

RESPONSE

MAPPING SOCIAL TECHNOLOGIES IN THE CULTURAL COMMONS

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This Response sets out my thoughts on a paper by Michael J. Madison, Brett M. Frischmann, and Katherine J. Strandburg, in which they introduce a framework for investigating arrangements for sharing and pooling various intellectual assets. They propose an adjusted version of the approach that Elinor Ostrom and her colleagues developed to study governance mechanisms for commons with natural assets. In this Response, I link the proposed study to a complementary approach that involves the concepts of incomplete knowledge, mental models, and social technologies. Furthermore, I use recent work by the economic historian Joel Mokyr to discuss the role of useful knowledge in economic progress. The discussion of useful knowledge leads to a comparison of physical and social technologies and their interaction in the production of goods and services and also in the creation and operation of social subsystems or social mechanisms. Following work by Douglass North and John Wallis, I separate productive activity into transformation and transaction functions and discuss how the wider social environment affects these functions. I then present a schema for analyzing institutional policy to explain why persuasion—in addition to new rules and methods of enforcement—is an essential instrument of institutional policy. Finally, I discuss the reluctance of modern economics to carefully measure, classify, and analyze the institutional structure of production, and to apply inductive reasoning. The research program planned by Madison, Frischmann, and Strandburg will provide useful knowledge about social technologies employed by the new knowledge industries at an important juncture in our economic and social development.

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III. MAPPING SOCIAL TECHNOLOGIES IN THE CULTURAL
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In my Response to Madison, Frischmann, and Strandburg's interesting and ambitious proposal to measure, record, and analyze the governance system for a broad range of commons that pool intellectual assets (they use the phrase "commons in the cultural environment"¹), I link their proposed theoretical framework to a complementary approach that involves the concepts of mental models and social technologies. As a backdrop for my discussion of social technologies and the proposal of Madison, Frischmann, and Strandburg, I highlight important new works by the economic historian Joel Mokyr.² In these works, Mokyr examines the role of the European Enlightenment in promoting the sudden growth of useful knowledge in the seventeenth century.³ The rising stock of useful knowledge provided a foundation for a steady increase in productivity that manifested itself in England just before the middle of the nineteenth century and eventually produced a sequence of industrial and economic revolutions.⁴ During the last quarter century, this trend has introduced the so-called knowledge industries and increased the importance of intellectual property rights. Although Mokyr is concerned with useful knowledge about natural phenomena rather than social phenomena, I find his conceptualization of various dimensions of knowledge helpful in discussing the Madison, Frischmann, and Strandburg project. I therefore extend Mokyr's classification to include useful knowledge about society—that is, positive and normative theories about social organization. I use his

¹ Michael J. Madison, Brett M. Frischmann & Katherine J. Strandburg, *Constructing Commons in the Cultural Environment*, 95 CORNELL L. REV. 657, 659 (2010). The authors use a modified version of the Institutional Analysis and Development (IAD) framework, which Elinor Ostrom and colleagues have evolved and tested. *See id.* at 675–83.

² *See* Joel Mokyr, *The Intellectual Origins of Modern Economic Growth*, 65 J. ECON. HIST. 285 (2005) [hereinafter Mokyr, *Intellectual Origins*]; Joel Mokyr, Lecture, Max Weber Lecture Series, MWP-LS 2007/06: The European Enlightenment, the Industrial Revolution, and Modern Economic Growth (Mar. 28, 2007) [hereinafter Mokyr, *European Enlightenment*], available at http://cadmus.eui.eu/dspace/bitstream/1814/7631/1/MWP_LS_2007_06.pdf. *See generally* JOEL MOKYR, *THE GIFTS OF ATHENA: HISTORICAL ORIGINS OF THE KNOWLEDGE ECONOMY* 1–77, 218–97 (2002) [hereinafter MOKYR, *GIFTS OF ATHENA*] (explaining Mokyr's definition of the concept of useful knowledge and his general theory on the important role that useful knowledge plays in the history of economic progress).

³ *See* Mokyr, *Intellectual Origins*, *supra* note 2, at 290; Mokyr, *European Enlightenment*, *supra* note 2, at 4–5.

⁴ *See* Mokyr, *European Enlightenment*, *supra* note 2, at 17–18 (explaining that "historians, celebrating the second Industrial Revolution as the central event of economic history . . . need to confront the importance of the precedence of . . . the Enlightenment that made it possible").

distinction between propositional knowledge (also referred to as *what* knowledge) and prescriptive knowledge (known as *how* knowledge).⁵

I refer to prescriptive social knowledge as *social technology*. Social technology is applied knowledge required to set up and maintain social systems or social mechanisms, including commons in the cultural environment. In an uncertain world with limited knowledge, decision makers frequently lack the prescriptive knowledge—the social technology—to set up social mechanisms for generating their desired social outcomes. Moreover, rule makers are often unaware that they lack the necessary knowledge.⁶

Whether we are involved in creating and maintaining social mechanisms or producing goods and services for the market, both undertakings involve two tasks: the physical transformation of inputs into goods and services, and the transfer of property rights from one person to another. The transformation function represents the first task, and the associated costs are transformation costs; the transaction function represents the second task, and the relevant costs are transaction costs.⁷ Attempts to embody advances in physical technology in the production process require appropriate complementary new social technologies. Innovations involving both physical and social technology have been essential for modern economic growth. The last 300 years have seen exponential increases in many branches of useful knowledge. It is virtually impossible to find a scale for comparing advances in the social and natural sciences, but my educated guess is that useful social knowledge has grown at a slower rate than useful natural knowledge. In support of this belief, I can point to several issues, such as failed attempts to set up in poor countries the social organization required for absorbing modern production methods; recurrent, unexpected, and little understood economic and financial crises throughout the world economy; and

⁵ See MOKYR, *GIFTS OF ATHENA*, *supra* note 2, at 4 (describing propositional knowledge as “knowledge . . . about natural phenomena and regularities” and describing prescriptive knowledge as “instructional” knowledge or “technique[]”).

⁶ The disastrous reintroduction of the gold standard (to correct payment imbalances without changing exchange rates) in the interwar period of the twentieth century is a telling example. It is virtually impossible to argue that those who were responsible for reviving the system knew all along that it would fail miserably but believed that they personally would benefit from the failure of the experiment. See generally D.E. Moggridge, *The Gold Standard and National Financial Policies, 1919–39*, in 8 *THE CAMBRIDGE ECONOMIC HISTORY OF EUROPE* 250, 250–314 (Peter Mathias & Sidney Pollard eds., 1989) (explaining the construction and operation of the gold standard during the interwar period).

⁷ I borrow the concept of joint transformation and transaction functions from Douglass C. North & John J. Wallis, *Integrating Institutional Change and Technical Change in Economic History: A Transaction Cost Approach*, 150 *J. INSTITUTIONAL & THEORETICAL ECON.* 609, 609 (1994). North and Wallis do not use the term “social technology.”

uncertainty over what constitutes appropriate intellectual property rights for the new knowledge economy.⁸

I discuss below why social technologies are fundamentally different from physical technologies. I consider why social systems that serve comparable functions differ greatly from one location to another while physical mechanisms do not display comparable diversity. I use an informal schema for analyzing institutional policy to further illustrate these issues.⁹ The Madison, Frischmann, and Strandburg proposal to apply a version of the Institutional Analysis and Development (IAD) framework developed by Elinor Ostrom and her colleagues is (using my terminology) an attempt to map the social technologies of various types of cultural commons. A well-managed project is likely to substantially increase knowledge about the institutional structure of such common-pool regimes. It will also provide knowledge about the outcomes associated with various structures, highlight certain social regularities, and possibly enhance the capacity of policymakers to reform these systems.

The remainder of this Response is divided into three parts. In Part I, I introduce Mokyr's work on the historical evolution of useful knowledge, including a brief summary of his system of classification. In Part II, I extend the Mokyr framework to allow for useful knowledge about social organization—that is, to allow for social knowledge. I compare social and physical technologies and then use a conceptual schema for analyzing institutional policy to further illustrate the complex nature of social technologies. Finally, in Part III, I discuss the potential contribution of the research project proposed by Madison, Frischmann, and Strandburg.

I

USEFUL KNOWLEDGE: NATURE AND SOCIETY

A. Nature

Modern technologies and sustained economic growth span only one thousandth of the approximately 250,000 years that man has lived

⁸ For a discussion of failures in transplanting legal systems from wealthy countries (the United Kingdom, Germany, and France) to less developed countries, see THRÁINN EGGERTSSON, *IMPERFECT INSTITUTIONS: POSSIBILITIES AND LIMITS OF REFORM* 174–90 (2005). For a discussion of the uncertainty and confusion surrounding financial bubbles and bursts throughout the modern era, see CHARLES P. KINDLEBERGER & ROBERT Z. ALIBER, *MANIAS, PANICS AND CRASHES: A HISTORY OF FINANCIAL CRISES* 5 (2005). For an extreme negative view of the current system of intellectual property rights, see Ugo Pagano & Maria Alessandra Rossi, *The Crash of the Knowledge Economy*, 33 *CAMBRIDGE J. ECON.* 665, 666–67 (2009).

⁹ See generally EGGERTSSON, *supra* note 8, at 127–203 (discussing various approaches to institutional policy and how to go about solving institutional problems).

on earth.¹⁰ Sustained economic growth originated about 250 years ago, and in the first 200 years, the growth experience was mostly limited to Western Europe and extensions of Britain overseas.¹¹ The economic rise of the West is perhaps the greatest puzzle in human history, but scientists, despite many attempts, have not yet converged on a shared explanation of the phenomenon.¹² History is apparently more reluctant than nature to reveal its secrets. Yet there is an understanding among economists that cumulative technological change is a necessary condition for sustained long-term growth.¹³ Improvements in social organization and the accumulation of capital can temporarily create spurts of productivity growth, but sooner or later diminishing returns will set in.

In academic economics, at least until recently, the so-called growth theory both recognized and avoided the role of technology in the growth process.¹⁴ Formal growth models, which typically use the letter *A* to represent technology, have assumed arbitrarily that *A* grows at a fixed rate through time. In the last twenty to twenty-five years, a new literature on social institutions has emerged outside the mainstream of economics. This new literature locates the fundamental sources of modern economic growth in political arrangements and other social forces that have provided private investors with secure property rights.¹⁵ The pioneers of the new institutionalism usually do not pay special attention to the evolution of science and technology, which is the focus of Joel Mokyr's recent works setting out to discover the sources of the scientific and technical knowledge that fueled the British Industrial Revolution.¹⁶

Mokyr claims that the European Enlightenment was the source of the Industrial Revolution and the related surge in productivity growth in the United Kingdom, which began between 1830 and 1850.¹⁷ The

¹⁰ See J.K. BRIERLEY, *A NATURAL HISTORY OF MAN* 41 (1970); Douglass C. North, *Economic Performance Through Time*, 84 *AM. ECON. REV.* 359, 365 (1994).

¹¹ See North, *supra* note 10, at 364–65.

¹² See, e.g., MOKYR, *Intellectual Origins*, *supra* note 2, at 287–88 (noting that the choices amount to a “veritable smorgasbord of explanations”).

¹³ See, e.g., Paul M. Romer, *Endogenous Technological Change*, 98 *J. POL. ECON.* S71, S72 (1990).

¹⁴ See EGGERTSSON, *supra* note 8, at 12–16. See generally *id.* at 9–22 (discussing institutions and modern growth theory, including the limited success of so-called endogenous growth theory).

¹⁵ See, e.g., DARON ACEMOGLU & JAMES A. ROBINSON, *ECONOMIC ORIGINS OF DICTATORSHIP AND DEMOCRACY* 287–348 (2006); BRUCE BUENO DE MESQUITA ET AL., *THE LOGIC OF POLITICAL SURVIVAL* 131, 149–61 (2003); AVNER GREIF, *INSTITUTIONS AND THE PATH TO THE MODERN ECONOMY* 388–405 (2006); DOUGLASS C. NORTH, *INSTITUTIONS, INSTITUTIONAL CHANGE AND ECONOMIC PERFORMANCE* 50–52, 107–17, 133–40 (1990).

¹⁶ See MOKYR, *Intellectual Origins*, *supra* note 2, at 288–89; Mokyr, *European Enlightenment*, *supra* note 2, at 4.

¹⁷ See Mokyr, *European Enlightenment*, *supra* note 2, at 17 (discussing the fact that the Enlightenment's effects were felt with increases in productivity and wages after 1830).

argument is intriguing because the Enlightenment was an intellectual movement of the eighteenth century (and, by some accounts, also of the second half of the seventeenth century).¹⁸ The Enlightenment had many facets, but its strong emphasis on useful knowledge was, according to Mokyr, the source of the modern technological revolution.¹⁹

The concept of useful knowledge symbolizes what was at the time a revolutionary ideology—namely, that nature exists for the benefit of mankind, and mankind must work to reveal the secrets of nature and apply the new knowledge to improve its material conditions.²⁰ In the eighteenth century, the fervent search for useful knowledge involved the measurement and classification of natural phenomena, the search for regularities in nature, attempts to discover practical applications, and the embodiment of the practical discoveries in scientific instruments and the means of production.²¹ Initially, the search was a slow process; the stock of useful knowledge expanded at a slow pace. Nevertheless, the tempo gradually picked up, eventually generating sustained and accelerating technical change and a long-term upward trend in productivity²²—but only in a small number of countries.²³ If this view is correct, the digital revolution, the new communication industries, and modern biotechnology are recent points on the exponential curve of technical change that has its origins in the European Enlightenment.

In his recent works, Mokyr limits himself to studying the evolution of useful knowledge about nature and does not explore the history of useful social knowledge.²⁴ I will attempt to extend Mokyr's schema to include useful social knowledge and then compare social and natural knowledge, focusing on the differences between physical and social technologies.

¹⁸ See Mokyr, *Intellectual Origins*, *supra* note 2, at 290.

¹⁹ See *supra* notes 3–4 and accompanying text.

²⁰ See Mokyr, *Intellectual Origins*, *supra* note 2, at 291 (noting the period's pervasive belief that progress came about by "controlling nature," which could be accomplished "by understanding [nature]").

²¹ See *id.* at 289 ("The three 'C's'—counting, classifying, cataloguing—were central to the Baconian program that guided much of the growth of useful knowledge in the century before the Industrial Revolution.").

²² See Mokyr, *European Enlightenment*, *supra* note 2, at 16–18.

²³ In history, rulers have been suspicious of new knowledge because it can challenge their authority and legitimacy. See Mokyr, *Intellectual Origins*, *supra* note 2, at 340–42 (discussing why the European Enlightenment survived opposition from political and religious authorities). See generally MOKYR, *GIFTS OF ATHENA*, *supra* note 2, at 232–52 (explaining the potential motives of different elites and their organizations to reject or accept new technology).

²⁴ See MOKYR, *GIFTS OF ATHENA*, *supra* note 2, at 3 (limiting discussion of useful knowledge to "knowledge of natural phenomena that exclude the human mind and social institutions").

Useful natural knowledge is accumulated during mankind's game against nature and "resides either in people's minds or in storage devices."²⁵ Broadly defined, knowledge includes miscellaneous data (such as measurements of metallic properties and geographic observations) as well as formal and informal theories of pure and applied natural science. Mokyr follows the conventions of distinguishing two types of knowledge: *what* knowledge (or propositional knowledge) and *how* knowledge (or prescriptive knowledge).²⁶ The two concepts correspond approximately (but not fully) to the conventional terms: science and technology.

In tracing the evolution of technology since the eighteenth century, Mokyr emphasizes the interactive relationship between science and technology. In the early phases of the British Industrial Revolution, new techniques often lacked a base in science.²⁷ The artisans or technicians knew only that they could achieve *A* by doing *B*. A broad base in science generally facilitates debugging, adapting, and improving a technique. Moreover, in the early years, new techniques were frequently an important source of scientific discoveries—rather than the other way around. There will always be two-way interactions between applied and pure knowledge, but with time, the dependence of scientific discoveries on prior technical developments has decreased.²⁸ Rapid expansion of pure scientific knowledge in the second half of the nineteenth century and in the twentieth century accelerated technical change. Basic scientific discoveries would typically lead, and technical applications would follow, often with a lag of many decades.²⁹ Some observers believe that during the last quarter of the twentieth century, the science-technology gap in new fields such as microbiology narrowed substantially. The rise of for-profit biogenetics research firms is consistent with this belief.³⁰

²⁵ *Id.* at 4–5; see also Paul A. David & Dominique Foray, *Economic Fundamentals of the Knowledge Society*, 1 POL'Y FUTURES IN EDUC. 20, 25–26 (2003) (discussing how knowledge is best defined and codified).

²⁶ See *supra* note 5 and accompanying text; see also MOKYR, GIFTS OF ATHENA, *supra* note 2, at 4–15 (classifying an addition to propositional knowledge as “a *discovery*, the unearthing of a fact or natural law,” while an addition to prescriptive knowledge is “an *invention*, the creation of a set of instructions that . . . makes it possible to do something hitherto impossible”).

²⁷ See Mokyr, *Intellectual Origins*, *supra* note 2, at 289.

²⁸ See MOKYR, GIFTS OF ATHENA, *supra* note 2, at 19–21.

²⁹ Experts report, for instance, that it took at least a half-century for industry leaders, such as the United States, to take full advantage of electrical power once it became available. See, e.g., Warren D. Devine, Jr., *From Shafts to Wires: Historical Perspective on Electrification*, 43 J. ECON. HIST. 347, 356–57 (1983).

³⁰ See, e.g., Robert P. Merges, *Property Rights Theory and the Commons: The Case of Scientific Research*, in SCIENTIFIC INNOVATION, PHILOSOPHY, AND PUBLIC POLICY 145, 156–57 (Ellen Frankel Paul, Fred D. Miller, Jr. & Jeffrey Paul eds., 1996).

The union of all sets of useful knowledge contains contradictory or inconsistent elements; people disagree in their beliefs about the true nature of various physical and social phenomena. The acceptance of particular elements of knowledge is based on social conventions that determine the criteria and process of verification.³¹

Availability is another critical aspect of knowledge. Whether knowledge is extensively used is directly related to its availability, and availability depends on the cost of access. In turn, the cost of access depends on communication technologies, knowledge-related organizations—such as universities, libraries, and scholarly journals—and, finally, on the control of knowledge through the system of intellectual property rights and informal ownership.³² The control mechanisms, however, also influence incentives for creating new knowledge.³³ The creation of significant new scientific or technical knowledge typically involves high fixed costs, whereas the marginal costs of distributing new knowledge is typically low, often close to zero. Those who invest in new knowledge usually cannot rely on marginal-cost pricing to recover their fixed costs. Maintaining investment in knowledge requires mechanisms other than competitive pricing, such as intellectual property rights, secrecy, and public funding. An optimal social system for generating and applying new knowledge must balance the two conflicting goals: incentives and availability. Richard Posner argues convincingly that rule makers lack the information and the mental capacity to design institutions that optimally balance incentives and availability.³⁴ The optimal solution for the various branches of science and technology is likely to involve different mixtures of public funding, secrecy, property rights, and open access. For instance, the optimal length of patents is probably not the same for all types of inventions. According to Posner, we can do no better than to evaluate the costs and benefits of marginal changes in the relevant institutions.³⁵

Economics recognizes knowledge as a scarce, perishable commodity. Its little-known supply-and-demand functions presumably have the usual positive and negative slopes, respectively. Trade in

³¹ See, e.g., Mokyr, *Intellectual Origins*, *supra* note 2, at 302–03 (noting that during the seventeenth century, the criteria for acceptance of knowledge turned in an “empirical and verifiable direction”).

³² See MOKYR, *GIFTS OF ATHENA*, *supra* note 2, at 7–9.

³³ See, e.g., Richard A. Posner, *Intellectual Property: The Law and Economics Approach*, 19 J. ECON. PERSP. 57, 58–62 (2005).

³⁴ See *id.* at 59–61 (“Unfortunately, economists do not know whether the existing system of intellectual property rights is, or for that matter whether any other system of intellectual property rights would be, a source of net social utility, given the costs of the system and the existence of alternative sources of incentives to create such property.”).

³⁵ See *id.* at 62 (noting that changes to the “legal rules governing intellectual property” might provide results that are “desirable regardless of the optimal term”).

knowledge is a complex affair and specialized institutions are required for supporting it. In the market for knowledge, buyers hesitate when they do not know what they are buying and do not know when they need it.³⁶ Once producers sell their first unit of new knowledge, they face the prospect that the market value of their product may immediately drop to zero.³⁷ Although economics traditionally defines knowledge as a pure public good—that is, a good that can be shared without diminishment and once given cannot be taken away—the real world is more complex. Institutional arrangements often make knowledge an exclusive asset that can be traded, for instance through licensing. Prior to the rise of the patent system, guild members used secrecy to protect their knowledge assets, and secrecy still plays a role the protection of intellectual assets. Even when knowledge is not explicitly protected or kept secret, individuals often must make costly investments before they are able to use particular elements of knowledge. Considerable investment in education is required, for instance, before one can make sense of Albert Einstein's theory of relativity.

One could classify all knowledge as belonging to one of two subsets: coded or tacit. Einstein's relativity theory is coded knowledge—that is, his theory is available in storage devices such as books.³⁸ Knowledge that has not been coded is tacit; it is stored only in individual minds and perishes if the possessors die without passing the knowledge along. In principle, tacit knowledge can be coded and stored outside the human brain, but the decision whether to code is influenced by the available coding technologies and costs, which can be prohibitive. And again, coded knowledge rarely immediately conveys to possessors the originator's relevant skills or capacities, as users of cooking recipes and computer manuals know.³⁹

B. Society

1. *Useful Social Knowledge*

In the modern era, useful knowledge about nature has evolved alongside useful social knowledge—knowledge about the social systems that coordinate human behavior and create structures of incentives and opportunities.⁴⁰ Complementary social organization was a necessary condition for modern technical advances.

³⁶ See, e.g., Kenneth J. Arrow, *Limited Knowledge and Economic Analysis*, 64 AM. ECON. REV. 1, 6–10 (1974).

³⁷ See David & Foray, *supra* note 25, at 38–40.

³⁸ See *id.* at 25–26.

³⁹ *Id.* at 26 (noting that codification does not achieve complete knowledge as “some things almost certainly will be altered, and, quite likely, other meanings will be lost”).

⁴⁰ See North, *supra* note 10, at 359–60.

The social world has a very different origin from the natural world. The natural world is exogenous to mankind. We did not create nature, and although we only partly understand it, its laws constrain our activities and shape our opportunities. We were subject to the laws of gravitation before Newton discovered the nature of these forces. The social world is different: it is man-made. It is entirely the creation of mankind (although many social structures have emerged in a spontaneous unplanned manner). Yet, we live in our own creation—society—without understanding social forces any better, or perhaps understanding them even less, than we understand the principles of nature.⁴¹ Social scientists acquire fame by explaining the nature of existing social systems and mechanisms. Think of the theories of Acemoglu and Robinson about the economic origins of democracy and dictatorship; Keynes's explanation of why markets get stuck in depressions; Ostrom's work on governance of the commons; Coase's discovery of the nature of the firm; or Long's discovery that firms use their patents to credibly signal technological prowess to financiers.⁴² Limited propositional and prescriptive social knowledge has not prevented rule makers from attempting to adjust social structures to create more desirable social outcomes. The long history of legal codes, for instance, testifies to such activities. I refer to applied (how) social knowledge as social technologies and now turn to a discussion of this form of knowledge.

2. *Social Technologies*

Following Mokyr's system of classification, we divide useful social knowledge into *what* and *how* knowledge. In the social domain, *what* knowledge includes normative social theories or models (ethics, religious beliefs), explicit theories of social regularities, and the measurement and classification of social phenomena. Belonging to the last category are anthropological records; various social-science databanks, such as Ostrom's database of arrangements for governing natural resource commons and recent databases containing social, economic, and political data for nations worldwide;⁴³ national income accounts; legal codes; and even Robert's Rules of Order for Fair and Orderly Meetings and Conventions. Knowledge about the structure of cultural commons also belongs in this category. Social technolo-

⁴¹ See *supra* note 8 and accompanying text.

⁴² See ACEMOGLU & ROBINSON, *supra* note 15, at 15–47; JOHN MAYNARD KEYNES, THE GENERAL THEORY OF EMPLOYMENT INTEREST AND MONEY 1–22 (1936); ELINOR OSTROM, GOVERNING THE COMMONS: THE EVOLUTION OF INSTITUTIONS FOR COLLECTIVE ACTION 15–28 (1990); R.H. Coase, *The Nature of the Firm*, 4 *ECONOMICA* 386, 390–98 (1937); Clarisa Long, *Patent Signals*, 69 *U. CHI. L. REV.* 625, 627 (2002).

⁴³ See, e.g., Robert Summers & Alan Heston, *The Penn World Table (Mark 5): An Expanded Set of International Comparisons, 1950–1988*, 106 *Q.J. ECON.* 327, 327 (1991).

gies are a subset of social knowledge and refer to our (presumed) knowledge of how to create particular regularities in collective behavior by setting up social systems or mechanisms. A social technology need not be deeply grounded in social science; it can stand on its own. The interactions back and forth between pure social science and social technologies and how these interactions have evolved over time is a largely unexplored topic. In the natural sciences laboratory, experiments are a critical tool for verifying theories and improving technologies, but in the social sciences laboratory, experiments are rare (except in experimental game theory).⁴⁴ Moreover, in the social sciences, normative social beliefs seem to interfere more with the testing of theories than in the natural sciences. Finally, costly measurement, shortage of data, and perhaps chaotic elements in social systems may interfere with the testing of social theories. In macroeconomics, the title of Edmund Phelps's book *Seven Schools of Macroeconomic Thought* symbolizes the problem of acceptance in social science.⁴⁵

The term social technology does not imply that there is necessarily a mechanical relationship between inputs, social mechanisms, and collective outcomes, or that desired collective outcomes are within the reach of the authorities. The positive theory associated with a social technology may indicate that a political authority can do no more than unleash a social process with uncertain outcomes; that within a relevant time span, the authority is unable to create a particular system and outcomes; or that the best way to approximately reach particular social goals is to introduce self-governance for relevant groups.

Outwardly, social systems, such as systems of property rights, seem to consist of rules and their enforcement mechanisms. Rules and enforcement mechanisms, however, are only a part of the story. Social systems emerge and create behavioral regularities when individuals, motivated by their normative and positive theories and expectations, confront a particular set of rules and enforcement mechanisms.⁴⁶

Moreover, enforcement (organized and spontaneous), which is a necessary feature of social systems, directly links social organization and physical technologies, which erases attempts to cleanly separate applied social and natural knowledge. Enforcement involves monitoring, measurement, enforcement of contracts, direct protection of rights, and punishment. Various physical technologies, such as communication and measurement technologies, can dramatically affect

⁴⁴ See Richard R. Nelson, *What Enables Rapid Economic Progress: What Are the Needed Institutions?*, 37 RES. POL'Y 1, 8–9 (2008) (arguing that the usefulness of experiments for “behavioral and social scientists” is “relatively limited”).

⁴⁵ See EDMUND S. PHELPS, *SEVEN SCHOOLS OF MACROECONOMIC THOUGHT* (1990).

⁴⁶ For a theoretical and empirical discussion of the role of belief systems in economic change, see DOUGLASS C. NORTH, *UNDERSTANDING THE PROCESS OF ECONOMIC CHANGE* (2005).

enforcement costs. The social technology available for creating a particular social mechanism, therefore, depends both on available applied social theories and available physical technologies. The dependency, however, between the two technologies is mutual. The application of physical technologies takes place in a social context. Effective use of advanced physical technologies in industry is conditional on appropriate social structures for quieting the anxiety of investors; protecting natural and cultural resources; and coordinating complex transactions within production units, between such units, and between households and production units.⁴⁷ Yet, the relationship is not entirely symmetric. Social technologies complement and enable physical processes without changing their basic nature; new physical technologies, however, often transform the nature of social systems.

Douglass North and John Wallis attempt to analyze the complex and complementary relationship between physical and social technologies by introducing a production function for an enterprise that separates two activities: transfer (of property rights) and transformation (physical transformation of inputs into output), each with a separate production function.⁴⁸ Both transaction and transformation activities use the usual inputs—land labor, capital, and intermediate goods. New physical technologies can increase the marginal product of inputs used in transaction activities and lower transaction costs.⁴⁹ Similarly, improved organization can increase the marginal product of inputs used in transformation activities and lower transformation costs.

The North-Wallis joint-production function refers to an economic enterprise, but the provision of social mechanisms such as effective systems of courts and law enforcement also involves interactive transfer and transformation activities. Note that physical technology strictly constrains the availability (the choice set) of social systems. A community that relies on very primitive (e.g., stone age) physical technology is only able to implement primitive social mechanisms.⁵⁰ Fi-

⁴⁷ See generally ALFRED D. CHANDLER, JR., *THE VISIBLE HAND: THE MANAGERIAL REVOLUTION IN AMERICAN BUSINESS* 272–80, 287–312 (1977) (vividly describing interactions between physical technologies and organization during the rise of the modern corporation).

⁴⁸ See North & Wallis, *supra* note 7, at 612–13.

⁴⁹ See *id.* at 617–18.

⁵⁰ Cf. Richard A. Posner, *A Theory of Primitive Society, with Special Reference to Law*, 23 J.L. & ECON. 1, 4–5 (1980). A study of primitive societies finds that they rely more heavily on religion to maintain order and provide social goods than on a political authority. See Brooks B. Hull & Frederick Bold, *Hell, Religion, and Cultural Change*, 150 J. INSTITUTIONAL & THEORETICAL ECON. 447, 455 (1994). The least organized societies attempt to maintain order by offering salvation for good behavior and damnation for misbehavior. See *id.* at 450–51. The somewhat better organized communities rely only on one of the two, heaven or hell.

nally, new techniques often impact productivity across various social spheres. The development of wireless telegraphy, a new physical technology, contributed to the rise of the modern corporation but also influenced the productivity of inputs used for law enforcement.

The productivity of the inputs in the North-Wallis joint-production function is related to the social environment in which the production unit is located, and the social environment typically has many organizational layers.⁵¹ Consider the production function of a regular manufacturing firm. Elements in the firm's social environment that are likely to affect its production function include the legal environment, the system of property rights, the degree of arbitrary government behavior, the extent of corruption, the efficiency of public services, and the local culture of cooperation. These external social conditions directly affect the firm's transaction activities (the transfer of property rights) and influence indirectly the productivity of the transformation inputs by interrupting transformation activities. The impact is indirect because transformation processes (the physical transformation of inputs into outputs) reflect the laws of nature and do not vary directly with the character of the social environment of the firm.

If we let ψ represent the social environment of a firm we can write its production function as

$$(1) Y = f_{\psi}(\{A_p, A_s\}; X_p, X_s)$$

In equation (1), A_p stands for physical technologies employed in transformation activities, and A_s represents the social technologies used in transaction activities. A_s includes both methods of organization, and physical technologies employed to operate and enforce particular organizational forms, especially technologies of measurement, monitoring, and enforcement. X_p is a vector of inputs (land, labor, and capital) used in transformation activities, and X_s is a comparable vector of inputs employed in transaction activities.

Consider now an attempt to transfer a new transformation (physical) technology, A_p , representing a manufacturing process from country D (developed) to country L (less-developed), along with the social technologies, A_s , typically used by firms in D to complement the transformation process in question. The transfer of the physical technology is relatively simple. Coding techniques in the natural sciences are advanced, and engineers and technicians with appropriate education can usually understand coded physical techniques without great difficulties. Also, new physical technology is partly embodied in the ma-

⁵¹ See, e.g., North & Wallis, *supra* note 7, at 617–18 (discussing the example of the telephone and how it increased productivity in other industries).

chinery that is imported. If the appropriate technical skills are not available locally, engineers can be imported and local workers trained.

The transfer of A_s is more complicated. First, it appears that we are less adept at coding transaction techniques than transformation techniques. Relative to transformation techniques, transaction techniques are to a lesser extent embodied in equipment. Second, and perhaps more important, is the direct link between ψ , the social environment, and social technologies, A_s . If we attempt to copy A_s in country D and transfer the social mechanisms to L , we are limited to copying rules, forms of organization, and physical measurement, monitoring, and enforcement methods. Social systems, however, emerge when individuals and their beliefs, theories, and expectations encounter a structure of rules and enforcement mechanisms. Moreover, the firm's transaction activities are directly influenced by systems of rules, enforcement, and beliefs associated with ψ_L , L 's wider social systems.

The example above involved the transfer of a new manufacturing process between countries. We can also use equation (1) to analyze attempts to transfer social mechanisms, from D to L , for instance the traffic control system or corporate law. In equation (1), the output, Y , is no longer a manufacturing product but orderly and safe traffic or a desirable level of "legality" in the corporate world. The problems associated with the transfer of a new manufacturing process can also plague the transfer of social systems. Their mental models and expectations guide the organizations and households in country L when they approach new rules and systems of enforcement. Relevant organizational units of the new system, such as courts, government bureaus, and households, operate in a wider social system, and again the general social environment, ψ , interacts with A_s . Again, these interactions can both directly lower the productivity of inputs used in transaction activities and indirectly affect the productivity of transformation inputs.⁵² International transfers of social mechanisms are most likely to succeed when the general social environments of the transfer and target countries are similar, as they are, for instance, in transfers of social legislation among the Nordic countries.⁵³ Otherwise, success depends on appropriate adjustments: in the imported rules, the en-

⁵² When Y represents outcomes from a social mechanism, we can modify (1) by removing A_p and X_p from the equation, which implies that no pure transformation activities are involved. This is, however, unrealistic. Alternatively, we can include the two sets of variables and use a more complex theory where the output of a social system involves both transaction activities (the transfer of property rights) and transformation activities (the physical transformation of inputs into outputs).

⁵³ See, e.g., Silja Häusermann & Bruno Palier, *The State of the Art: The Politics of Employment-Friendly Welfare Reforms in Post-Industrial Economies*, 6 SOCIO-ECON. REV. 559, 570 (2008) (discussing the spread of "employment-centered reforms" in the form of labor-activation policies across the Nordic countries in the 1990s).

forcement systems, and in elements of the social environment. The knowledge and capacity to make such adjustments is often unavailable.

The inability to effectively import (or create) the social mechanisms required for supporting new production methods is a key explanation of the vast gap in productivity between rich and poor countries—a gap opened up by a series of industrial revolutions starting in England in the eighteenth century.⁵⁴ The productivity gap between the richest and poorest countries is now of a magnitude that is unique in human history. Income per capita in the richest country is about 100 times higher than in the poorest one.⁵⁵ Problems of creating locally appropriate social technologies or importing them is a major reason for these productivity differences—rather than a lack of financial resources or problems in coding and transferring physical technologies. High-income countries also have problems in designing effective social technologies, for instance to control industrial pollution or effectively use revolutionary new physical technologies, such as biotechnology and digitalization of information. To further illustrate these problems, the next Part introduces a schema for analyzing institutional policy.

⁵⁴ Another hypothesis concerning the factors that explain the huge gap between rich and poor countries in the modern era focuses on the role of domestic power relationships. Economic reforms, some claim, fail or do not occur because reforms would threaten the ruling political and economic elites who monopolize access of others to positions of authority in the political and economic systems. My “incomplete knowledge” hypothesis in part complements these other approaches. See, e.g., BUENO DE MESQUITA ET AL., *supra* note 15; DOUGLASS C. NORTH, JOHN JOSEPH WALLIS & BARRY R. WEINGAST, *VIOLENCE AND SOCIAL ORDERS: A CONCEPTUAL FRAMEWORK FOR INTERPRETING RECORDED HUMAN HISTORY* 25–27 (2009).

⁵⁵ See Dani Rodrik, Arvind Subramanian & Francesco Trebbi, *Institutions Rule: The Primacy of Institutions over Geography and Integration in Economic Development* 1 (Nat'l Bureau of Econ. Research, Working Paper No. 9305, 2002), available at <http://www.nber.org/papers/w9305>. The estimate is based on World Bank data adjusted for purchasing power parity (PPP) differences (caused by exchange-rate distortions). The richest country was Luxemburg and the poorest Sierra Leone. See *id.*; see also Lant Pritchett, *Divergence, Big Time*, 11 J. ECON. PERS. 3, 8–12 (1997) (“The magnitude of the change in the absolute gaps in per capita incomes between rich [countries] and poor [countries] is staggering.”); J. Bradford DeLong, *The Shape of Twentieth Century Economic History* 17–20 (Nat'l Bureau of Econ. Research, Working Paper No. 7569, 2000) (discussing the rise of massive income inequality among nations in the modern era), available at <http://www.nber.org/papers/w7569>

II

ANALYZING INSTITUTIONAL POLICY

The various subbranches of social science differ in their emphasis on policy or *how* issues.⁵⁶ In its early years, Keynesian macroeconomics almost immediately took the leap from pure knowledge to applied knowledge (presumably because the Great Depression motivated the scholarly effort), while the new institutional economics has focused primarily on *what* knowledge and sought to explain the logic of social structures and the forces of change.⁵⁷ The new institutional economics is a multidisciplinary approach. It integrates goal-oriented behavior in the political, economic, and even cultural domains, which leaves little room for social reform.⁵⁸ The actors who implement social change are elites who wield formal political power (*de jure* power) and leaders who possess raw violence potential (*de facto* power) because of their control over economic resources. In equilibrium (sometimes labeled *social equilibrium*) these camps are at rest.⁵⁹ Moreover, the social system remains at rest (there is no major institutional change) until some external forces upset the social equilibrium—in particular, various favorable and unfavorable shocks arriving from outside the system or slow-moving autonomous internal changes, such as diverse rates of population growth between competing groups.⁶⁰ The social-equilibrium view provides useful insights (when contemplating reform, do not ignore political and economic power), but it is incomplete. The approach is incomplete because it does not recognize that leading (and all) actors have incomplete knowledge of social systems and social technologies. In this Part, I put the problem of knowledge in the foreground. My focus is directed at elite rule makers or leaders who, for whatever reason, genuinely desire institutional reform (reform on their terms). I am not concerned with the forces that brought the authorities to this conclusion but rather with the practical problem of managing institutional policy. I assume that the reformers face only spontaneous or grassroots resis-

⁵⁶ See, e.g., Abhijit Banerjee, *The Uses of Economic Theory: Against a Purely Positive Interpretation of Theoretical Results 2–3* (Mass. Inst. of Tech., Dep't of Econ., Working Paper No. 02-24, 2002), available at http://papers.ssrn.com/sol3/papers.cfm?abstract_id=315942.

⁵⁷ See EGGERTSSON, *supra* note 8, at 1–6 (claiming that the new institutional economics has not emphasized the policy implications of its contributions and proposing an approach to emphasize institutional policy).

⁵⁸ The logical implication of endogenous policy—that the chance for reform is limited—is sometimes named the Determinacy or Bhagwati Paradox. See *id.* at 142–45; see also Jagdish N. Bhagwati et al., *DUP Activities and Economic Theory*, 24 EUROPEAN ECON. REV. 291, 303–05 (1984) (discussing the underlying theory behind the Determinacy Paradox).

⁵⁹ See generally ACEMOGLU & ROBINSON, *supra* note 15, at 238–46 (explaining the four situations in which a society will achieve an equilibrium).

⁶⁰ See *id.* at 31–32 (predicting that “democratizations are more likely to arise in a situation of economic or political crisis”).

tance and opposition that is channeled in a nonviolent manner through the political system.

The process of institutional policy involves three primary categories of players (as well as various subcategories of each): rule makers, right holders, and duty bearers. Planned institutional change involves (almost) always both winners (right holders) and losers or nonwinners (duty bearers). In the policy process, rule makers supply new rules, and right holders and duty bearers acquiesce, voluntarily or involuntarily.⁶¹ The ultimate purpose of the new rules is the creation of desired behavioral regularities and associated outcomes. Social mechanisms or social systems (or subsystems) intervene between rule making and behavioral regularities. The term social technology refers to applied social knowledge (theories, social models) concerning how to use rules and methods of enforcement to create social mechanisms that generate specific outcomes. Economics usually identifies two classes of policy instruments: new rules (such as laws and regulations) and corresponding formal systems of enforcement, but in a world of incomplete social knowledge, we must add a third category—persuasion.

In making institutional policy, rule makers (the authorities) confront right holders and duty bearers with new rules that enable or constrain their activities. Right holders and duty bearers rely on their positive and normative theories and expectations when they respond to the new measures. Their responses generate (or fail to generate) the desired social subsystem. These theories, which the policymaker tries to anticipate, concern issues such as the legitimacy of the authorities and their new rules, forecasts of which social outcomes the new rules are likely to generate, and the likely responses of the other players.⁶² On this view, the final outcome of major social experiments depends on the content of mental models or theories at all levels, the evolution of these models, and how they are eventually coordinated. Behavioral regularities emerge when the relevant players have coordinated their strategies.⁶³ Clearly, the policymaker has strong interest

⁶¹ See William H. Riker & Itai Sened, *A Political Theory of the Origin of Property Rights: Airport Slots*, 35 AM. J. POL. SCI. 951, 953–56 (1991).

⁶² I have studied two separate cases involving the confluence of beliefs (or theories), rules, and persuasion in the process of institutional change. I have examined the introduction of a controversial fisheries-management system in Iceland at the end of the 1980s. See EGGERTSSON *supra* note 8, at 191–202. Moreover, the intense struggle, also in Iceland, involving a new genetics corporation and a proposed central electronic health sector database, which was to include the nation's health records, is examined in Thráinn Eggertsson, *Genetic Technology and the Evolution of Property Rights: The Case of Decode Genetics* (Univ. of Ice., Inst. of Econ. Studies, Working Paper No. W08:03, 2008).

⁶³ The new field of bounded rationality macroeconomics has a comparable view of the policy process as the one presented here. See Thomas J. Sargent, *Evolution and Intelligent Design*, 98 AM. ECON. REV. 5, 12 (2008) (raising the troublesome question: “what hap-

in using various forms of persuasion to influence the theories favored by the relevant right holders and duty bearers.

The process of institutional policy also involves inconsistent and incomplete social theories at the level of the rule maker. Public rule making is often a complex process spanning several levels and branches of government, and the final rule structure that evolves is often the outcome of a battle between social theories—as well as conflicting interests.⁶⁴ Consider, for instance, the large role that courts in the United States have had in providing right holders in the modern biotechnology industry with rules that have been vital in the development of the industry. In two of the most important rulings, the U.S. Supreme Court in *Diamond v. Chakrabarty*⁶⁵ and the Supreme Court of California in *Moore v. Regents of the University of California*,⁶⁶ the Justices were deeply divided, and their arguments provide vivid evidence that the process of institutional reform involves a battle between competing normative and positive social theories.⁶⁷

To summarize, when information is scarce and knowledge is incomplete, persuasion often has a large role in the policy process. Factions at the level of the rule maker promote their favorite theories; the rule maker uses persuasion in an attempt to adjust and coordinate the theories of diverse right holders and duty bearers. And people subject to new rules fight back and try to mobilize public opinion against the changes that they oppose. These ideological battles often involve genuine theoretical differences but also strategic lies or preference falsification, adding yet another layer of complexity.⁶⁸ The battles of ideas augment traditional influence peddling, such as contributing money to election campaigns of politicians and outright bribes.

pens when macroeconomic policymakers incorrectly use what, from nature's point of view, is actually an auxiliary model? Data give the government no indication that it should abandon its model. Nevertheless, the government can make major policy design mistakes because its [sic] misunderstands the consequences of policies that it has not chosen.”).

⁶⁴ See Riker & Sened, *supra* note 61, at 961–66 (discussing divisions within the U.S. federal government over how to adjust rules to cope with severe problems of crowding at U.S. airports).

⁶⁵ 447 U.S. 303 (1980) (5–4 decision).

⁶⁶ 793 P.2d 479 (Cal. 1990).

⁶⁷ See, e.g., *Diamond*, 447 U.S. at 321–22 (Brennan, J., dissenting) (“[T]he Court’s decision does not follow the unavoidable implications of the statute. Rather, it extends the patent system to cover living material even though Congress plainly has legislated in the belief that § 101 [of the U.S. Patent Act] does not encompass living organisms.”); *Moore*, 793 P.2d at 510 (Mosk, J., dissenting) (“[T]he majority cite no case holding that an individual’s right to develop and exploit the commercial potential of his own tissue is *not* a right of sufficient worth or dignity to be deemed a protectible property interest. In the absence of such authority . . . the right falls within the traditionally broad concept of property in our law.”).

⁶⁸ See TIMUR KURAN, PRIVATE TRUTHS, PUBLIC LIES: THE SOCIAL CONSEQUENCES OF PREFERENCE FALSIFICATION 3–6 (1995) (developing the notion of preference falsification as “misrepresenting one’s genuine wants under perceived social pressures”).

III

MAPPING SOCIAL TECHNOLOGIES IN THE
CULTURAL COMMONS

Incomplete knowledge and scarce information also imply that rule makers (and their advisers) frequently have an incomplete understanding of already existing social systems and mechanisms in addition to their incomplete knowledge of appropriate social technologies for reforming the systems. If we return to equation (1): $Y = f_{\psi}(\{A_p, A_s\}; X_p, X_s)$, we see that attempts by an authority to modify ψ —for instance, the social environment of an industry—requires an understanding of the nature of A_s and its interaction with ψ . Moreover, the rule maker requires accurate information about the de facto nature of ψ : What are the rules in use, allowing for enforcement? How well do the rules match industry requirements? What adjustments has the industry made in its own internal rule structure? For example, the heated debates about the consequences of the extensions in the last thirty years of intellectual property rights suggest that hard facts are scarce. Reliable data are lacking, in spite of raging debates about the effects of changes in the copyrights system on creative artists, consumers, and corporations, or the effects of extensions of patent rights on scientific progress in biotechnology. We need more hard facts about possible changes in A_s that households, enterprises, and industries have made in response to changes in the environment, ψ . We also need more information about possible behavioral changes that the new structures have generated.⁶⁹

Information about systems in use is a relatively scarce resource because it is more costly to acquire such information than information about de jure rules and their intended consequences. Various factors combine to create gaps between de jure and de facto social systems. Lax enforcement of public rules or an absence of official rules in certain areas creates opportunities for private ordering and gives rise to a variety of new social technologies that sometimes go unnoticed outside the industry. For instance, when private groups conclude that their institutional framework lacks specific or desirable public rules, they can simply create their own. Private action, of

⁶⁹ See, e.g., Robert P. Merges, *The Concept of Property in the Digital Era*, 45 Hous. L. Rev. 1239, 1261–62 (2008) (noting that the current collection of evidence amounts to “a battle of anecdotes”); Nelson, *supra* note 44, at 8 (“[I]t is far more difficult to get reliable evidence on the efficacy of a new institution or social technology than for a new physical technology.”); Ruth Towse, *Copyright and Artists: A View from Cultural Economics*, 20 J. Econ. Survs. 567, 580 (2006).

course, requires that the relevant groups overcome their collective action problems.⁷⁰

In some instances, governments deliberately provide only a basic infrastructure of rules and leave it to social groups to self-organize and govern themselves. To some extent, this is true of intellectual property rights, which specify the owners' maximum rights that they are then free to modify or relax. Owners of copyrights are free to sign up with Copyleft, and holders of patent rights can decide not to enforce their rights when others use their patented knowledge in basic research.⁷¹ In general, laws and guidelines on the books often permit various forms of cooperation (within limits, especially antitrust limits), such as patent pooling.⁷²

Lax central enforcement and formal or informal freedom to reorganize can create huge variation in organizational structures, as Elinor Ostrom discovered in her study of common-pool regimes for natural resources.⁷³ Almost no industry or producer organization has a longer history than the natural commons. Yet prior to the investigations by Ostrom and her colleagues, we were not aware of the organizational complexity and variation in this area. Coded knowledge of the social technologies used by the new information technology industries is limited, as I have discussed. In his Nobel lecture, R.H. Coase laments how little we know about the organizational structure of production and states: "However, I have come to the conclusion that the main obstacle faced by researchers in industrial organization is the lack of available data on contracts and the activities of firms. I have therefore decided to do something about it."⁷⁴

During the Enlightenment, eighteenth century Europe was preoccupied with the measurement and classification of natural phenomena that later helped to discover regularities in nature. Modern economics has followed another path, and the reason in part involves the methodology that has prevailed in the field since about World War II. Mainstream economics has relied heavily on deductive rather

⁷⁰ For a classic example of the use of private order in a California farming community, see ROBERT C. ELLICKSON, *ORDER WITHOUT LAW: HOW NEIGHBORS SETTLE DISPUTES* 15–120 (1991).

⁷¹ See Margit Osterloh & Sandra Rota, *Open Source Software Development—Just Another Case of Collective Invention?*, 36 RES. POL'Y 157, 158–59 (2007); see also Stan J. Liebowitz & Richard Watt, *How to Best Ensure Remuneration for Creators in the Market for Music? Copyright and its Alternatives*, 20 J. ECON. SURVS. 513, 525–37 (2006) (providing a list of various other alternatives to the use of the copyright system).

⁷² See U.S. DEP'T OF JUSTICE & FED. TRADE COMM'N, *ANTITRUST GUIDELINES FOR THE LICENSING OF INTELLECTUAL PROPERTY* § 5.5 (1995) (providing the standards of the Department of Justice and the Federal Trade Commission for when they will prosecute patent pooling as an antitrust violation).

⁷³ See OSTROM, *supra* note 42, at 58–142.

⁷⁴ R.H. Coase, *The Institutional Structure of Production*, 82 AM. ECON. REV. 713, 719 (1992).

than inductive reasoning.⁷⁵ The modus operandi in economics is to derive theories from first principles, develop hypotheses and, if at all, test them on available data. Available data are often government statistics or industrial statistics that have been collected for administrative purposes and do not always correspond to the theoretical concepts that are being tested. There are of course many exceptions to my stylized description of research in economics and, moreover, the line separating inductive and deductive reasoning is blurred because informal theories and mental models always guide attempts to measure and classify natural or social phenomena. Yet, it is fair to say that in modern economics the methodology that the Ostrom research program employed is a remote outlier.

The ongoing industrial and economic revolution has in the last decades brought us new industries (for instance, the biotechnology and the software industries) that rely heavily on knowledge assets rather than massive industrial equipment. The Internet and digitalization methodologies have brought the cost of copying and distributing data close to zero. New industrial structures are evolving, but our knowledge about the new social technologies is limited. Various sources indicate that the new industries frequently pool and share their intellectual assets, but we have scant information about the structure, conduct, and performance associated with these organizational forms.⁷⁶ Some observers see the new physical technology as an opportunity for creating a radically better society than we have ever known but fear that inappropriate social technologies may interfere.⁷⁷ In particular, they fear that recent changes in intellectual property rights may drastically interfere with progress both in the cultural domain and in natural science. Others disagree, but in their heated debates, the antagonists typically rely on stylized ideas about the phenomena and unsystematic snippets of evidence.⁷⁸

The IAD framework is basically an inductive approach—an attempt to map social technologies in use and then search for regulari-

⁷⁵ See Colleen F. Johnson, *Deductive Versus Inductive Reasoning: A Closer Look at Economics*, 33 Soc. Sci. J. 287, 289 (1996) (explaining that “the hypothetico-deductive model continues to be the model of explanation that neoclassical economists cling to as descriptive of the discipline”).

⁷⁶ See, e.g., Robert P. Merges, *Contracting into Liability Rules: Intellectual Property Rights and Collective Rights Organizations*, 84 CAL. L. REV. 1293, 1340–52 (1996) (providing information about patent pools, mega pools, and patent pools based on contract).

⁷⁷ See, e.g., YOCHAI BENKLER, *THE WEALTH OF NETWORKS: HOW SOCIAL PRODUCTION TRANSFORMS MARKETS AND FREEDOM* 1–2, 22–28 (2006). *But see* Merges, *supra* note 69, at 1240–41 (discussing such beliefs critically).

⁷⁸ See Robert P. Merges, *A New Dynamism in the Public Domain*, 71 U. CHI. L. REV. 183, 183 (2004) (“The growing Conventional Critique in the intellectual property (IP) world is this: there are too many IP rights; they are too strong; ‘something’ has to be done. No one knows for sure how accurate the Conventional Critique is, though those of us in the field all have our opinions.”).

ties. The proposal by Madison, Frischmann, and Strandburg to modify the IAD framework and apply it to the cultural commons (or intellectual common-pool regimes)⁷⁹ is an excellent one. The IAD model is a well-tested framework for measuring, classifying, and analyzing social technologies. A well-managed research program of the kind proposed by the authors could make a significant contribution to useful social knowledge at an important juncture in social and economic development.

The easiest part of such a research program is the mapping of social technologies in use.⁸⁰ To reliably associate outcomes or results with particular social structures is a more complex task but not an impossible one. Outcomes associated with natural commons, which utilize resources such as forests or water resources, can be defined and measured more easily. In the cultural commons, the definition of outcomes is not immediately obvious, and they often occur with a lag and require difficult, counterfactual studies.

Consider, for instance, the problem of measuring whether a particular structure governing a cultural commons has accelerated or slowed down the development of new medicinal drugs or new scientific discoveries. If the investigators conclude that particular institutional arrangements are producing undesirable results, the next set of questions they face are even more complex: ideally, they would want to establish whether public rule makers are able to create superior outcomes in the activity in question by adjusting its social environment. The answer requires knowledge about how local decision makers adjust their social technologies, A , to changes in their social environment, ψ . Ideally, we would like to provide the public rule maker with a policy model that relates available instruments to efficient outcomes—assuming the rule maker prefers economically efficient outcomes, which, according to political economy, may not be the case. *C'est la vie!*

⁷⁹ See Madison, Frischmann & Strandburg, *supra* note 1, at 666.

⁸⁰ See *id.* at 678–80.