex structure of consensus-based committees, alliance liaisons, and an escalation process. Trifurcated dispute resolution, with some disputes going to the American Arbitration Association, others to a single expert, and IP-related matters to federal district court.	No consensus-based committees established, other than a limited-scope committee for pricing disputes. Escalation process is established. Life cycle product teams are created for individual projects. No arbitration provision.	No consensus-based committees established, no escalation process, no dispute resolution provision other than California choice of law provision.
Consideration	Upfront and milestone payments.	Payment occurs upon completion.	Upfront and milestone payments.
Regulatory Process	Yes (FDA review).	Yes (FAA review).	No.
End-Game Structure	Series of nested options for ownership of foreground IP with alternative options delineated if either party terminated the collaboration early.	No options on foreground IP.	No options on foreground IP; simple survivorship clause provided that certain provisions, including license grants, continued despite termination of the contract.
License Grant	Initial nonexclusive license grant to background IP, switching to exclusive license upon GSK's exercise of development option.	Nonexclusive license grant to background IP.	Nonexclusive license grant to background IP.

240. *See supra* note 173 and accompanying text.

Provision	GSK/Anacor	Boeing/Spirit	Intel/Nanosys
Foreground IP Ownership	Each party to own intellectual property developed solely by its employees, and both parties to jointly own intellectual property developed collaboratively. Patent Subcommittee established to oversee prosecution and enforcement of joint patents. Parties required to obtain reasonable scope of protection for jointly and solely owned patents. If a party did not elect to prosecute or enforce a patent, then the other party had the option to do so. GSK given consultation right with respect to Anacor's patent prosecution and enforcement.	All intellectual property created in the course of the collaboration is to be owned by one party or the other, to be determined according to certain fields of ownership. No jointly owned intellectual property contemplated.	Nanosys to own all jointly created foreground IP, with nontransferable license grant to Intel.

B. Analyzing a Larger Sample of Collaborations

This Subpart expands the analysis above to a larger sample of alliance contracts using quantitative methods. The results of this quantitative study corroborate the qualitative analysis outlined above. The evidence suggests that spillover and entropy problems lead collaborators to include management committees in their alliance contracts, while little evidence is found supporting the argument that holdup problems drive committee use.

As noted above, the purpose of undertaking a large-*n* quantitative analysis is not to conclusively identify the determinants of alliance design—a project requiring several papers to fully run its course. This Article defers that work to subsequent research. Rather, the goal here is to take a critical first step in expanding the evidentiary basis for further theorizing, which until now, has proceeded on a thin factual record.

1. Constructing the dataset

For the tests below, a sample of collaboration, joint development, and strategic alliance agreements involving firms in the life sciences,

semiconductor, software, and chemical industries was hand-collected. Those industries were chosen because they are characterized by rapid technological change, high R&D spending, and regular interfirm collaboration. The sample of agreements was taken from publicly available material contracts filed with the Securities and Exchange Commission (SEC). To isolate the agreements, searches were run on exhibits to SEC filings by industry, as defined by four-digit SIC code[241] using LexisNexis's EDGAR database.[242] A date restriction was applied to search for agreements filed between 1995 and 2011.[243] The initial results of those searches were then deduplicated and screened for miss-hits.[244] For agreements in semiconductor, software, and chemicals SIC codes, all of the resulting agreements were added to the sample; for life sciences agreements, which occur with a much higher frequency, a random selection of contracts was included in the sample. The result was a sample of 146 agreements, roughly evenly divided between the four industries except with respect to chemicals contracts, where only 16 contracts were identified. The sample breaks down by industry type and year as indicated in the following frequency table:

241. The U.S. Department of Labor maintains Standard Industrial Classification (SIC) codes, which segment major industries into 2-digit, 3-digit, and 4-digit categories (with 2-digit classifications being the most general and 4-digit the most specific). A list of 2-digit SIC codes is available at *SIC Division Structure*, OCCUPATIONAL SAFETY & HEALTH ADMIN., https://www.osha.gov/pls/imis/sic_manual.html (last visited Feb. 2, 2016).

242. For general information on EDGAR, see *EDGAR Search Tools*, SEC. & EXCHANGE COMMISSION, http://www.sec.gov/edgar/searchedgar/webusers.htm (last visited Feb. 2, 2016). Keyword searches were run to identify agreements. The searches included "collaboration agreement," "development agreement," and "alliance." One limitation of this approach is that it does not pick up on contracts that that go by other, idiosyncratic titles.

243. This broad window was selected to ensure a sufficient volume of chemicals, semiconductor, and software agreements were pulled. Please note that Table 2 below reports agreements by the year they were executed, not the year filed with the SEC.

244. A common example of a miss-hit would be a contract such as a purchase agreement or loan agreement that mentioned in one of its provisions a collaboration or joint development agreement between the parties.

Table 2
Agreements by Year

	Industry			
Year	Life Sciences	Semiconductors	Software	Chemicals
1993	0	1	0	0
1994	1	0	2	0
1995	0	1	0	0
1996	3	2	2	0
1997	0	3	1	1
1998	2	2	11	2
1999	3	6	8	0
2000	2	6	7	0
2001	4	3	2	0
2002	4	4	3	0
2003	3	4	2	0
2004	6	3	4	2
2005	4	1	3	2
2006	2	2	3	0
2007	2	1	2	0
2008	4	1	0	2
2009	8	1	2	0
2010	3	1	1	3
2011	1	3	0	3
2012	0	0	0	1
2013	0	0	0	1
Total	52	45	53	17

Because the contracts are taken from SEC filings, there are two obvious limitations to the dataset. First, the contracts here all involve at least one publicly traded firm obliged to meet SEC reporting requirements, creating a bias towards public company agreements. Second, the agreements reflect a filing party's decision that the deal was material enough to require disclosure, a choice upon which parties may differ. Those two limitations mean that the sample may not include a number of agreements, such as those between small startups. Therefore, caution should be exercised when attempting to generalize the results of the analysis below.

2. Variables and hypotheses

As illustrated above, innovation agreements are often highly complex, employing a host of governance mechanisms. As a result, a wide range of dependent variables could be selected. Because the study here undertakes a preliminary, illustrative analysis, it focuses on a single dependent variable—whether a contract establishes a consensus-based governance committee—in order to set the stage for more extensive analysis in later research. I focus on the use of such governance committees because they are a clear, readily testable example of the information-sharing and contract referee mechanisms Gilson et al. argue are central to braided contracting.[245] To capture the incidence of consensus-based committees in the agreements analyzed, the dummy variable *Governance Committee*, which is set to one when a committee is established, was created. At this stage, the analysis does not differentiate between single- and multicommittee structures, deferring such analysis to later research.

Explanatory variables were measured by using various provisions in the alliance agreements as proxies for opportunism, spillover, and entropy hazards.[246] This approach, similar to Geis's interesting quantitative analysis of outsourcing transactions,[247] is of course an approximation of the actual exchange hazards affecting a given alliance. In a perfect world, information on the subjective perceptions of all relevant executives on each side of a collaboration, coupled with objective indicia of certain transaction costs, would be used to measure the explanatory variables. But as much of that information is not readily available, this approach serves as a suitable second-best solution, considering the sparseness of the empirical record.

This Subpart proceeds by discussing the three types of explanatory variables—spillover, entropy, and opportunism—in turn, and then describing various control variables. At the conclusion of the description of each variable, a specific hypothesis regarding that variable's relationship with the dependent variable—the incidence of governance committee use—is summarized in italics. The subsequent discussion of the results will refer back to the numbered hypotheses presented here.

---

245. Selecting governance committees as a dependent variable also connects this Article to recent strategy research, which examines the use of such administrative mechanisms in alliance agreements. *See* Reuer & Devarakonda, *supra* note 208 (manuscript at 4).

246. Dichotomous variables were also used to measure the effect of various factors on the decision to use a governance committee. This strategy introduces an obvious limitation: reducing complex contractual provisions to a simple yes/no indication of their occurrence necessarily results in a loss of detail. The hope is that the three case studies discussed in Part III.A above provide sufficient context with which to interpret the results of this larger-*n* analysis. In any event, until a rich, systematized cartography of complex contracts develops, compromises of this sort are inevitable if meaningful scale in sample sizes is to be achieved.

247. *See* Geis, *An Empirical Examination of Business Outsourcing Transactions*, *supra* note 34, at 249-50.

a. Spillover variables

To capture the role spillover problems may play, six dummy variables were specified. The first variable, *Joint IP*, is set to one if the collaboration agreement provides that certain foreground IP created through the collaboration may be jointly owned by both parties. Although joint ownership is often regarded as a suboptimal arrangement,[248] it nevertheless occurs with regularity.[249] Joint ownership raises the prospect of appropriability problems because under U.S. patent law, a joint owner does not need consent from the other owner(s) to exploit the asset.[250]

The second variable, *Noncompete*, is set to one if the agreement includes a noncompetition provision, which would suggest that a party is concerned about leaks of sensitive information for use outside the scope of the collaboration.[251] This Article hypothesizes that an incidence of either joint ownership or noncompete provisions will correlate positively with the establishment of governance committees.

Hypothesis 1(a): Joint ownership of foreground IP will correlate positively with committee incidence.

Hypothesis 1(b): Use of a noncompete provision will correlate positively with committee incidence.

In addition to variables for joint IP ownership and noncompete provisions, dummy variables were also created, drawing on other studies, to capture the strength of intellectual property rights in an industry.[252] Agreements were coded by industry according to SIC code, using dummy variables *Life Sciences*, *Semiconductors*, *Enterprise Software*, and *Chemicals*. Those variables were set to one where at least one of the parties was identified by an industry's SIC code.[253] This Article hypothesizes that stronger appropriability regimes will require

248. *See* Joseph Yang, *IP Issues in Joint Ventures and Strategic Alliances*, *in* 2 ADVANCED LICENSING AGREEMENTS 2012, at 159, 163-64 (Ira Jay Levy & Joseph Yang eds., 2012); *see also* John Hagedoorn, *Sharing Intellectual Property Rights—An Exploratory Study of Joint Patenting Amongst Companies*, 12 INDUS. & CORP. CHANGE 1035, 1044-45 (2003).

249. *See* BADER, *supra* note 143, at 15-16; Hagedoorn, *supra* note 248, at 1041-44.

250. 35 U.S.C. § 262 (2014) ("In the absence of any agreement to the contrary, each of the joint owners of a patent may make, use, offer to sell, or sell the patented invention within the United States, or import the patented invention into the United States, without the consent of and without accounting to the other owners.").

251. Note that information leakage can include, but is not limited to, opportunistic behavior.

252. *See, e.g.*, Oxley, *supra* note 179, at 402-03.

253. Thus it is possible that a single agreement could involve parties falling within multiple SIC codes (for example, software and semiconductors), which occurred in nineteen instances.

more governance because the cost of spillovers will outweigh the costs of operating the administrative mechanisms, and so there will be a positive correlation with strong appropriability regimes (such as life sciences and chemicals, and the incidence of governance committees) and a negative correlation with weak appropriability regimes (such as semiconductors and software, and governance committees).

> *Hypothesis 1(c): Deals in the life sciences and chemicals industries will correlate positively with committee incidence, and deals in the semiconductor and software industries will correlate negatively with committee incidence.*

There is a possibility that the industry dummy variables actually measure something other than the strength of a sector's appropriability regime. For example, they may capture industry-specific path dependencies. There may be established best practices in certain sectors, perhaps driven in part by standardized templates that attorneys use when drawing up agreements, which determine the use of certain governance mechanisms, rather than concerns arising from strong or weak intellectual property rights. Or perhaps other idiosyncratic circumstances lead certain industries to adopt particular governance mechanisms more than others. For example, the lengthy, costly, and highly uncertain Food and Drug Administration (FDA) approval process in life sciences may lead biotechnology alliances to incorporate more extensive governance mechanisms than collaborations in other industries.

A total absence of path dependencies would be surprising, and a longitudinal study examining how contract design practices develop over time is an important project for future research. And there is little question that the costs of a typical collaboration differ between industries. But there is reason to believe that neither are entirely outcome determinative. First, collaborations by nature tend to be novel rather than cookie-cutter transactions, which undercuts a number of the incentives for persistent path dependencies. Innovation projects are often idiosyncratic by nature, and so the economies of scale observed in the production of boilerplate contracts do not readily obtain.[254] It is not unusual for collaboration agreements involving the same company to have materially different governance mechanisms.[255] Relatedly,

254. *See* MITU GULATI & ROBERT E. SCOTT, THE THREE AND A HALF MINUTE TRANSACTION: BOILERPLATE AND THE LIMITS OF CONTRACT DESIGN 33-44 (2013) (describing theories accounting for the "stickiness" of boilerplate terms in contracts and potential causes of dysfunction).

255. *Compare* Licensing and Development Agreement Between International Business Machines Corporation and IBIS Technology Corporation (Mar. 1, 1998) (including no management committee), Development and License Agreement [Between PeopleSoft, Inc. and Momentum Business Applications, Inc.] (filed Nov. 25, 1998), https://contracts.onecle.com/peoplesoft.momentum.lic.1998.shtml (same), *and* Toshiba Corp. & NeoMagic Corp., Product Joint Development Agreement (Jan. 21, 1997) (same), *with* Joint Development Agreement Between International Business Machines Corporation

footnote continued on next page

many of the law firms servicing one industry also serve other industries, creating the means for cross-pollination.[256] Second, the study is designed in part to address the possibility of unique industry characteristics. Two industries with strong intellectual property regimes, life sciences and chemicals, and two industries with weak regimes, semiconductors and software, were selected in order to differentiate between characteristics of intellectual property rights in an industry and other factors.[257] For instance, agreements from the chemical industry were included so that collaborations from a high-strength intellectual property regime that are not subject to FDA process were included in the dataset to provide a potential counterpoint for life sciences agreements. It is not out of the question for more than one industry to have developed the same idiosyncratic approach to contract design, but that possibility becomes less plausible as the number of industries with similar patterns increases. A broader sample including more industries is an important project for future research.

---

and Nexx Systems, Inc. 8 (June 8, 2010) (providing for quarterly meetings of project managers), Joint Development Agreement [Between Commerce One, Inc. & PeopleSoft, Inc.] 3 (June 5, 1999) (including a management committee), *and* Development Agreement [Between Synergy Semiconductor Corp. and Toshiba Corp.] 4 (Nov. 14, 1990) (including a management committee).

256. Practitioners have noted the spread of alliance contracting from the chemicals and biotechnology industries to other industries. *See* VILLENEUVE ET AL., *supra* note 70, at 1-1 to 1-4 ("Since the early 1980s, . . . the number and visibility of [alliance] arrangements have increased dramatically beginning when cash-hungry biotechnology companies began using corporate partnering arrangements to help finance the enormously expensive clinical development of human therapeutic products. Since then, many other industries have enthusiastically embraced these arrangements. . . . The classic corporate partnership structure arose in the chemical and materials industries, spread to biotechnology and is now widely used in all technology industries."). Law firm expertise appears to have expanded to cover multiple industries in turn. For example, Cooley LLP, one of the leading firms that advises on alliance design, regularly represents clients in a wide variety of industries. *See, e.g.*, *Technology Transactions*, COOLEY, https://www.cooley.com/technology (last visited Feb. 2, 2016) (noting that Cooley works with "companies of all sizes, at all stages of development," has a "sophisticated team dedicated to the digital media, e-commerce, electronics, information technology, alternative energy and telecommunications fields," and also has "a separate Life Sciences transactions group focused on the biotech, health care, medical device and pharmaceutical markets"); *see also* WilmerHale, Strategic Alliances, Joint Ventures and Licensing (2015), https://www.wilmerhale.com/uploadedFiles/Shared_Content/Editorial/Publications/Documents/2015-WH-TTL-Deals.pdf (summarizing alliance transactions across a number of industries upon which WilmerHale has advised in 2015).

257. I also wished to use the incidence of provisions addressing regulatory filings as a control variable to test whether early-stage research life sciences collaborations differed from those contemplating regulatory process, but collinearity issues precluded inclusion of such a control variable in the model.

b. Entropy variables

To assess the role entropy problems may have in the design of committee governance mechanisms, two dummy variables were created, *Sequential* and *Reciprocal*. The variables *Sequential* and *Reciprocal* are intended to capture the quality of the task interdependence between parties participating in the collaboration. *Sequential* is set to one if tasks between the parties are organized one after the other, such as where one party performs a task and then hands off the output to the other party, while *Reciprocal* is set to one if the interactions between the parties are more interwoven, such as where there is a consistent and fairly seamless back-and-forth between the parties as they progress through the collaboration.[258] Task interdependencies were coded by analyzing portions of the contracts such as research plans and statements of work.[259] The hypothesis is that reciprocal task structures, which require more interaction between the partners' employees, will raise coordination costs, and so they will correlate positively with governance committee incidence; sequential task structures will correlate negatively, since clearer task partitioning reduces coordination costs.

Hypothesis 2(a): Reciprocal task structures will correlate positively with committee incidence.

Hypothesis 2(b): Sequential task structures will correlate negatively with committee incidence.

c. Opportunism variables

Finally, to gauge the role opportunism problems may play, five unique dummy variables were created. The first two variables, *Multistage* and *Discrete Project*, attempt to capture the level of uncertainty in the collaboration.[260] *Multistage* is set to one if the agreement contemplates more than one stage of the project, which presumably increases uncertainty. Because uncertainty is presumably higher and more continuous in multistage projects, the

258. Reuer & Devarakonda, *supra* note 208 (manuscript at 23) (coding agreements' task interdependencies as sequential, reciprocal, or pooled). If a collaboration is set to zero on both the *Sequential* and *Reciprocal* variables, the task interdependence between parties is deemed to be pooled.

259. Public versions of alliance contracts are often redacted, which required some reading between the lines to make this call. But the structure of the parties' obligations typically allowed for ready interpretation.

260. These variables are more precise measures of uncertainty than other potential proxies such as the duration of a collaboration or the size of the transaction. With respect to the former, the duration of the agreements was often redacted, limiting visibility on the effect long-term dealings had. With respect to the latter, deal value was also often redacted, although all of these can be presumed to be major transactions since they were filed as material contracts with the SEC.

hypothesized correlation between multistage projects and committee incidence is positive.

Hypothesis 3(a): Multistage projects will correlate positively with committee incidence.

Discrete Project is set to one if the agreement sets forth a defined project with a limited scope. This variable is meant to test Gilson et al.'s assertion that variance in governance design is attributable to how discrete the collaborative project is meant to be: open-ended agreements will use mechanisms such as consensus-based governance committees, while more discrete projects will not. This variable differs from *Multistage* above with respect to goal definition. For example, a collaboration may have discrete goals, such as the realization of certain delineated products, but also anticipate a number of development stages, including research, testing, manufacturing, and marketing. On the other hand, a project encompassing only a single stage, such as R&D, can still be quite diffuse, with open-ended goals that are only loosely defined. Consistent with Gilson et al.'s argument, the relationship between project discreteness and committee incidence is negative.

Hypothesis 3(b): Project discreteness will correlate negatively with committee incidence.

The third variable, *Exclusive License*, attempts to hone in more closely on holdup risk. *Exclusive License* is set to one if either of the parties grant a license to background IP on an exclusive basis to its counterparty, which presumably raises the risk of holdup since the licensor cannot readily transact with another partner with respect to the licensed asset should the collaboration go sour. Exclusive licensing is therefore hypothesized to correlate positively with committee use.

Hypothesis 3(c): Exclusive license to background IP will correlate positively with committee incidence.

The fourth and fifth variables, *Convenience Termination* and *Efforts*, test whether alternative contractual solutions to holdup problems operate as substitutes for consensus-based committees. *Convenience Termination* is set to one if at least one of the parties is able to terminate the collaboration without cause. If a provision allowing termination for convenience is included in the agreement, then it may act as a substitute in this respect to committee governance. *Efforts* is set to one if the parties' development performances are subject to an efforts obligation. Obliging parties to abide an efforts standard may also act as a substitute for committee governance in addressing holdup

problems. Because both are presumed to be substitutes, the hypothesized correlation between each variable and committee use is negative.

Hypothesis 3(d): Termination for convenience provisions will correlate negatively with committee incidence.

Hypothesis 3(e): Efforts obligations will correlate negatively with committee incidence.

d. Control variables

To capture other factors that may be associated with governance committee design, several dummy control variables were created. The first, *Milestone Schedule*, relates to how the collaboration is financed.[261] Use of a milestone-payment, or earnout, mechanism may conversely expose both of the parties to ex post haggling over whether milestone requirements were met. We might therefore expect the incidence of these financing arrangements to correlate positively with governance committee use. The second control variable is *Equity*, which is set to one if the collaboration also included an acquisition of an ownership interest. Whether shares were acquired in conjunction with a transaction was determined by searching collaborators' contemporaneous Form 13Ds and Form 13Gs, and analyzing the contracts themselves for reference to a share acquisition.[262] Finally, the analysis controlled for cross-border deals using the dummy variable *Cross Border*, and for time effects using the continuous variable *Date*.

One variable that this study did not control for is reputation effects or prior relationships. These indicators of reputation effects or repeated games were left out in order to test braided contracting theory, which presumes that preexisting informal constraints are sometimes inefficacious,[263] on its own terms. An important task for future research, of course, is to further test the validity of that assumption. Furthermore, if social norms and other informal mechanisms do shape alliance design, even if subtly and unevenly across transactions, as they may well do, they may interact with each of the multiple exchange hazards introduced above in different ways. For example, an informal routine by which know-how is transmitted throughout a project

261. *See generally* Josh Lerner & Robert P. Merges, *The Control of Technology Alliances: An Empirical Analysis of the Biotechnology Industry*, 46 J. INDUS. ECON. 125, 134-35, 153 (1998) (describing milestone financing and its determinants).

262. If acquirers failed to file a Form 13D or 13G, or if less than the threshold amount of shares required for a 13D or 13G filing was acquired, then the incidence of equity acquisitions may be underreported.

263. *See* Gilson et al., *Braiding*, *supra* note 34, at 1399-1403.

team, thereby reducing entropy costs, may also police opportunism.[264] But informal routines may also exacerbate spillover concerns as employees from each party interact. Conversely, measures designed to address opportunism or spillovers may inadvertently interfere with informal mechanisms for coordinating innovation processes. Introducing the possibility of informal constraints thus inserts a significant level of complexity, which is premature given the state of the current scholarship and is best addressed in subsequent work.

e. Methods

The analysis reported below estimates the use of consensus-based committees as a function of the independent and control variables outlined above. Since the dependent variable is dichotomous, a logit model was used to test the hypotheses. Similar results, not reported here, were also obtained using a probit model.

3. Results

Table 3 below presents the summary statistics and correlations for all variables except *Date*. Perhaps most striking is the diversity in how agreements are designed. No variable occurs universally across agreements. The most prevalent is project discreteness, with 92% of the contracts sampled having discrete project definitions. Other than that, the summary statistics are more mixed. For example, over 50% of the collaborations established governance committees, approximately 66% of collaborations provided for joint ownership of foreground IP, over 50% of collaborations were multistage projects, approximately 75% of collaborations were either sequentially or reciprocally task interdependent, nearly 70% had efforts obligations, nearly 50% included earnouts, and almost 40% of the deals were cross-border transactions.

Many of the correlations are as expected, although there are a number of surprising results. As we would expect, the correlations between the use of a governance committee and jointly owned intellectual property (Hypothesis 1(a)), industry type (Hypothesis 1(c)), multistage projects (Hypothesis 3(a)), and exclusive licensing (Hypothesis 3(c)) are positive and significant. Notably, however, the relationships between governance committee use and a number of variables were not as expected. Noncompete provisions (Hypothesis 1(b)) and reciprocal task interdependencies (Hypothesis 2(a)) were hypothesized to correlate positively to committee use but were found to have a negative relationship. And efforts obligations

264. *See* Sabel, *Learning by Monitoring*, *supra* note 199, at 138-39 (arguing that routines supporting joint learning may also monitor opportunism).

(Hypothesis 3(e)) were hypothesized to have a negative relationship with committee use, but the results indicate a positive correlation.

Table 3
Descriptive Statistics and Correlations

Variables	1	2	3	4	5	6	7	8	9
1. Governance Committee	1								
2. Discrete Project	0.162	1							
3. Multistage	0.368**	0.021	1						
4. Efforts	0.131	0.016	-0.029	1					
5. Exclusive License	0.255**	0.110	0.231**	0.132	1				
6. Convenience Termination	0.135	0.192*	0.169*	0.057	0.197*	1			
7. Joint IP	0.421**	0.296**	0.296**	0.122	0.180*	0.103	1		
8. Noncompete	-0.044	0.140	0.140	-0.028	-0.063	-0.043	-0.078	1	
9. Life Sciences	0.525**	0.334**	0.334**	0.226**	0.493**	0.348**	0.325**	-0.205*	1
10. Semiconductors	-0.339**	-0.239**	-0.239**	-0.101	-0.372**	-0.239**	0.003	0.028	-0.504**
11. Enterprise Software	-0.387**	-0.123	-0.123	-0.144	-0.370**	-0.176*	-0.338**	0.278**	-0.540**
12. Chemicals	0.220**	-0.202*	-0.089	-0.035	0.158	-0.077	-0.013	-0.122	-0.141
13. Sequential	0.878**	0.133	0.352**	0.089	0.252**	0.164*	0.385**	-0.064	0.533**
14. Reciprocal	-0.210	0.029	0.033	0.082	-0.272**	-0.032	0.074	0.069	-0.208*
15. Upfront Payment	0.129	0.114	0.022	0.081	0.178*	0.411**	0.131	-0.072	0.338**
16. Milestone Schedule	0.221**	0.241**	-0.840	0.234**	0.314**	0.274**	0.227**	-0.024	0.491**
17. Equity	0.039	0.061	-0.049	0.044	0.079	-0.082	0.029	-0.108	-0.014
18. Cross Border	0.150	-0.016	0.156	-0.044	0.238**	0.068	0.153	-0.004	0.243**
Mean	0.52	0.92	0.53	0.69	0.43	0.4	0.66	0.34	0.36
Standard Deviation	0.501	0.276	0.501	0.463	0.497	0.491	0.474	0.474	0.483
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
n	146	146	146	146	146	146	146	146	146

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Variables	10	11	12	13	14	15	16	17	18
1. Governance Committee									
2. Discrete Project									
3. Multistage									
4. Efforts									
5. Exclusive License									
6. Convenience Termination									
7. Joint IP									
8. Noncompete									
9. Life Sciences									
10. Semiconductors	1								
11. Enterprise Software	0.020	1							
12. Chemicals	-0.297**	-0.230**	1						
13. Sequential	0.285**	-0.384**	0.196*	1					
14. Reciprocal	-0.201*	0.004	-0.132	-0.056	1				
15. Upfront Payment	-0.145	-0.150	-0.106	0.097	-0.142	1			
16. Milestone Schedule	-0.145	-0.364**	-0.054	0.293**	-0.156	0.273**	1		
17. Equity	-0.126	-0.053	0.371**	0.009	-0.127	0.073	0.068	1	
18. Cross Border	0.044	-0.312**	-0.028	0.180*	-0.164*	0.057	0.205*	-0.038	1
Mean	0.31	0.36	0.12	0.55	0.21	0.44	0.49	0.16	0.39
Standard Deviation	0.463	0.483	0.322	0.499	0.405	0.498	0.502	0.366	0490
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Maximum	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
n	146	146	146	146	146	146	146	146	146

** Correlation is significant at the 0.01 level (2-tailed).

* Correlation is significant at the 0.05 level (2-tailed).

Table 4 below presents logit regression results. As discussed above, the event of interest is whether an agreement established a consensus-based governance committee. Positive coefficients indicate a greater probability of committee use, and negative coefficients indicate a lower probability of committee use. The results of the logit analysis provide preliminary evidence supporting an inference that spillover and entropy problems, but not opportunism hazards, influence parties' decisions to establish consensus-based committees.

Column (1) presents results for opportunism-related independent variables and controls only. Here we see very strong evidence that multistage projects (Hypothesis 3(a)) are positively correlated with committee use, and weaker evidence that project discreteness (Hypothesis 3(b)) is also positively correlated. The positive relationship between project discreteness and committee use is surprising because it is the opposite of the relationship hypothesized above—i.e., alliances with discrete project scopes employed governance committees, while alliances with vague scopes did not—just the opposite of how Gilson et al. envision the relationship between discreteness and governance mechanism design. The relationship between exclusivity (Hypothesis 3(c)) and committee use is as anticipated, but the correlation is not statistically significant. No evidence was found supporting an inference that termination for convenience (Hypothesis 3(d)) and efforts provisions (Hypothesis 3(e)) correlated with committee use.

Column (2) presents results for spillover-related and control variables only. Here, the correlations between committee use and jointly owned IP (Hypothesis 1(a)), life sciences deals (Hypothesis 1(c)), and chemicals deals (Hypothesis 1(c)) are all positive, as expected, and highly statistically significant. But no reliable evidence is found for significant correlations between committee use and noncompete provisions (Hypothesis 1(b)), semiconductor deals (Hypothesis 1(c)), or software deals (Hypothesis 1(c)).

Column (3) presents results for entropy-related and control variables only. The results here are unexpected: the relationship between sequential task interdependencies (Hypothesis 2(b)) and committee use is positive and highly significant, but not so for reciprocal task allocations (Hypothesis 2(a)). We see just the opposite relationship than was hypothesized for both Hypotheses 2(a) and 2(b).

Column (4) presents results when all three categories of independent variables are included in the model. Here we observe that project discreteness (Hypothesis 3(b)) remains positively and significantly correlated with committee use, although the strength of the correlation has decreased somewhat. No other opportunism-related variables are significantly correlated with committee use, however. As for the spillover-related variables, joint ownership of foreground IP (Hypothesis 1(a)) remains positively correlated with the use of governance committees, although the strength of the evidence supporting that correlation has diminished. Correlations between committee use and life sciences (Hypothesis 1(c)) and chemicals (Hypothesis 1(c)) are no longer significant. With respect to the entropy-related variables, evidence that sequential task allocation (Hypothesis 2(b)) is positively correlated with committee use is very strong, and there is no significant relationship between reciprocal task structures (Hypothesis 2(a)) and committee use.

Table 4
Results of Logistic Regression Analysis for
Main Effects of Exchange Hazard Type

Independent Variables	Governance Committee			
	(1)	(2)	(3)	(4)
Discrete Project	1.764**			6.523**
	(0.836)			(3.065)
Multistage	1.719***			1.056
	(0.424)			(1.159)
Efforts	0.785*			2.239*
	(0.450)			(1.338)
Exclusive License	0.243			-1.326
	(0.435)			(1.706)
Convenience Termination	-0.205			-1.327
	(0.470)			(1.528)
Joint IP		2.009***		2.642*
		(0.539)		(1.415)
Noncompete		0.947*		1.469
		(0.549)		(1.520)
Life Sciences		4.298***		1.428
		(1.121)		(2.115)
Semiconductors		0.312		-2.967
		(0.764)		(2.181)
Enterprise Software		0.875		-1.556
		(0.857)		(1.834)
Chemicals		3.852***		0.918
		(1.251)		(2.286)
Sequential			6.882***	8.047***
			(1.213)	(2.206)
Reciprocal			1.162	1.074
			(0.961)	(1.368)
Upfront Payment	0.217	-0.312	1.072	0.358
	(0.455)	(0.529)	(0.187)	(1.435)
Milestone Schedule	0.305	-0.671	-1.241	-4.079*
	(0.452)	(0.566)	(0.918)	(2.195)
Equity	0.049	-0.609	1.226	0.250
	(0.554)	(0.698)	(1.204)	(1.551)

Independent Variables	Governance Committee			
	(1)	(2)	(3)	(4)
Cross Border	0.164 (0.428)	0.212 (0.539)	-0.100 (0.779)	0.085 (1.352)
Date	0.000*** (0.000)	0.000 (0.000)	0.000* (0.000)	0.000 (0.000)
Constant	-19.291***	-10.104	-20.626*	-30.455
n	146	146	146	146
Log-Likelihood	155.928	117.714	56.87	34.618
Degrees of Freedom	10	11	7	18
Nagelkerke R-Square	0.362	0.586	0.841	0.911

* $P < 0.10$
** $P < 0.05$
*** $P < 0.01$

Taken together the models present preliminary evidence supporting three conclusions. First, the results suggest that traditional holdup concerns do not motivate collaborators to employ governance committees. Exclusive licensing of background IP, which is probably the most direct measure of holdup risk captured in the model, is not significantly correlated with governance committee use. Efforts obligations correlate positively and significantly with governance committees, meaning that parties employing efforts obligations also use governance committees. If both efforts obligations and governance committees address holdup risk, then parties are using them redundantly. It is possible that such redundancy is intended, in a "belt-and-suspenders" sense, but the more reasonable inference is that governance committees simply address different exchange hazards. Multistage projects are positively correlated with governance committee use, and provisions allowing a party to terminate for convenience are negatively correlated with committee incidence, but neither relationship is statistically significant in the full model. There is strong evidence of the relationship between project discreteness and governance committee use, but that relationship is just the opposite of what was hypothesized—committees are used in situations where uncertainty is more manageable, rather than when uncertainty is comparatively high. Thus, although holdup problems may dog collaborators, governance committees do not appear to be the tool parties use to address them.

Second, the results provide support for the multivalent conception of contracting introduced above. Evidence that jointly owned IP and sequential task interdependencies are consistently, significantly correlated with governance committee use suggests that spillover and entropy problems affect

the decision to use a consensus-based governance committee. Correlation between jointly owned IP and governance committee use makes sense in that the veto rights made available through a consensus-based governance committee provide parties with a means to control, to some extent, the exploitation of jointly owned foreground IP. The finding that sequential but not reciprocal task interdependencies correlate significantly with committee use is more puzzling. Recall that this Article hypothesized that there would be a greater need for a coordination mechanism where collaborators anticipated a dense thicket of reciprocal tasks. But here we see just the opposite: reciprocal task structures do not correlate with governance committee use, while sequential task structures do. Evidence of a positive correlation between sequential but not reciprocal task interdependencies introduces an important potential implication. Namely, committees may not be straightforward coordination mechanisms, but rather may be tools for defining the boundaries of new tasks within a modular system. Committees may be employed to carefully maintain sequencing of tasks between the parties, and to control information flows within a federated codevelopment process.

Third, the results also suggest that a number of relationships are more complicated than initially anticipated, opening new avenues for future research. For example, the correlations in Table 3 and the results in Table 4 reveal interplay between sequential task interdependencies and the *Life Sciences* variable, which has a significant and positive correlation with committee use in Model (2) but not in the complete model.[265] Interestingly, project discreteness is also positively correlated with life sciences deals. It may be that the ability to codify technology into well-defined units acts as a primitive that shapes parties' decisions with respect to both project discreteness and task structuring. Where patent rights are strong, parties carefully define discrete project scopes for a deal and establish clearly articulated sequences of tasks. Both of those mechanisms prevent costly information spillovers. And those governance tools correlate with committees, which are designed to ensure the project remains within scope and to funnel information in a situation where the parties want strict, deliberate controls on interactions between personnel. Thus, the results illuminate a potential interconnection between multiple exchange hazards and governance mechanisms that is obscured without a multivalent framework.

265. Variance inflation factors (VIF) were examined to test for indications of multicollinearity for all variables. The highest VIF value was for *Life Sciences*, which had a value of 4.754, which is well below the critical value of 10 but above the minimum threshold of 3, suggesting that multicollinearity may have a limited effect on the results. The next highest VIF value of 2.584 was for *Enterprise Software*.

C. Revisiting Gilson et al.'s Three Examples

A multivalent approach also explains differences in Gilson et al.'s three case studies. Recall that, as discussed in Part I.C above, Gilson et al. argue that alliance variation is explained by differences in project discreteness: vaguely defined projects introduce high and often continuous uncertainty into collaborations, unlike partnerships with more tightly defined scopes that allow for uncertainty to resolve during the course of the alliance.[266] As discussed at the end of Part I.C, scrutiny of their examples clouds that argument. And the broader survey of alliance agreements presented in Part II.B also does not support that argument. Project discreteness is often consistent across agreements, and yet variation occurs.

However, the differences in Gilson et al.'s three agreements do readily map onto the multivalent framework outlined above. For instance, the Ligand/Warner-Lambert contract establishes a committee bound by unanimity rules, similar to the other life sciences agreements examined in the sample above.[267] Like many of the other agreements discussed above, the Ligand/Warner-Lambert Agreement also provides for the joint ownership of foreground IP.[268] The Agreement also sequences tasks between the parties, assigning certain development tasks to each party and determining which party owned the associated know-how.[269] In those respects, the Ligand/ Warner-Lambert Agreement is consistent with the argument that the veto rights provided by such committees are tools for addressing spillover and entropy problems, which appear to be major concerns in the Agreement.[270] Such committees are absent in the Apple/SCI and Deere/Stanadyne contracts, consistent with the results presented above.[271] That outcome is consistent with those contracts' more reciprocal task structures (e.g., colocated employees), with their industry types, and with their less fully developed intellectual property ownership provisions.

The multivalent approach thus provides an alternative explanation of the governance mechanisms at the core of Gilson et al.'s theory. Alliance contracts are designed to respond simultaneously to a confluence of exchange hazards, not solely to foster informal constraints. The multivalent approach is not only a more accurate understanding of alliance contract design, but also a richer theoretical toolkit.

---

266. *See supra* note 146 and accompanying text.

267. Ligand/Warner-Lambert Agreement, *supra* note 142, at 13-14.

268. *See id.* at 25-26.

269. *See id.* at 9-10, 15-16.

270. These concerns are inferred from the task structure and intellectual property provisions included in the contract. *See supra* notes 268-69 and accompanying text.

271. *See supra* Part III.B.4.

D. Summary and Theoretical Implications

Part II asked the question whether a more accurate theory of alliance design is possible. As a tentative answer, the multivalent approach outlined in that Part presents an alternative framework, based on scholarship arguing that economic organization turns on multiple types of transaction costs. The key insight of this multivalent approach is that the relationship between governance mechanisms is contingent. Whether governance mechanisms are substitutes or complements depends upon the full array of exchange hazards affecting a transaction. As the intensity of those hazards fluctuates between transactions, parties are faced with different tradeoffs, leading to the diversity of governance strategies we observe in practice. To illustrate, Part III undertook a modest empirical study of what factors affect the use of consensus-based governance committees in strategic alliance contracts. The preliminary results suggest that spillover and entropy concerns, but not holdup problems, animate the use of such committees. Committees appear to be used to give parties veto rights to stem information leakage and to create the asset boundaries of foreground IP, but only in situations where spillover and entropy costs outweigh the holdup risks unanimity poses. Thus, this approach appears to fill some of the conspicuous gaps in braided governance theory identified at the end of Part I: the diversity of committee use is explained, and the role of uncertain intellectual property and veto rights are incorporated in that answer.

This multivalent framework provides more detailed foundations for approaching the difficult question of what leads to fragility in innovation networks. Recent research in economic sociology, which has pioneered the study of collaboration by conceptualizing the innovation network as a distinct mode of economic organization,[272] has begun directly addressing the question of what leads to alliance underperformance and failure. For instance, Schrank and Whitford have created a taxonomy of absolute network failures and relative network underperformance, and they root the differences between different forms of network dysfunction in the different types of exchange problems collaborators face.[273] This Article's analysis contributes to that

272. This research has its origins in Powell's argument that networks were not simply located on Williamson's market-hierarchy continuum, but were an altogether separate phenomenon. Walter W. Powell, *Neither Market nor Hierarchy: Network Forms of Organization*, *in* 12 RESEARCH IN ORGANIZATIONAL BEHAVIOR 295, 296-99 (Barry M. Staw & L.L. Cummings eds., 1990); *see also* Joel M. Podolny & Karen L. Page, *Network Forms of Organization*, 24 ANN. REV. SOC. 57, 58-59 (1998); Joel M. Podolny, *Networks as the Pipes and Prisms of the Market*, 107 AM. J. SOC. 33, 34-36 (2001); Laurel Smith-Doerr & Walter W. Powell, *Networks and Economic Life*, *in* THE HANDBOOK OF ECONOMIC SOCIOLOGY 379, 379 (Neil J. Smelser & Richard Swedberg eds., 2d ed. 2005).

273. Andrew Schrank & Josh Whitford, *The Anatomy of Network Failure*, 29 SOC. THEORY 151, 153-54 (2011) (differentiating between the problems of opportunism and incompetence).

scholarship by illuminating the foundations—the actual contractual governance mechanisms—of innovation networks, which are often assumed but unexamined.[274] Exploring those foundations allows us to begin building a theory of how the bilateral contracts underpinning a network affect the pathologies research identifies.

Where does this preliminary analysis leave braided contracting theory? On one hand, this analysis unsettles braiding theory by suggesting that some unique formal contract provisions are not tools for fostering informal constraints but are rather direct responses to overlooked forms of transaction costs. On the other hand, this analysis does not necessarily refuse a place for informal contracting—it simply suggests that a more nuanced theory is required to understand how informal norms fit into a highly complex contracting landscape. In that respect, it presents a potential path for braiding theory's continuing evolution.

One implication of the multivalent approach is that the basic framing of the substitutionary-versus-complementary debate over the formal/informal interface is misguided. Governance strategy does not boil down to a binary choice between formal and informal. Rather, the institutional network supporting collaboration is much broader. The debate should be reframed to address how parties navigate the fluid relationship between *formal* governance mechanisms before the question of informal governance is even broached.

When we consider informality in this more complicated institutional landscape, what we will likely find is that informal constraints continue to play a role. But it may not be the singularly focused role of preventing opportunism as envisioned in some scholarship. Multivalence will provide a framework for asking whether social norms affect not only opportunism problems, but also other types of exchange hazards. We might find that the social norms preventing holdup also facilitate interorganizational learning. And so the potential for tradeoffs and complementarities intimated in the analysis above may play out in similar fashion on the informal side of the institutional equation.

IV. Reframing Enforcement Policy

The discussion in Parts II and III suggests that, rather than fostering informal constraints to address holdup threats, formal contract provisions in alliance contracts appear to respond directly to other types of transaction costs. That analysis has implications for normative debates regarding the proper scope of court intervention in disputes between collaborators.

274. *See, e.g.*, Gary Gereffi et al., *The Governance of Global Value Chains*, 12 REV. INT'L POL. ECON. 78, 84-87 (2005) (providing a theory of network structure without exploring the implications of contractual governance mechanisms).

The analysis above suggests that Gilson et al.'s call for minimalistic court intervention may be misguided because the empirical basis for their analysis is called into question. That analysis also provides an alternative reading of the cases cited in support of minimalist enforcement policy. But a maximalist intervention policy—such as a contextualist mode of interpretation—is not necessarily the answer.[275] Rather, a careful reading of the case law through a multivalent lens reveals a far more interesting institutional dynamic. Consistent with an environment where contracts respond to multiple types of exchange hazards, disputes between collaborators are equally multidimensional. A variety of doctrines—not just contract but also property, antitrust, and tort—are potentially implicated. This is evidenced not only in the case law prior commentators have used to support minimalistic enforcement but also in the unique dispute resolution systems often incorporated in collaborative innovation agreements. From this perspective, the question is not whether tribunals should modestly or aggressively intervene in collaboration disputes, but rather how a tribunal should balance a variety of available legal levers.

The discussion in this Part proceeds as follows. First, Gilson et al.'s argument for low-powered sanctions in disputes between collaborators, upon which they base on their braided theory of contracting, is reviewed. Second, this analysis attempts to show that *Eli Lilly & Co. v. Emisphere Technologies, Inc.*,[276] the leading case in their theory, does not necessarily support their low-powered sanctions argument. Third, the dispute resolution systems collaborators construct, which mirror a multidimensional conception of innovation problems by shunting disputes to different tribunals based on the underlying substance of the claims, are described in further detail.

A. Braided Governance in the Courts: The Argument for Low-Powered Sanctions

Braided contracting is largely a self-enforcement theory of contract. Court enforcement is presumed to have limited efficacy, and the focus of much of the analysis is on how parties can solve their own problems without recourse to the courts.[277] For example, in Gilson et al.'s model, the braiding mechanisms are designed to render information observable between the parties; they are

275. For an overview of the formalism versus contextualism debate, see Robert E. Scott, *Text Versus Context: The Failure of the Unitary Law of Contract Interpretation*, *in* THE AMERICAN ILLNESS: ESSAYS ON THE RULE OF LAW 312, 312-17 (F.H. Buckley ed., 2013).

276. 408 F. Supp. 2d 668 (S.D. Ind. 2006).

277. For example, Bozovic and Hadfield's "scaffolding" model presumes that formal enforcement is unnecessary for formal contract terms to play a role; rather, contract doctrine plays a referential role, used by the parties but not applied by a court. Bozovic & Hadfield, *supra* note 108, at 7.

not means for facilitating verification by an enforcement tribunal. On this view, courts only play a role by enforcing the information-exchange regime, not taking the next step of vindicating parties' expectations.[278] To do so, Gilson et al. argue, courts should take a minimalistic, or "low-powered," approach when called upon to enforce contracts governing collaborative innovation.[279] In practice, this means disciplining blatant breaches of information-exchange obligations with damages limited to reliance costs.[280] Because it is difficult for a court to assess parties' performances in an environment of continuous uncertainty, where parties' intentions are inchoate and subject to revision,[281] determining what qualifies as success or failure per the terms of the contract and, in turn, an aggrieved party's expectations will be difficult.[282] "Verifiability" is an acute problem.[283] Thus, Gilson et al. recast neoformalist arguments for minimalist contract enforcement as a tool for protecting the braided governance mechanism.[284]

Gilson et al. point to a case involving a pharmaceutical collaboration, *Eli Lilly*,[285] as their central example of a court adopting their prescribed approach.[286] In that case, a dispute arose when Emisphere learned that Eli Lilly

278. Gilson et al., *Braiding*, *supra* note 34, at 1415-16.

279. *Id.*

280. *Id.* at 1416.

281. Gilson et al., *Contracting for Innovation*, *supra* note 34, at 448-49.

282. *Id.* at 455-57.

283. *See supra* text accompanying note 81 (discussing the technical concept of verifiability).

284. For a concise statement of the neoformalist position, see Scott, *supra* note 106, at 851-52, 851 n.11.

285. Eli Lilly & Co. v. Emisphere Techs., Inc., 408 F. Supp. 2d 668 (S.D. Ind. 2006).

286. Gilson et al. also point to a second matter, the Federal Trade Commission's consent decree with Intel regarding conduct with respect to customers who use Intel's platform technology. Gilson et al., *Braiding*, *supra* note 34, at 1419-21. Here, this matter is not explored to the same extent as *Eli Lilly* for two reasons. First, it is not clear that the case involved braided contracting. In parallel litigation between Intel and Intergraph, one of the participants in the platform, it appears that their relationship was governed by only a nondisclosure agreement and a letter agreement indicating that Intergraph would be a strategic customer participating in the program. Intergraph Corp. v. Intel Corp., 195 F.3d 1346, 1366 (Fed. Cir. 1999). So it is not clear that the braiding mechanisms Gilson et al. focus upon even existed. Second, and most obviously, this is an antitrust matter, not a contract case. The different conceptual foundations, purposes, and remedial options available in an antitrust matter complicate the application of this example in the contract context. The analysis of whether competition has been harmed through a refusal to deal is different from whether a contractual commitment has been broken. This is not to say that antitrust laws are an inappropriate framework for governing disputes between collaborators. *See* Yane Svetiev, *Antitrust Governance: The New Wave of Antitrust*, 38 LOY. U. CHI. L.J. 593, 632-34 (2007) (exploring antitrust institutions as a tool for governing collaborative innovation). Rather, the point is that one cannot simply assume that the logics and incentives of one regime seamlessly map upon another.

had set up a parallel team researching compounds that overlapped with the collaboration's targets, and was providing confidential information obtained through the collaboration to that secret team.[287] After Emisphere invoked the agreement's dispute resolution provision, Eli Lilly responded with a complaint in the Federal District Court for the Southern District of Indiana for a declaratory judgment that it had not breached its collaboration agreement with Emisphere and sought to enjoin Emisphere from terminating the agreement.[288] Emisphere counterclaimed for patent infringement and for breach of contract, and in the meantime it terminated the agreement in order to pursue a collaboration with Novartis.[289]

The court found that Eli Lilly breached the collaboration agreement and that Emisphere was entitled to terminate the agreement.[290] In the court's opinion regarding Emisphere's breach of contract counterclaims, Gilson et al. find the indicia of a low-powered enforcement approach. They point to the court's holding that Eli Lilly breached an implied covenant not to use the information gained through its relationship with Emisphere outside of the collaboration,[291] and they note that the court expressly recognized that Eli Lilly and Emisphere "entered into a close, collaborative research relationship that required trust and good faith on both sides."[292] On that basis, Gilson et al. argue that the decision is an example of a low-powered sanction: "By sanctioning only 'red-faced' violations of the collaborative agreement, such as the secret research group formed by Eli Lilly outside the informal exchanges created by the agreement itself, the court imposed a low-powered formal sanction: It did not attempt to regulate the nature or course of the collaborative interactions."[293] That low-powered sanction protected the "collaboration protocols established by the parties, and the resulting specific investments in information exchange, [which were] left entirely within the province of the internally generated, informal enforcement mechanism."[294] The court's low-powered enforcement approach only "excluded a (secret) alternative process that undermined the trust that was in fact generated through braiding,"[295]

287. *Eli Lilly*, 408 F. Supp. 2d at 675-76.

288. *Id.* at 671-72.

289. *Id.* at 678 n.2, 680.

290. *Id.* at 697.

291. Gilson et al., *Braiding*, *supra* note 34, at 1417-18.

292. *Id.* at 1417 (quoting *Eli Lilly*, 408 F. Supp. 2d at 697).

293. *Id.* at 1417-18.

294. *Id.* at 1418.

295. *Id.*

rather than pursuing a high-powered remedy such as granting Emisphere damages in accordance with its expectation interest.[296]

B. Reinterpreting the Case Law

Gilson et al.'s call for low-powered sanctions faces two challenges. First, the analysis presented in Parts II and III above complicates their positive theory of contract design. If formal governance mechanisms such as the contract referee system do not braid informal and formal constraints, but rather respond to spillover and entropy problems, then Gilson et al.'s theory of enforcement lacks a necessary predicate. Courts need not take care to protect carefully braided formal/informal governance if there is no braid to maintain.

Second, it is not clear that the key case, *Eli Lilly*, supports the argument that concerns about braided governance should animate courts' enforcement decisions. When read in the broader context of the litigation between Eli Lilly and Emisphere, it is difficult to see how *Eli Lilly* actually reflects a low-powered approach designed to protect the collaboration's information-exchange mechanism.

One difficulty for the minimalist account is the type of relief granted. Four months after its decision on the merits of Emisphere's breach of contract counterclaim, the court issued its opinion with respect to the relief requested.[297] This latter opinion appears to be an instance of high-powered enforcement. In accordance with the collaboration agreement's intellectual property ownership provisions, the court granted Emisphere's request for specific performance and required Eli Lilly to assign the rights to the patents at issue to Emisphere.[298] Thus, Emisphere received one of the things it was expecting from the collaboration: an ownership interest in a promising new compound. According to Gilson et al.'s logic, this award creates incentives to opportunistically game the litigation system, and, in turn, should be considered wrongly decided. In other words, if granting a party's expectation interest is indicative of a high-powered sanction,[299] then it is hard to see how *Eli Lilly* is a case of low-powered sanctioning.

Furthermore, a low-powered sanction, which responds directly to the information-exchange mechanism in Gilson et al.'s theory, was available in the

296. *See* Gilson et al., *Contract and Innovation*, *supra* note 41, at 195 ("High-powered sanctions like expectation damages, which might function to crowd out the informal mechanisms that support performance, should be avoided.").

297. Eli Lilly & Co. v. Emisphere Techs., Inc., No. 1:03-cv-1504-DFH-TAB, 2006 WL 1131786 (S.D. Ind. Apr. 25, 2006).

298. *Id.* at *3.

299. *See* Gilson et al., *Braiding*, *supra* note 34, at 1424; Gilson et al., *Contract and Innovation*, *supra* note 41, at 195; *supra* note 296 and accompanying text.

first decision; yet the court did not employ it. At the end of the second opinion, which addressed Emisphere's breach of contract claims, the court noted that the contract included an escalation procedure that required negotiations between senior management.[300] Emisphere argued that failure to abide by that escalation procedure was a breach of contract.[301] The court could have decided to enforce those dispute resolution mechanisms before deciding other claims, a sanction that would have driven the parties back to the information-exchange mechanism at the heart of the agreement. Instead, the court declined to enforce those provisions, ruling that Emisphere waived such a claim by failing to stay or dismiss the suit on the grounds of the dispute resolution provision.[302] If anything, that would appear to be the low-powered sanction for which Gilson et al. are looking because it would have required the parties to abide by the contract referee mechanism that is central to their theory.

On the other hand, this second opinion in the *Eli Lilly* litigation does appear to support a multivalent framework. The opinion suggests that spillover problems, rather than holdup problems, animated the dispute. When explaining the rationale for granting injunctive relief, the court notes that:

> Without injunctive relief [assigning Emisphere the rights to the patents at issue], Lilly presumably would be in a position to exploit the invention itself and to license the Emisphere technology to others. The result would be that, as a result of Lilly's breach of contract, Emisphere would lose effective control of its proprietary carrier technology. It would be highly unfair to leave Lilly in control of the . . . patent application and to relegate Emisphere to a mere damages remedy as it watches from the sidelines while Lilly controls and exploits inventions the parties agreed would be "Emisphere Technology."[303]

Concerns over the inappropriate exploitation of intellectual property were front and center in the dispute. Analysis of similar disputes between collaborators suggests that such appropriability concerns are often the primary issue in litigation.[304]

Relatedly, *Eli Lilly* is interesting because it involves a multidimensional application of substantive law. The court employed a combination of contract and patent law when resolving the dispute. The court noted that Eli Lilly's

300. Eli Lilly & Co. v. Emisphere Techs., Inc., 408 F. Supp. 2d 668, 696 (S.D. Ind. 2006).

301. *Id.*

302. *Id.*

303. *Eli Lilly*, 2006 WL 1131786, at *2.

304. *See, e.g.*, Onyx Pharm., Inc. v. Bayer Corp., No. C 09-2145 MHP, 2011 WL 7905185, at *4 (N.D. Cal. May 10, 2011); Dow Chem. Can. Inc. v. HRD Corp., 656 F. Supp. 2d 427, 443 n.7, 449 (D. Del. 2009); Synopsys, Inc. v. Magma Design Automation, Inc., No. C-04-3923 MMC, 2007 WL 322353, at *16 (N.D. Cal. Jan. 31, 2007); Synopsys, Inc. v. Magma Design Automation, No. 05-701 (GMS), 2006 U.S. Dist. LEXIS 33751, at *3-4 (D. Del. May 25, 2006).

actions risked not only a patent infringement claim, but also a breach of contract claim, and cited cases where both bodies of law were employed.[305] From this perspective, a focus on contract doctrine captures only one half of the equation, overlooking the question of how to optimize the comparative strengths—and minimize the inevitable tradeoffs—of the applicable doctrines in a way that facilitates exchange. With a variety of doctrines implicated, the choice before the enforcement court is not simply whether it will hew to a more formalist or contextualist mode of contract interpretation, but also how it will efficiently intermix a number of available doctrines.

Notably, it is this balancing between doctrines, rather than an enforcing court's interpretive mode, that has attracted what little commentary there is on this topic. As a number of commentators have noted, the availability of multiple doctrines presents an arbitrage opportunity to parties, who may push certain claims depending on perceived advantages with respect to merits and/or remedies.[306] Tradeoffs arise in the enforcement calculus in disputes that straddle a number of adjacent doctrines, just as they do when drafting an agreement in an environment of pluralistic exchange hazards.

C. Bifurcated Dispute Resolution Systems

Analysis of dispute resolution systems often included in alliance contracts further supports a pluralistic view of enforcement infrastructure. These systems often send different types of disputes to different tribunals, bifurcating or even trifurcating dispute resolution between multiple courts or arbitrators. The organizational boundaries of enforcement courts are used to segregate and cabin innovation problems by type.

Consider the dispute resolution provisions in the 146 sampled agreements analyzed above. These dispute resolution systems often escalate disagreements to higher levels of management by requiring more senior management to become involved when deliberations in subordinate committees become deadlocked, which Gilson et al. have pointed out.[307] But they also often

305. *Eli Lilly*, 408 F. Supp. 2d at 689-91.

306. *See, e.g.*, Omri Ben-Shahar, *Damages for Unlicensed Use*, 78 U. CHI. L. REV. 7, 10 (2011) (discussing the "fuzzy" division between infringement and breach of contract remedies in intellectual-property-related disputes); Phillip B.C. Jones, *Violation of a Patent License Restriction: Breach of Contract or Patent Infringement?*, 33 IDEA 225, 228-29 (1993); Robert P. Merges, *A Transactional View of Property Rights*, 20 BERKELEY TECH. L.J. 1477, 1504-13 (2005) (discussing the tradeoffs involved in bringing either a patent infringement or a breach of contract suit); Maureen A. O'Rourke, *Rethinking Remedies at the Intersection of Intellectual Property and Contract: Toward a Unified Body of Law*, 82 IOWA L. REV. 1137, 1188-89 (1997); Edwin E. Richards, *Drafting Licenses to Guide Whether Potential Disputes Lie in Contract or Infringement*, 7 COMPUTER L. REV. & TECH. J. 45, 51-52 (2002).

307. *See supra* notes 124-26 and accompanying text.

bifurcate dispute resolution on substantive grounds, a phenomenon that has so far been largely overlooked.[308] The distinction made between types of transaction costs above often roughly maps onto the dispute resolution systems established in these collaborations.

The complex dispute resolution system adopted in the GSK/Anacor Agreement provides an intriguing example. As noted above, that contract established an intricate collection of committees to oversee the collaboration.[309] First, a general Joint Research Committee was created, which served as the central governing body. In addition, subcommittees were established: Joint Project Teams to oversee day-to-day progress on their respective projects and a Joint Patent Subcommittee to make decisions regarding inventorship, patent filings, and patent enforcement.[310] All committees were required to make decisions by consensus.[311] In addition to the committee structure, "alliance managers" were also appointed to serve as liaisons between the parties.[312] Those alliance managers could attend committee meetings as nonvoting observers, but they did not participate in the governance of the collaboration themselves.[313] Thus, the parties cabined certain types of exchange hazards within the organizational boundaries of the committee structure—appropriability problems were addressed through the Joint Patent Subcommittee, while coordination problems were addressed through the Joint Project Teams and Alliance Managers.

The agreement established an equally complex dispute resolution process atop that committee structure. Figure 1 below provides an overview of the structure of the dispute resolution system. In Figure 1, disputes are separated into three lanes—those related to intellectual property, contracts, and project management—depending upon the nature of the controversy.[314] Following process-mapping conventions, ovals indicate the origin and terminus of a dispute. Rectangular boxes represent institutions within the internal governance system. Taken as a whole, the dispute resolution system is broken

308. Bifurcated dispute resolution only recently attracted scholarly attention. *See, e.g.*, Christopher R. Drahozal & Erin O'Hara O'Connor, *Unbundling Procedure: Carve-Outs from Arbitration Clauses*, 66 FLA. L. REV. 1945, 1966-69 (2014) (analyzing the use of bifurcated dispute resolution provisions in a variety of agreement types).

309. *See infra* Figure 1.

310. GSK/Anacor Agreement, *supra* note 217, at 26. The Joint Research Committee was also authorized to create additional subcommittees as necessary. *Id.* at 25.

311. *Id.* at 24, 26.

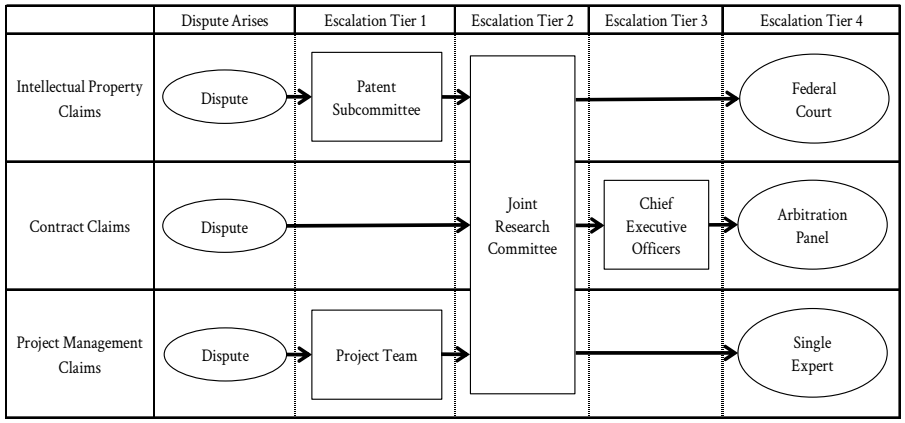
312. *Id.* at 26.

313. *Id.*

314. This segmentation is based upon a reading of the management and dispute resolution provisions in the agreement, which created different resolution processes according to the underlying dispute's type.

down into four escalation phases. Following the emergence of a dispute, matters are escalated to the first tier of dispute resolution institutions—the Patent Subcommittee for intellectual property disputes, or the Project Team for project management claims. If the first-tier institutions are unable to settle the matter, then the intellectual property or project management disputes are escalated to the Joint Research Committee, which is the second-tier resolution institution. Note that, if the initial dispute involves a contract claim—not intellectual property or project management disputes—then the matter skips the first tier of institutions and goes straight to the Joint Research Committee. If the Joint Research Committee is unable to resolve the dispute, then the matter may be escalated to the third-tier institution, the company CEOs, if it is a contract dispute, or escalated directly to the fourth-tier institutions, in the case of intellectual property or project management problems. Intriguingly, the agreement trifurcates the fourth-tier institutions, dividing the resolution of disputes between federal court, tripartite arbitration, and single-expert arbitration.

Figure 1
GSK/Anacor Dispute Resolution System



Thus, depending upon the substance of the disagreement, a dispute could be escalated to a different combination of internal dispute resolution institutions and then to one of three different external tribunals. When designing this dispute resolution system, GSK and Anacor did not make the traditional either/or choice between arbitration and public courts; rather, they cobbled together a collection of enforcement institutions and tailored their respective remits according to the type of issue in dispute. Appropriability

claims, typically sounding in patent law, were sent to federal district court.[315] Coordination problems at the Joint Research Committee level were adjudicated on an expedited basis by a single expert arbitrator,[316] while opportunism claims, such as whether or not a "Diligence Failure Event" had occurred, and all other claims sounding in contract were sent to tripartite arbitration under American Arbitration Association rules.[317] Separating adjudication in such a fashion was likely an attempt to ensure injunctive relief was readily available to address spillover issues, and to leverage court and arbitrator expertise.

Establishing a constellation of enforcement institutions appears to be a common strategy among collaborations. Table 5 below reports the number of agreements in the sample of 146 contracts analyzed in Part II above that include (1) arbitration provisions and (2) provisions bifurcating dispute resolution, typically by carving out intellectual-property-related disputes from arbitration clauses for resolution in federal district court. The use of arbitration provisions is high compared to other commercial contracts, with nearly 55% of the total sample including an arbitration provision.[318] The incidence of arbitration provisions in life sciences collaborations is even higher, with nearly 70% of the agreements choosing arbitration, while arbitration in software agreements is markedly lower, with about 28% of contracts including an arbitration provision. Looking only at agreements that included an arbitration provision, the majority bifurcate dispute resolution, sending some types of disputes to an arbitration panel and other types to federal court. This suggests that segmenting dispute resolution according to exchange hazard type, as in the GSK/Anacor example, may not be an isolated occurrence.

315. GSK/Anacor Agreement, *supra* note 217, at 74.

316. *Id.* at 28.

317. *Id.* at 19, 73-74.

318. Theodore Eisenberg & Geoffrey P. Miller, *The Flight from Arbitration: An Empirical Study of Ex Ante Arbitration Clauses in the Contracts of Publicly Held Companies*, 56 DEPAUL L. REV. 335, 335 (2007) (reporting that only about 11% of their total sample, which included a wide variety of agreement types, had an arbitration clause).

Table 5
Incidence of Arbitration Provisions and
Bifurcated Dispute Resolution Systems by Industry

Industry	Contracts' Dispute Resolution Provisions	
	Arbitration	Bifurcated System
Life Sciences	37 69.81%* 	22 41.51%* 59.46%**
Semiconductors	19 41.30%* 	9 19.57%* 47.37%**
Enterprise Software	15 28.30%* 	13 24.53%* 86.67%**
Chemicals	9 52.94%* 	6 35.29%* 66.67%**
Total	80 54.79%* 	50 34.25%* 62.50%**

* Percentage calculated using total sample of 146 agreements as denominator.

** Percentage calculated using number of agreements per industry with arbitration provisions as denominator.

Conclusion

This Article is an effort to both consolidate and reframe the debate regarding the legal infrastructure of collaborative innovation. It analyzes both the relevant privately ordered institutions (the contracts structuring alliance transactions) and the public institutions (the tribunals called upon to resolve disputes). Illuminating the connection between the contracts and the enforcement infrastructure provides a path for further research on both sets of institutions.

This Article's underlying theme is that collaborative innovation is more complicated than one would expect. To provide a means for navigating that complexity, it proposes a framework built around the notion that the transaction cost concept can be subdivided into a variety of discrete exchange hazards. The resulting multidimensional conception of the challenges collaborators face is useful because it allows us to see the potential tradeoffs and complementarities parties face when choosing governance mechanisms.

Contracts are multivalent—responding to a variety of hazards simultaneously—and the diversity we observe in governance strategies appears driven by differing intensities among exchange hazards from collaboration to collaboration.

Multivalence also helps to explain the role of court intervention by recasting the normative debate from a narrow focus on contract doctrine to a systemic approach that asks how a multitude of available doctrines can be used to support collaboration. Traditional relational contract scholarship has viewed the legal infrastructure supporting exchange as a closed system: the tools available for responding to opportunism problems are found in the doctrine of contract. Enforcement problems are understood through the lens of interpretation, with the old formalist versus contextualist debate staking out the alternatives.[319] But the analysis above suggests that contract law is only one node in a broader enforcement network. In other words, the legal infrastructure supporting collaboration is an open system, and the key normative project for legal scholars is to understand it in those terms.

In advocating for a more nuanced approach to contract design that explores agreements at a deeper level of complexity, this Article echoes Brian Quinn's call for circumspection in transactional research.[320] Alliance agreements, like most commercial contracts, are complicated; and simple, if elegant, theories cannot always capture them with fidelity. Studying transaction design is a project borne of necessity. A more nuanced approach is needed because highly stylized theories of contract design are not a luxury that courts and counsel can afford. For academic research to have real policy traction, it must contend with the full complexity of commercial reality. Legal academics are uniquely situated to perform this theoretical work: proximity to the private bar gives a comparative advantage with respect to the details of commercial contracting behavior, and it suggests the possibility of fruitful collaborations with colleagues in other parts of the academy.

Two potential implications arise from this Article for the broader population of complex contracts other than alliance agreements. First, multivalence may be a promising approach for tackling relational contracts more generally. Grappling with multidimensional exchange hazards in relational contracts is a way to revisit Macneil's original understanding of the problem. In Macneil's theory, multiplicity is primarily conceived in terms of interactions between actors or institutions. Relational exchange occurs within a "social matrix" of transacting parties, social norms, and institutions, like a pebble creating ever-increasing concentric rings when falling into a pond.[321]

319. *See supra* note 275.

320. Quinn, *supra* note 51, at 165 (suggesting "modesty in claims made of those of us who study transactional law").

321. *See* Ian R. Macneil, *Relational Contract Theory: Challenges and Queries*, 94 NW. U. L. REV. 877, 884 (2000).

The appropriate approach to resolving contract disputes, it follows, is to zoom out from the immediate transaction to consider "all significant relational elements."[322] Macneil likens contractual dispute resolution to Chayes's theory of public law litigation,[323] outlining a form of adjudication sprawling and searching by nature—open in scope, with a nonbilateral party structure, pursuing a predictive fact inquiry, and involving active judicial administration following an award.[324]

The challenge of that view has been how to imbue it with normative content. How is a judge adjudicating a contract dispute to know when she has zoomed out enough on the relationship to capture *all* of the relationship's *significant* elements? Macneil provides little guidance on how to prioritize interactions or otherwise understand the inner workings of relational contracts. Thus, although there may be reason to understand some dispute resolution procedures as mirroring Macneil's vision of contract adjudication qua public law litigation, the general consensus has been that Macneil's primarily descriptive theory has not produced actionable prescriptions—there is, to be blunt, no law of relational contract.[325]

A multivalent view of contractual hazards and responses, rooted in transaction cost economics, may provide a way to render Macneil's theory more tractable. Multivalence acknowledges the complexity Macneil took as fundamental, but it uses transaction cost economics' theoretical apparatus as a means for navigating that complexity. Multivalence acts as a *framework*, in the sense in which Ostrom used the term, to fit separate theories into an overarching construct.[326] Such a framework is not meant to be a simple laundry list of important hazards and governance responses. Rather, the goal is to understand how multiple hazards interact with one another, and how various governance institutions combine in turn.

Second, multivalence may be a way to capture a fairly common phenomenon in a number of areas of law. Navigating multiple transaction costs is a task with which the courts and lawyers are well familiar in other contexts. Such a balancing occurs regularly in corporate law (often understood as a specialized species of contract)[327] where courts differentiate agency costs, policed through the duty of loyalty, from other costs, controlled through the

322. *Id.* at 884-86 (capitalization altered) (italics omitted).

323. *See* Abram Chayes, *The Role of the Judge in Public Law Litigation*, 89 HARV. L. REV. 1281, 1302 (1976).

324. Macneil, *supra* note 47, at 891-92.

325. *See* Eisenberg, *supra* note 57, at 816-17.

326. *See* ELINOR OSTROM, UNDERSTANDING INSTITUTIONAL DIVERSITY 281-88 (2005).

327. *See* John Armour et al., *What Is Corporate Law?*, *in* REINER KRAAKMAN ET AL., THE ANATOMY OF CORPORATE LAW: A COMPARATIVE AND FUNCTIONAL APPROACH 1, 20 (2d ed. 2009) (noting that corporate law can be understood as a species of contract law).

more permissive duty of care.[328] Multivalence may provide a lens not only for better understanding similar problems across discrete doctrines, but also for ultimately combining them into a more coherent framework.

328. *See, e.g.*, *In re* Caremark Int'l Inc. Derivative Litig., 698 A.2d 959, 967 (Del. Ch. 1996) (analyzing directors' duty of care or attention where plaintiff claimed they failed to adequately monitor the corporation and differentiating that claim from an alleged breach of the duty of loyalty).